

PRE-LEARNING QUESTIONS OF ENERGY SOURCES ON RADEC LEARNING MODEL: VALIDATION AND DEVELOPMENT

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Abstract

Currently, almost all aspects of the development of human life are depends on energy from various energy resources. The introduction of the importance of energy resources in life needs to be instilled in children from an early age. However, in general, teachers in primary and secondary schools have difficulty in conveying material about energy sources in an easy and interesting way. Based on this analysis, this study aims to improve valid pre-learning questions that can support the application of the learning model as Read, Answer, Discuss, Explain and Create (known as RADEC) on the topic of energy sources. The method in this research is a development method which consists of two steps, the first step is development, and the second step is validation of pre-learning questions. The instruments used in this study were pre-learning questions on the topic of energy sources, and pre-learning question validation sheets. The subjects were 6 elementary school teachers from several schools in West Java. The data was analysed descriptively. The results showed that the pre-learning questions developed were valid and suitable for the use of learning with the RADEC model. These pre-learning question about energy sources is expected to support students developing their critical thinking through the RADEC learning model.

Keywords: Critical thinking skills, Development and validation, Energy sources, Pre-learning questions, RADEC learning model.

1. Introduction

The results show that most of Indonesia's energy needs are still supplied by energy derived from fossil fuels. Besides being a group of non-renewable resources, fossil fuels are also fuels that produce greenhouse gases. The amount of greenhouse gases is always increasing in volume from year to year. This is a big problem for the future of environmental sustainability [1, 2]. The progress of a country is indicated by the level of energy consumption. In general, energy sources are categorized into two points. The first point is renewable energy sources, and the other is non-renewable energy sources. Regarding renewable energy sources, it is defined as energy sources whose formation process occurs continuously so that their availability is abundant and never runs out. Examples of this type of energy sources are solar energy, geothermal energy, wind energy, energy from biomass, etc. Regarding non-renewable energy sources, it can be defined as energy sources whose availability is limited, and the formation process takes a very long time, so if used continuously will likely run out. Examples of non-renewable energy sources are fossil energies such as oil, coal, natural gas, etc. Comprehension of energy concept is abstract and theoretical, yet, teacher still using presentation and homework as learning method, so that students always been bored and less comprehend.

The introduction of the importance of renewable energy as a substitute for fossil energy needs to be instilled in children since school education. For this purpose, various ways can be taken. Renewable energy material can be used as a separate subject in schools, the introduction of energy sources can be done by including certain topics related to certain subjects. For example, the topic of energy sources can be included in the content of natural science lessons (IPA). Or the topic can be used as material in making pre-learning questions. Pre-learning questions are accommodated in a learning model as Read-Answer-Discuss-Explain-And Create, in which it is well-known as RADEC. It is one of the alternative learning models in accordance with Indonesian conditions [3, 4]. The RADEC learning model is a new alternative learning model, in which it aims to support students acquire and achieve many useful competencies [5, 6].

Several stages of RADEC are:

- (i) Read. Students read information from various sources. They can get from books, other printed sources of information and electronic information sources such as the internet, readings related to energy sources, and then given pre-learning questions to guide students in understanding information related to sources.
- (ii) Answer. Students answer pre-learning questions based on the knowledge gained from reading activities, pre-learning questions are arranged in the form of worksheets.
- (iii) Discuss. Students learn in groups to discuss answers to pre-learning questions and motivate each other to complete tasks in worksheet.
- (iv) Explain. Students conduct presentation activities in the form of presentations from answering worksheet and teaching materials that include all indicators of cognitive aspects of learning that have been formulated in the lesson plan.
- (v) Create. Teacher facilitates students to learn to use the knowledge they have mastered to generate creative ideas or thoughts related to energy source materials.

The first stage in RADEC learning model is reading which is carried out in simultaneously with the answering stage (answering pre-learning questions). Pre-learning questions must be directed so that students know the essential part of the content of the material that must be mastered [7]. The use of pre-learning questions can improve reading habits before studying, reading comprehension of the content of the material, and the achievement of cognitive aspects of learning outcomes in chemistry subjects. Pre-learning questions are questions related to teaching materials that include a variety of questions, from questions which trains low thinking skills to high thinking skills because questions can train higher order thinking skills, this is in line with the opinion [8] which says that questions are part of one aspect of skills in the teaching and learning process, the role of questions is very important in constructing a learning experience for students.

Based on the results of preliminary observations made by the researcher, it is found that the pre-learning questions that are often asked so far are still at the simple level questions, namely the level of memory and understanding. While other types of pre-learning questions that add insight and train thinking skills have not been raised, in this case training critical thinking skills, resulting in passive learning where students are silent, and the quality of learning is not as expected.

Preliminary research on the RADEC learning model in relation to improving the quality of learning processes and outcomes is as follows: research conducted by Pratama et al. [8] which resulted in one solution to be able to build critical thinking skills is to use the) RADEC learning model. The approach in learning that is carried out by the teacher plays a role in growing critical thinking skills. Teachers need to use learning models that can stimulate students' critical thinking skills [9]. The RADEC learning model has a good impact on the ability of prospective teachers to plan learning [10]. The RADEC learning model can train 21st century skills. The RADEC learning model has a positive impact on learning outcomes, both material-oriented, namely understanding concepts [11] and learning skills-oriented, namely the ability to think creatively [12] students' critical thinking skills have increased in the moderate category through the RADEC model [13].

From several studies that have been conducted on valid pre-learning questions, especially energy source material in the RADEC learning model in improving critical thinking skills, there is no gap that causes this research to be interested in conducting research with the title "Pre-learning questions of energy sources on RADEC learning. models: validation and development". The formulation of the problem in this research is how to develop valid energy source pre-learning questions that can support the RADEC learning model. The purpose of this study is to develop valid energy source pre-learning questions that can support the implementation of RADEC learning model.

2. Research Method

We used the instrument development and validation method by adapting the instrument development process proposed [14]. The process includes eight steps which are grouped into two phases, that are development and validation phase. The development phases are (1) instrument conceptualization; and (2) instrument development. The validation phases are (1) face and content validation; (2) pilot study - construction validation; (3) analysis item; (4) revision the instrument; (5) field study - construct validation; and (6) criterion validation [15].

The development stage consists of the instrument conceptualization stage and the instrument development stage. The conceptualization instrument carried out is an analysis of the elementary school curriculum which will be developed based on the analysis of learning materials, basic competencies and indicators that will be made and developed in the instrument. At the instrument development stage, instrument development is the preparation of pre-learning questions that are adjusted to critical thinking skills indicators that refer to the critical thinking indicators from Robert Ennis, namely the indicators chosen are developing strategies and tactics (Strategies and Tactics) by determining actions, providing explanations Advanced Clarification by defining and considering it, drawing conclusions (Inference) by making deductions/inductions and considering the results, providing a simple explanation (Elementary Clarification) by clarifying, asking and answering questions and determining the basis for decision making (The basic for decision) by take into account the authenticity of the source.

The instrument developed consisted of questions for pre-learning critical thinking skills for grade 4 elementary school with the theme of saving energy, sub-theme of energy sources, as many as 18 questions along with an attachment to the answer key.

3. Results of Research and Discussion

The results of the research are in the form of pre-learning questions related to energy source materials that have been validated in accordance with the stages of development and validation of pre-learning questions carried out. At stage 1: the development stage which includes conceptualization and the process of making pre-learning question items, starting with an analysis of literature studies related to energy source materials and then developing instruments. The analysis of the literature study that we carried out consisted of (1) curriculum analysis in this case the analysis of core competencies, basic competencies, indicators and learning objectives [16], (2) analysis of the need for pre-learning questions oriented to critical thinking skills that are adapted to learning indicators on energy source material, (3) Preparation of pre-learning question instruments to support learning with the RADEC model, and (4) Development of tasks and rubrics based on indicators of students' critical thinking skills designed to obtain an initial list of energy source pre-learning question instruments.

In Phase 2: Validation Phase includes validity testing. Validation is a crucial process to confirm that the instrument developed can measure what it is intended to measure. Also, validity refers to the ability to expect a particular event, or its relationship to measure other constructs based on the way the scale is constructed. The validity process includes face validity, content validity, and criterion validity and construct validity [17]. Face validity is a process that needs selected respondents to evaluate the instrument based on the question interface, sentence structure, grammar and other problems in the instrument that are deemed necessary. While testing the size of the conceptual variable is quite large, it also helps the researcher to detect early on possible misunderstood or misinterpreted questions.

Development and validation related to the scope of energy studied are alternative energy sources consisting of water, wind, geothermal, solar, organic fuels, and nuclear, changes in energy forms, energy use and natural resources in daily life. Based on this scope, understanding of alternative energy sources and their use as well as natural resources is still lacking. Meanwhile, mastery of

concepts in understanding changes in various forms of energy shows good results. Therefore, the conceptualization of energy must be concreted with the media.

Changes in the form of energy into other forms of energy are presented through concepts that include everyday experiences, for example in a light that is on, the change in the form of electrical energy into the form of light and heat energy. As for alternative energy sources and their use, it does not necessarily include everyday experience. For example, wind, sunlight, and water can be used to generate electricity. Likewise with the use of natural resources which explains that coal and natural gas can be used in everyday life as fuel.

Different results were obtained from the input and suggestions of expert validators referring to five indicators of critical thinking skills including determining the basis for decision making (The basic for decision) by considering the truth of the source, recounting, formulating strategies and tactics (Strategies and Tactics) by determining actions, provide Advanced Clarification by defining and considering, showing examples of implementing and explaining the differences in showing various achievements in the energy context mentioned above.

The next follow-up from the researcher is to correct the lack of problem structure in the energy context so that the results of the development and validation can be used properly.

In this study, we construct validity. Also, we made investigation to ensure that the instrument developed measures correctly what is intended to be measured based on the basic competencies of the energy source material associated with several indicators of critical thinking skills. The final validation process includes criterion validity, criterion validity occurs when the instrument has an empirical relationship with several criteria or standards [14, 15]. There are two types of criterion validity, namely predictive validity and concurrent validity. Since there is no instrument to measure instructional readiness, the use of predictive validity is suggested. Predictive validity includes trying to predict the future or draw conclusions. The conceptualization of pre-learning questions oriented to critical thinking skills is shown in Table 1.

Conceptualization of pre-learning questions oriented to critical thinking skills is a process of adjusting the basic competencies of energy source material with indicators of critical thinking skills. The critical thinking skill indicator determines the basis for decision making by paying attention to the truth of the source, which becomes its basic competence. In general, the basic competence was in the form of evaluation and identification of the characteristics of space as well as the use of natural resources for the welfare of the community from the city/district level to the provincial level. In indicators of building strategies and tactics by determining actions, the basic competence is an understanding of tempo and tone. Indicator provides further explanation (Advanced Clarification) by defining and considering, its basic competence in the form of identifying the implementation of obligations and rights as citizens in everyday life. In the indicator draw conclusions (inference) by making deductions/inductions and considering the results, the basic competencies are in the form of identifying various energy sources (renewable and non-renewable), changes in energy forms, and alternative energy sources (water, wind, sun, geothermal, fuel, organic, and nuclear) in everyday life. And on the basic clarification indicators by asking and answering questions, the basic competence is in the form of comparing instruction texts to use the same and different tools.

Table 1. Conceptualization of pre-learning questions oriented to critical thinking skills.

Construction (Conceptual definition)	Aspect (Operational definition)
Critical Thinking Skills Indicator	Basic Competencies
<ul style="list-style-type: none"> • Determine the basis for decision making (The basic for decision) taking into account the truth of the source. • Building Strategies and Tactics by determining actions. • Provide further explanation. • (Advances Clarification) by Defining and considering. • Drawing conclusions (Inference). • by Making deductions/inductions and considering the results. • Elementary Clarification by asking and answering questions. 	<ul style="list-style-type: none"> • Identifying the characteristics of space and utilization of natural resources for the welfare of the community from the city/district level to the provincial level. • Understand tempo and pitch. • Identifying the implementation of obligations and rights as citizens in everyday life. • Identify various energy sources (renewable and non-renewable), changes in energy forms, and alternative energy sources (wind, water, solar, geothermal, organic fuels, and nuclear) in everyday life. • Comparing the text of the instructions for using the same and different tools.

Based on the results of the validation of the instruments provided, the teacher validator has provided input and suggestions regarding the content of the questions and the language used is adjusted to the age of the 4th grade students. In addition, the teacher validator provides corrections about the level of difficulty of the questions, so that the questions can be understood by students. As for the validator, the lecturer provides input and advice in terms of the suitability of critical thinking skills indicators with the expected basic competencies set in the achievement of indicators.

Preparation of pre-learning questions was made and developed with the aim of measuring teacher readiness in implementing the RADEC model at the Answer stage. There are five constructs of energy source questions that were developed as the core of the instrument based on indicators of critical thinking skills. Each indicator of critical thinking skills has a relationship and is adjusted to the achievement of basic competencies and indicators that have been determined in the energy source material. Although there are improvements in the implementation of the validation, it does not reduce the essence of the content of the energy source material and the level of difficulty of the questions. The improvements proposed by the validator build a better construct and conceptualization as well as the results of group discussions contribute to the reinforcement that supports the creation of this instrument.

Pre-learning questions related to energy sources are made to improve students' critical thinking skills. In addition to supporting students to better master concepts, critical thinking skills also stimulate students to have high awareness in choosing and deciding the fuel used in everyday life. These conditions are expected to stimulate students to be able to think about and utilize other alternative energy sources.

4. Conclusion

The application of the RADEC model in learning must be supported by the readiness of the teacher in making pre-learning questions related to the material discussed, in this case the energy source material. The teacher has difficulty in making pre-learning questions. Therefore, this study discusses the process of developing and validating instruments in the form of pre-learning questions on energy source materials so that valid pre-learning questions are generated. In practice, the process of developing this learning question instrument goes through several stages. The conceptualization stage is the main stage because this stage is intended to ensure that the items created are representative and can be measured. The results of this study are in the form of pre-learning questions on energy source materials that are valid in learning.

The contributions and implications obtained by the teacher are as follows: first, based on good reliability, the pre-learning question instrument for energy sources can be used in high-grade elementary schools. Second, with pre-learning questions on energy source materials that have been validated, it shows the level of teacher confidence in preparing lessons using the RADEC model. Third, the pre-learning question instrument on energy materials can be used as a benchmark for the success of teachers in promoting the RADEC model in their classrooms.

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