ICEE-2

Critical Thinking Skills of Fourth Grade in Light Properties Materials through the Radec Model

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Abstract. The purpose of this study is to determine the effect of the Read, Answer, Disscuss, Explain and Create (RADEC) models on the critical thinking skills of elementary school students. The research method used in this study is a quasi-experimental method with one group pretest postest design. The study was conducted in fourth grade students of state primary schools in Sumedang Regency. The sample used in the study amounted to 27 students. Consisting of 12 male students and 15 female students. The instruments used were tests of critical thinking questions, observation sheets and questionnaires. Critical thinking skills tests were carried out with two stages of pretest and posttest. Data processing techniques using SPSS for window version 23. From this study, the average score of students' critical thinking skills pretest was 68.33 while the average posttest score was 82.22. The Mann-Whitney test results obtained the value of sig = 0,000. This shows that there are significant differences in the average value of pretest and posttest. Next, the N-gain value of 0.4 is obtained. So it is interpreted that there is a significant difference in the critical thinking skills of fourth grade students on the material properties of light before and after treatment using the RADEC learning model. Therefore, it can be concluded that students' critical thinking skills have increased in the medium category through the RADEC model.

Keywords: Critical thinking skills, the properties of light, and the RADEC Model.

INTRODUCTION ~In the 21st century, Skills have become a hot topic discussed in recent times. The development of science and technology in the 21st century presents its own challenges to the world of education. Learning in the 21st century has undergone development in which one of the skills that need to be mastered is to think high-level like critical thinking (Kalelioglu & Gulbahar, 2014; Kereluik et al., 2013).

Good critical thinking will meet various intellectual standards such as clarity relevance, adequacy, and coherence Ennis (Costa, 1985: 54) revealed that critical thinking focuses on determining what will be believed or done, where this critical thinking activity involves innate and ability. Students' critical thinking skills in learning can be developed by all who play a role in the learning environment.

Critical thinking is an intellectual process in making a concept, applying, analyzing, synthesizing, and evaluating various kinds of information obtained either from observations, experiences, or reflections that are ultimately used as a basis for action or decision making [Walker, 2005]. Therefore Developing critical thinking skills can help students make conclusions by considering data and facts that occur in the field.

One of the main goals of schools is to improve students' ability to think critically, make rational decisions about what is believed and done (Nur & Wikandari, 2008). Formal education that takes place today tends to be trapped in the lower order of thinking, which is to sharpen aspects of remembering and understanding (Widowati, 2008). Therefore, learning is needed to develop more critical

thinking skills or high order thinking skills needed by students in facing challenges in the future.

Critical thinking skills are very important to be developed and improved through science learning in elementary school. Science learning in elementary schools is the initial foundation in producing students who have scientific knowledge, skills and attitudes. Science subjects at the elementary school level teach about basic concepts related to the environment around us (Pertiwi, 2018). The intended science is not just a collection of facts, but how to proceed in obtaining the facts which is based on the ability to use basic science knowledge to predict or explain phenomena that are different in terms of scientific processes and attitudes. According to Samatowa (2015: 3) through science learning, students can naturally develop curiosity. Science learning in schools must be sought so that students can learn scientific knowledge and process skills that can be used in everyday life, so as to foster students' thinking skills, especially critical thinking skills (Susilo, et. al., 2012). In addition, science is also able to provide opportunities for students to think critically by following the method of "finding themselves" a solution to the problem at hand. The ability of students to think critically can vary according to their level of knowledge, understanding, and development (Rezaei, et. al., 2013)

One of the problems faced by education today is the weakness of the learning process [Sanjaya, 2011). The tendency of the science learning process has not been fully able to optimize students' thinking abilities. The results of the 2015 Trend in International Mathematics and Science Study (TIMSS) showed that the results of students' score obtained by fourth grader elementary school students in Indonesia were 397 and were ranked 45 out of 48 countries. The results of the Program for International Students Assessment (PISA) initiated by The Organization for Economic Cooperation and Development (OECD) released in December 2016, show the main indicators of the average score of achievement of Indonesian students in science and mathematics is indeed alarming. Implied our concern about the ability of competitiveness in the future. Indonesia is ranked 64th out of 72nd countries (OECD, 2015). The PISA assessment does not only measure the ability of 15-year-old students included in the school curriculum, but is future-oriented (Puspendik, 2016). Based on this it can be concluded that the scientific ability of students in Indonesia is still very low.

Specifically, Johson (2007) argues that learning science in students in schools must be directed to be able to: 1) solve problems encountered in everyday life with the concepts of science that have been learned, 2) have a scientific attitude in solving the problems faced. Critical thinking skills need to be improved in learning activities, because everything is global, information comes in easily that causes good or bad information to continue to

flow and can affect the mental nature of children. Therefore, it is necessary to have the ability to think and assess clear and imaginative evidence, play logic and find alternative solutions to give children a clear route amid the chaos of thinking in the current technological and globalization era (Martaida, et. al., 2017).

Critical thinking skills are skills that are not inherent in humans from birth. Critical thinking skills must be trained in the learning process. Aspects of critical thinking indicators are classified into five according to Ennis (1985: 46), namely (1) Provide a simple explanation (elementary clarification, (2) Build basic skills (basic support, (3) Draw conclusions (inference), (4) Provide further explanation, (5) Set the strategy and tactics. Critical thinking is the main thing taught in schools, can include teaching students to: respect reason and truth; open minded; respect for others during the discussion; Willing to see thoughts from the perspective of others (Bailin et. al., 1999).

Based on a study conducted by Rofiudin (2000) states that critical thinking skills are very important to be developed because it will be useful in the development of one's life after school. But the current reality of the ability to think high school / MA students, especially critical thinking is still low. Marzano's research results show that one reason for the low quality of thinking of students today is the strength of the wrong view that students' thinking abilities will automatically develop after students master all subject matter, and new critical thinking education can be taught in advanced education (Ramli, 2017).

Based on the research data that has been mentioned, it can be seen that the low achievement of Indonesian science as above is also influenced by sudents' ability to think critically towards a problem at hand. Though critical thinking is really needed by students to face various challenges. Critical thinking is a process that can be taught to students, but with a note the teacher must be able to choose and determine the right learning model with the development of students themselves. In addition, science learning cannot develop optimally because a person is too accustomed to think procedurally so that it is possible to respond to and solve problems freely. People who think procedurally like this are accustomed to follow the pattern of behaving and behaving as the pattern developed by their environment. Seeing from some of the results of research that has been done, the implementation can be said to have not been fully successful in improving the quality of learning in schools. Therefore, this study provides other alternatives which are then expected to be able to provide solutions in the implementation of learning in Indonesia through the Read-Answer-Discuss-Explain-and Create model .

The RADEC model is a learning model oriented to mastering 21st century competencies and skills. The RADEC model

has several advantages including developing communication skills, working together, and helping students gain conceptual understanding. Conceptual understanding of science or phenomena to be explained is one of the determinants in critical thinking skills. With the advantages of the RADEC model, it is hoped that this model can develop students' abilities in critical thinking skills. In line with research conducted by Pratama, et al. (2019) in his research RADEC Learning Model (Read-Answer-Discuss-Explain-and Create). The importance of Building Critical Thinking Skills in Indonesian Context states that one solution to be able to build students' critical thinking skills is to use RADEC learning models Read-Answer-Discuss-Explain-and Create).

The RADEC learning model was developed by Sopandi (2017) with the aim of improving the quality of learning and encouraging students to master the 21st century competencies and skills needed. This model is a model that has been adapted to the learning conditions in Indonesia. This model has learning steps that are easy to remember and understand.

The RADEC model was developed on the basis of a number of things as the following. First, this model is based on the goal of national education which is to develop all the potential possessed by students to become human beings who believe in God, are noble, healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens (Government of the Republic of Indonesia, 2003). Second, this model was developed on the basis of constructivism theory. According to Vygotski (Sopandi, 2017) suggested that cognitive abilities in children can develop through interaction with the social environment. In this theory, known as the Proximal Development Zone (ZPD). So in the learning process, there are times where students need to learn independently about a concept of subject matter without help from others. It aims to see the ability of students.

The RADEC learning model has several advantages including being able to encourage students to gain 21st century skills. In the 21st century there are several competencies that must be possessed by humans, namely conceptual understanding, critical thinking, collaboration and communication, and creative thinking (Morocco, et. al., 2008). Another advantage of the RADEC model is that the stages of this model are easy for teachers to understand and remember. This is evident from research conducted (Sopandi, et. al., 2019) whose results are as many as 97.2% of teachers who participated in the training are interested in implementing the RADEC learning model in schools because it is easy to understand and the results of implementation in their schools can help students to build character, enhance students' conceptual understanding and encourage students to develop 21st century competencies. The steps of the

RADEC model are proposed (Sopandi, 2017), namely Read, Answer, Disscuss, Explain and Create.

Read-Answer-Discuss-Explain-and Create (RADEC) is one alternative learning model that helps students gain competencies both cognitive, attitudes, and skills (Sopandi, 2017). The RADEC Learning Model can practice critical thinking skills. The reason:

- Through the search for other information or teaching resources, chilidren's critical thinking skills can be awakened.
- The RADEC model can facilitate ideas or ideas from each child, so that critical thinking skills are formed.
- At the *Read* stage, the reading stage will grow knowledge, and that knowledge becomes the capital to build critical thinking.
- The Create phase will build students' critical thinking (Sopandi, et. al, 2019).

Based on this it will be interesting if the application of the RADEC learning model can be used to prove the improvement of students' critical thinking skills on the material properties of light. Based on the background described above, this study was conducted to see the effect of applying the RADEC learning model to improve students' critical thinking. More clearly the formulation of the problem in this study is how to improve critical thinking skills using the RADEC learning model on the material properties of light?

METHOD

The method used in this research is quasy experiment with one group pretest-posttest design.

Tabel 1 *One Group Pretest-Posttest Design*

Pre-Test	Treatment	Post-Test
O	X	O

The sample in this study was 27 fourth grade students of SD Negeri Tanjungsari Subdistrict, Sumedang Regency. It consists of 12th male students and 17th female students. The sampling technique in this study used purposive sampling with specific objectives. The design in this study can be seen in Figure 1, as follows.

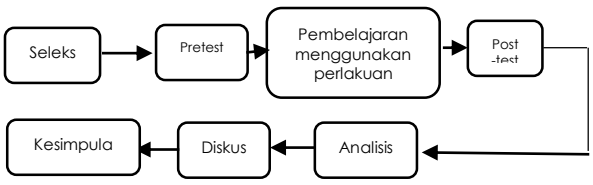

Figure 1. Research Flow

The instruments used in this study were pre-research questionnaires, observation sheets of RADEC learning implementation, pre-reading and post-reading tests, reading habits questionnaires, critical thinking skills tests and student responses to the RADEC learning model.

Pre-research questionnaire, this questionnaire was administered prior to the treatment. The purpose of giving a questionnaire is to know the habits of students related to the research to be conducted. This questionnaire will also be used as additional information and can be linked to data obtained during the learning process. The information extracted in the form of information about students' habits in reading, conducting discussions, and making work or projects in the learning process.

Observation sheet of the implementation of learning the implementation of learning is observed based on the activities of the teacher and students during the learning process.

The observation sheet is used to observe the extent to which the planned RADEC stages are carried out both by the teacher and students. Observations were made using checklist sheets and columns containing information related to the implementation of learning.

Reading and Post-test, pre-reading and post-reading tests are evaluations of the RADEC learning stages whose purpose is to determine students' abilities before and after carrying out the read and answer stages. Pre-reading tests are given before students read teaching materials and post-reading tests are given after students read teaching materials or before the learning process is carried out.

Critical thinking skills test, this test measures critical thinking skills related to the properties of light. Material relating to the material properties of light. The items are arranged and developed based on indicators of critical thinking skills. The questions are in the form of a 3-tier diagnostic test consisting of verbal statements, reasons and levels of confidence.

Questionnaire student responses, questionnaire responses given to students in the form of statements about an object of response in the form of a rating scale or checklist. The purpose of giving questionnaire responses is to streng then the argument of the treatment the process conducted in the experimental class. The statements in the questionnaire include statements consisting of aspects of student responses to learning after participating in RADEC learning activities.

DATA COLLECTION

Data collection is done by providing observation sheet instruments, pre-reading and post-reading tests, questionnaires and tests of students' critical thinking skills. Based on the results of data processing, the data obtained will be processed using SPSS 23.00. The test used is a test of students'

critical thinking skills. The test is carried out twice, namely the initial test (pretest) and final test (posttest).

Increased critical thinking skills after RADEC learning is obtained by calculating the average value of the gain, which is normalized (N-gain). This is intended to avoid mistakes in interpreting the gain of each student. The formula used is

$$< gain \geq = \frac{S_f - S_i}{S_m ideal - S_i}$$

(Hake, R.R., 1999)

Information:

<g> = normalized average score

S_f = average score of the final test

S_i = the average score of the initial test

S_m ideal = maximum score ideal

The interpretation of the normalized average *gain* is shown in Table 2 below.

Table 2 Categories normalized gain values

Range (<g>)	Category
(<g>) ≥ 0.7	High
0.7> (<g>) ≥ 0.3	Is
0.3> (<g>)	Low

(Hake, RR, 1999)

RESULTS AND DISCUSSION

In this section the researcher elaborates on the results of research analysis related to critical thinking skills using RADEC learning. The test results are obtained from the pretest and posttest scores . To find out the increase in the results of critical thinking skills seen from the results of the pretest, posttest and gain calculated based on normalized. The results of critical thinking skills in public elementary schools in Tanjungsari Subdistrict, Sumedang Regency are described as follows. The initial ability of students is seen from the results of the pretest scores taken before carrying out RADEC learning.

Table 3 : Test Results for *Critical Thinking Skills* Normalit

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Tes	Statistic	df	Sig.	Statistic	df	Sig.
Nilai	Pretest	,241	27	,000	,884	27	,006
	Postest	,257	27	,000	,869	27	,003

a. Lilliefors Significance Correction

Based on Table 3 above the *Asymp. Sig* pretest value is 0.006 <0.05 and the *Asymp.Sig* posttest value is 0.003 <0.05, so it can be concluded that the posttest value is **not normal** . So that it does not need to proceed for homogeneity tests or non-parametric tests, but continued with the *Mann-Whitney* test to see the average difference in each value.

Table 4 *Pretest and Posttest* Average *(Mann-Whitney*) Test Results Critical Thinking Skills

Mann-Whitney Test

Ranks

	Tes	N	Mean Rank	Sum of Ranks
Nilai	Pretest	27	15,19	410,00
	Postest	27	39,81	1075,00
	Total	54		

Test Statistics[a]

	Nilai
Mann-Whitney U	32,000
Wilcoxon W	410,000
Z	-5,860
Asymp. Sig. (2-tailed)	,000

a. Grouping Variable: Tes

Based on table 4 the *Mann-Whitney* test results give the *Asymp.Sig* value = 0,000 <0.05. This shows that there are significant differences in the average value of the pretest and posttest scores. So it can be concluded that there are differences in students' critical thinking skills before and after the implementation of RADEC learning on the material properties of light in fourth grade.

CONCLUSION

The conclusion of this study is that there is a significant difference in the critical thinking skills of fourth grade students of state elementary schools in Tanjungsari Subdistrict, Sumedang District on the properties of light before and after treatment using RADEC learning models. From this study, the average score of students' critical thinking skills pretest was 68.33 while the average posttest score was 82.22. The Mann-Whitney test results obtained the value of sig = 0,000. This shows that there are significant differences in the average value of pretest and posttest. Furthermore, *N*-gain value of 0.4 is obtained so that it is interpreted that there is a significant difference in the critical thinking skills of fourth grade students on the material properties of light before and after treatment using RADEC learning models. Therefore, it can be concluded that students' critical thinking skills have increased in the medium category through the RADEC model.

SUGGESTION

Based on the research conclusions, suggestions are made:

The RADEC learning model needs to be known by the teacher as an alternative to improve the process of critical thinking skills in elementary school students.

The RADEC is one alternative learning model that helps students gain competencies both cognitive, attitudes, and skills (Sopandi, 2017). So that the classroom atmosphere becomes more active. Therefore RADEC learning can be used in science learning specifically to improve the critical thinking skills of fourth grade students on the properties of light.

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