Applying RADEC model in science learning to promoting students’ critical thinking in elementary school

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Abstract. Teaching to promoting critical thinking expertise is very significant for providing students to reside in the worldwide era. Critical thinking is scholarly expertise that needs direction and practice, especially for elementary school students. The lack of teachers’ skills and ability in choosing appropriate learning model in natural science learning for promoting critical thinking for students is one of the reasons to done this study. This study aims to observe and describe the improvement of the students’ critical thinking at class IV, appearing in natural science learning after implementing RADEC model in class IV SD Negeri Surialaya, Tasikmalaya, West Java as shown from the student’s comments. This research applied a descriptive method. The instrument of the research was the observation sheets of students’ critical thinking and teachers’ activities in boosting critical thinking. The data gathered through observation. The results showed that elementary science teachers did not orient to improving critical thinking among students, as very little of the classroom students showed in critical thinking skills. The developed model this study provides can use as a tool to assess science classes regarding improving critical thinking of the elementary school students.

1. Introduction

Science is a single of the discipline studied from elementary school through university, even into subject’s compulsory tested nationally. According to Government Regulations No. 22 the year 2006 [1], the issues of Sciences should be given to all learners from primary schools to equip learners with the ability to think logically, analytically, systematically, critically, and creatively, as well as the ability to cooperate. The capabilities compulsory so that scholars can have the competence to bring in, handle, and practice the information to exist in a condition that is always growing, ambiguous and vying.

The importance of science is because of the very relevant in daily life. Learning science in elementary school requires students able to analyze the problem to do their investigation. Natural science is related to a study, finding, solving problems and understanding the surrounding scientifically and systematically through observations. Science is the utilize of proof to establish certain justifications and forecasting of common wonder, inclusive of the wisdom achieved over this action (The National Academy of Sciences, 2008) [2]. This subject is not merely about mastering factual knowledge, concepts, or principles but also finding the process that it will develop learners’ scientific ideas, process skills, and attitude. Creative thinking skill is one of the significant thinking skills for students in science learning. Students which
critical thinking skills will be able to identify problems, create an experiment design, do experiments independently in groups, and communicate their results of the solution to their classmate.

The fact that happens in the field, in the learning process, the product takes precedence over the process. Students have little role in developing critical thinking expertise to solve the problems they face. In every learning process required the direct involvement of students. Students should be placed as subjects not as objects in the learning process, while teachers act as mentors and facilitators, but in fact, the teaching-learning process is still teacher-centred. This causes students difficulties in studying science seen from the low learning outcomes.

Based on the outcomes of interviews conducted with one of the teachers of science subjects obtained information that there are some problems of learning that less emphasis on aspects of thinking so that students tend to optimize themselves by receiving just what is explained by the teacher. Teachers often use conventional learning models such as lectures, frequently asked questions and assignments without variation by adding learning models that require students to be active in the teaching activity in the classroom. This causes the capability to think analytically in learning does not form on students, so that result of science student learning of elementary school in Surialaya most under minimal mark criteria.

If the above learning conditions are left continuously, it can cause good harm to school students themselves, society, nation, and state, both for the present and for the time which will come. Without this troubleshooting is confirmed the quality of our educational outcomes will always sink and be rooted in below average educational outcomes in other countries. For solve learning obstacles that have not been by the demands of national education goals and the requirements of the need to equip them learners with 21st-century skills, Sopandi [3] introduced alternative learning models that are appropriate to the conditions in Indonesia. Learning exemplary in query is the model Read, Answer, Discuss, Explain, and Create (RADEC). The model name is customized with syntax learning to keep in mind the sequence of implementation. As for the series of learning, steps are as follows: Read-Answer-Discuss-Explain-Create. The exemplary is simple to figure out and its application can aid scholars to proceeds characters, expertise, and diverse 21st-century competence (critical thinking and clear out the obstacle, collaboration, communication and creative thinking).

Critical thinking is needed in learning in the 21st century. Critical reasoning is crucial considering it can help a person understand how he views himself, sees the world, and relates to others, helps to examine the behaviour of himself, and judges himself. Critical thinking allows one to analyze his thoughts to ensure that he has determined the choice and drawn intelligent conclusions. The urgent of critical reasoning expertises today has become a global issue. Therefore, a few provincials in the world such as the UK, USA, and Australia from the west, as well as Hong Kong and Japan from Asia tried to assess and develop it. However, work on critical thinking for students is not easy. It takes the seriousness of educators if they want their students to succeed in resolving problems with critical thinking. [4]

Critical thinking has become the sole of the devices needed in everyday life to face the challenges of survival. In daily life people are confronted with resolutions that lack argument, considering, explaining, analyzing and assessing data before deciding. This process involves critical thinking because it will allow a person to make decisions that are reliable and valid, act ethically, and can adapt to changes in a particular environment.

Critical thinking is sole of the competencies that requisite be comprehended by learners in science. A critical word borrowed from the Greek Kritikos and Criterion. Word “Kritikos” means consideration while criterion implies a standard measure or standard. So etymologically, the word implies critical considerations based on a standard measure or standard. Thus, etymologically critical thinking implies a mental activity or thinks that a person can consider using a standard size or specific [5][6].

The Critical Thinking Association resoled critical thinking as “the logically well-regulated step of vigorously and expertly gestate, implementing, interpreting, incorporating, and/or assessing data accumulated from, or provoke by, surveillance, know-how, consideration, analysis, or conversation, as a pilot to conviction and movement” [7].

Ennis [8] describes critical thinking is “reasonable reflective thinking focused on deciding what to believe or do”. According to Beyer [9], describes the critical thinking as an accurate evaluation activity,
beliefs, and by using the argument, or briefly he stated that critical thinking is an action that a person in making judgments with good reasoning. Another translation of critical thinking is the capacity to use knowledge in a flexible and means, through the understanding of the problem or issue, evaluating the evidence, to consider multiple perspectives, and take a position [10].

Critical thinking is also referred to as metacognition (Tempelaar, 2006) or the process of thinking about thinking. Critical reasoning expertise are crucial as they allow students to pledge adequately with the problems of public, experimental, and practicable (Shakirova, 2007). Simply put, the students who can think critically can solve problems effectively. Just gain insight or data is not sufficient. To be practical in the organization (and in their private life), students should be competent to figure out the problem to form an adequate judgment; it necessity be adequate to consider analytically [11].

This is similar as stated by Krulik and Rudnick [12] which said that in critical thinking there is thinking which test, question, connect, evaluate all aspects of the situation or a problem. For example, when a person is reading a text or listening to a scientific explanation of the science expressions or she should be trying to understand and trying to find or notice the existence of things that are special and the need or important. Likewise, from a data or information, he will be able to make conclusions that are true at the coinciding see a contradiction or whether there is any consistency or discrepancies in the information. Thus, in critical thinking, people analyze and reflect on the outturns of thinking.

Additionally, Gokhale [13] in a study entitled Critical Thinking Collaborative Learning enhances stated that the rationale of critical thinking about is a matter that involves the investigation, fusion, and appraisal of a concept. Cotton [14], stated that critical thinking is also called logical thinking and analytical thinking. Burden and Byrd, categorized critical thinking as a thinking process that calls for a series of high-level cognitive skills [15].

Beyer [9], in a comprehensive review of the existing literature, suggested that critical thinking demands a batch of skills and effective approach that include: (1) Distinguish between verifiable facts and claims of the value, (2) Distinguish relevant from irrelevant information, claims and reasons, (3) Determine the factual accuracy of statements, (4) Determine the credibility of the source, (5) Identifying ambiguous claims or arguments, (6) Identify unstated assumptions, (7) Detecting bias, (8) Identify the logical error, (9) Recognizing logical inconsistencies in this line of reasoning, (10) Determining the strength of the argument or claim.

According to Langrehr [16] to train students' critical thinking should be encouraged to answer questions relating to the following matters: (1) Determine the consequences of a decision or an event; (2) Identify the assumptions used in a statement; (3) To formulate main problems; (4) Finding a bias based on a different viewpoint; (5) Disclose the cause of an event; (6) Choose factors that supports the decision. There are three barometers of critical thinking confer to Krulik and Rudnick [17], Glazer [18], Ennis [19], Facione [20], specifically (1) the identification and interpretation of information, (2) the analysis of information, and (3) evaluation of the evidence and arguments.

Critical thinking skills in school are necessary to prepare the younger generation that can make good decisions and become a mature thinker so that they can bring the nation to a better condition. To evolve critical thinking skills in science teaching and learning activities, it is expected in the teaching-learning process to use strategies, models, methods, techniques, and tactics. In learning, it does not just increase the knowledge only for students but also to help students analyze and evaluate measures workmanship step in finding a true solution to the problems faced. Selection of appropriate learning models expected to maximize processes and students’ learning outcomes. Students are actively in class with teacher assistance. Teachers encourage students to be allowed to develop their creative ideas, answer questions, explain the answers and give reasons for the answer.

According to Maulana [21], critical thinking skills can be developed through learning science and mathematics in school or college, which focused on systems, structures, concepts, principles, and tight linkage between an element and the other element. Furthermore, Ruggiero [22] states that critical thinking is a life skill, not a hobby in the academic field. The progress of critical thinking skills in science learning is possible since the material of science and critical thinking skills are the two things that can’t be separated.
Based on the explanation above, it is extremely advocating for critical thinking taught to students from the elementary school. This can be done in learning science through RADEC model, bring in any given teaching materials and test questions. Although it may seem difficult, competence in critical thinking should already be accustomed to the students to ease them in solving problems.

Problem formulation in this research is “What is the critical thinking skill of students class IV SD Negeri Surialaya, Tasikmalaya. in science learning with RADEC Model? Moreover, the research questions is: How the improvement of creative thinking students class IV SD Negeri Surialaya, Tasikmalaya through the implementation of the RADEC learning model?

2. Methods
This research used qualitative research; qualitative research is intended to traverse and comprehension the interpretation of singles or classes assign to social or human problems. The activity of investigation demands transpire query and procedures, gathering facts in the participants’ setting; analysis the facts synthetically, construct from specifics to common topics; and building explanations of the definition of facts. The last recorded announce has a pliable writing form [23]. This research used descriptive method through which the researcher tried to describe applying RADEC model in science learning to promote students’ critical thinking in class IV SD Negeri Surialaya, Tasikmalaya, West Java in applying the concept of science in natural resources’ material. The objects of the research were the teacher and 16 students of class IV SD Negeri Surialaya, Tasikmalaya. This research was conducted in April 2018. The research is done in three meetings on Tuesday. Research instruments to observe students 'critical thinking skills [24], students' critical thinking aspects [25] and teacher skills in encouraging students to think critically [26] are made based on indicator items presented by The Critical Thinking Consortium. The data collected through observation and documentation. The researcher, in this research, also had a role as the instrument. The data gathered in this research were in the form of qualitative data. The data obtained then were analyzed by using descriptive analysis.

3. Results and Discussion
Based on observations on the implementation of learning in the fourth grade of Surialaya Tasimalaya Elementary School in science learning with the RADEC model, scores were obtained regarding students' critical thinking abilities, student thinking scores per aspect, teacher ability scores in encouraging critical thinking in learning and teacher RADEC model learning scores. Table 1 shows the result observation of student’s critical thinking based on indicators in science learning.

In Table 1, it can be seen that the score of the indicator of thinking of the students in the three meetings is still in pretty good criteria with the utilization of the RADEC model in science learning. This score is fairly low because it appears that students have not been allowed to realize each indicator of their critical thinking in learning. Students have not been skilled in critical thinking in learning science even though there seems to be a slight increase in the thinking of some students from each meeting. Students are poorly trained to think critically in learning.

Critical thinking is a methodology that helps students develop a deep understanding of science and also the competencies needed to succeed in science. The key to increasing analytical reasoning in science is to nurture scholar’ potential to create judgments that are wise and sustainable. the teacher can do this by arranging stronger questions and several assignments and inviting students to use wiser reasons to arrive at their conclusions.

Table 2 was the result observation of questions task for critical thinking by the teacher and average student ability answering questions regarding Energy material in the learning. From table 2, it can be seen that students' capacity to think critically for the ten aspects of critical thinking is still relatively low. In implementing science learning with the RADEC model, it appears that students are less skilled in critical thinking. Students are not well-educated in every single of the points of critical thinking, and do not yet have good enough abilities and are honed in critical thinking during the learning process. Here it looks like a high-level thinking ability as requested by Beyer [17] and the Consortium of Critical
Thinking [24] in critical thinking in fourth-grade students are still in a lower level and has not been well mastered and well good honed.

| No | Student’s Index of Critical Thinking | First Meeting (%) | Second Meeting (%) | Third Meeting (%) | Average Total Average (%) |
|----|--------------------------------------|-------------------|--------------------|-------------------|--------------------------|
| 1  | Generating ideas                     | 20                | 25                 | 40                | 28.33                    |
| 2  | Predicting and hypothesizing         | 25                | 30                 | 50                | 35                       |
| 3  | Demonstrating comprehension of an idea | 25             | 40                 | 45                | 36.67                    |
| 4  | Comparing                            | 30                | 45                 | 50                | 41.67                    |
| 5  | Interpreting information             | 35                | 50                 | 60                | 48.33                    |
| 6  | Choosing among possible solutions    | 30                | 30                 | 40                | 33.33                    |
| 7  | Considering impact                   | 35                | 50                 | 60                | 48.33                    |
| 8  | Communicating science ideas          | 25                | 45                 | 60                | 43.33                    |
| 9  | Proposing a practical course of action | 0               | 25                 | 40                | 32.5                     |
|    | Average                              | 28.1              | 37.7               | 49.4              | 38.42                    |

| No | Aspect                          | Questions                                           | (%) | Total Average |
|----|---------------------------------|-----------------------------------------------------|-----|---------------|
| 1  | Comparing                       | How are A and B similar and different                | 40  |               |
| 2  | Considering impact              | How did A affect or contribute to B                  | 45  |               |
| 3  | Brainstorming                   | How many different ways can you think of doing A?  | 50  |               |
| 4  | Learning about an event         | Describe the event or character                      | 40  |               |
| 5  | Explaining                      | Why do you think A happen?                          | 45  | 43 %          |
| 6  | Estimating or predicting        | What do you think will happen?                      | 50  |               |
| 7  | Improving performance           | What might you do to improve your performance?      | 40  |               |
| 8  | Assessing merit                 | Do you think A is good?                             | 45  |               |
| 9  | Examining an image              | What do you notice about the image?                 | 40  |               |
| 10 | Checking answer                 | Is your answer correct?                             | 35  |               |

The results of the observation of the teacher’s ability to encourage scholars to think analytically by using the RADEC model during the learning process are shown in Table 3.
Table 3. The capability of teacher to promoting critical thinking by using Radec model.

| No | Aspects                                      | First Meeting (%) | Second Meeting (%) | Third Meeting (%) | Average (%) | Total Average |
|----|---------------------------------------------|-------------------|--------------------|-------------------|-------------|---------------|
| 1  | Shape the climate to support thinking       | 40                | 50                 | 60                | 50          |               |
| 2  | Create opportunities for thinking           | 35                | 55                 | 65                | 51.67       |               |
| 3  | Build capacity to think                     | 45                | 65                 | 65                | 58.33       | 57 %          |
| 4  | Provide guidance to inform thinking         | 40                | 70                 | 70                | 60          |               |
| 5  | Strategies for framing questions that invite critical thinking | 45                | 75                 | 75                | 65          |               |
|    | Average                                     | 41                | 63                 | 67                | 57          |               |

In Table 3, the score obtained from the teacher's ability to encourage scholars to think analytically using the RADEC model as a whole is in the criteria of Good. The capacity of instructors to improve critical thinking is still not as good as expected. This is due to the inexperience of teachers using strategies in educating scholars to think analytically in learning. If the teacher is sufficiently trained in using the strategy and fully understands the application of each step of the critical thinking strategy, it will certainly improve students' critical thinking, especially in science learning, which later can improve students' critical thinking skills for the better.

The results of the observation and assessment of the implementation of the RADEC model by teachers in science learning notice in Table 4.

Table 4. Implementation of RADEC model in learning by teacher.

| No | Learning Step | First Meeting (%) | Second Meeting (%) | Third Meeting (%) | Average (%) | Total Average |
|----|---------------|-------------------|--------------------|-------------------|-------------|---------------|
| 1  | Read          | 50                | 65                 | 85                | 66.67       |               |
| 2  | Answer        | 40                | 60                 | 75                | 58.33       |               |
| 3  | Discuss       | 45                | 65                 | 72                | 60.67       | 58 %          |
| 4  | Explain       | 44                | 60                 | 70                | 58          |               |
| 5  | Create        | 0                 | 40                 | 55                | 47.5        |               |
|    | Average       | 44.75             | 58                 | 71.4              | 58          |               |

From the outcomes of the implementation of learning by the teacher using the RADEC model, it was concluded that the execution of learning carried out by the teacher as a whole was in the criteria of Good. The teacher is allowed to accomplish learning with the RADEC model even though it is not very good as expected especially at meetings one and two. This is because teachers lack experience and training in implementing learning with this model. The lack of teacher skills in implementing this model is mainly seen at the stage of explaining and create. The results showed that elementary science teachers did not orient to improving critical thinking among students, as very little of the classroom students showed in critical thinking skills.

The talent of instructor to implement the RADEC model in science learning and teacher skills in encouraging scholars to think critically has not been allowed to enhance students' critical thinking skills in good criteria. To achieve a better score, Instructor must model the thinking process to students, using effective questioning techniques to encourage students to think critically, and guide students' critical thinking processes. So, teachers and students must practice a lot of learning using the RADEC model.
and develop students’ critical thinking skills with the strategies mentioned by Beyer [17], Langrehr [21] and the Consortium of Critical Thinking [26]. The background and abilities of students and teachers greatly influence the capacity to think analytically of teachers and students in learning.

4. Conclusion
Science education’ teachers at the elementary level can enhance scholars’ critical thinking skills by using RADEC model that assiduously holds students in the education activity instead of depending on oration and mechanically memorization. Some blockades can hinder critical thinking direction. Lack of drilling, little assets, low of students’ capability, and time limitations scheme to invalidate study territories that encourage critical thinking. However, busily appealing scholars in RADEC model or collective tasks can uplift students’ critical thinking progress if teacher’s representation the thinking process, use effectual examining skills and escort students’ critical thinking activities.

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