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Development and Validation of Mastery Concept Based Pre-Learning Questions to Support The Implementation of RADEC (Read-Answer-Discuss-Explain-Create) Learning Model

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Abstract

The fact shows that elementary school students are generally passive because most of the elementary school teachers only ask lower-order cognitive questions such as memorization. Therefore, the purpose of this study was to develop pre-learning questions that are able to stimulate and equip students to have higher order thinking skills. This study was using a research method for developing and evaluating instruments by adapting the instrument development process that has been developed by DeVellis (2003). This development process took two phases, that was the development phase and the validation phase. Pre-learning questions are made up of a set of questions for the fourth grade of elementary school with a validated energy theme. Data analysis was carried out through validity testing uses the SPSS version 25. The test results of pre-learning questions show that the questions are feasible to use. The implication of this study is to produce a cognitive assessment instrument whose validity is tested in accordance with the appropriate cognitive stages to support the implementation of the RADEC (Read-Answer-Discuss-Explain-Create) learning model used in schools by teachers.
Keywords: pre-learning questions, mastery of concepts, RADEC learning model

INTRODUCTION

The parameters of educational success refer to the achievement of life skills as well as the development and strengthening of character. Life skills can be interpreted as a series of knowledge that must be possessed by a person so that he is able to face and solve life challenges in his life in the future (Mawardi, 2012). Supporting to have good life skills requires mastery of essential and fundamental concepts so that it can facilitate the achievement of higher-order thinking skills. According to Tso (2021) states that higher-order thinking skills include the ability to build lower learning domains in mastering concepts (Tso, 2021). In line with this, Anderson & Krathwohl (2001) stated that measuring mastery of concepts involves thinking skills at a high level in the learning process which must be supported by appropriate evaluations or tests on each indicator (Nofiana et al., 2014). Therefore, in the learning process, there must be a match between learning objectives and learning outcomes, while changes that can occur

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in the concept ownership process can be measured and developed through evaluation activities that are in accordance with teaching methods (Yin et al., 2014).

Learning objectives play an important role, where teachers can assess students' cognitive abilities by using cognitive taxonomy in formulating various kinds of questions and can generate and develop certain expected cognitive processes. The questions asked by the teacher in the teaching process are common. Tofade (2013) states that the questions used by the teacher aim to assess students' knowledge, measure understanding and stimulate students' critical thinking so that these questions can discuss students' cognitive levels ranging from low thinking levels that only remember facts to questions that require processing. Higher-order thinking to facilitate deep thinking. Therefore, in this case, the question is not an ordinary activity anymore but can present various cognitive domains to achieve learning outcomes (Tofade et al., 2013). Questions play an important role in the way teachers structure the classroom environment, organize the content of the subject matter and apply the way students assimilate the information presented and can facilitate discussion in the classroom (Mccomas & Abraham, 1991).

The activity of asking questions is an activity that cannot be separated from teaching and learning activities in the classroom both orally and in writing. Questions made by the teacher can be used as an assessment to determine student knowledge, but if the teacher is not skilled in making questions it will hinder learning, for example, students become confused and limit students' creative thinking. Today, most teachers in asking learning questions still revolve around low-level cognitive questions or memorization (Dahliana et al., 2019). The learning process only focuses on memorizing teaching materials as much as possible and cannot effectively stimulate students' critical thinking (Ulandari et al., 2020) so that students become passive in the learning process (Bhawanayani et al., 2018), and students' higher-order thinking skills still low (Putranta & Supahar, 2019). The teacher's ability to ask questions is a skill that requires certain techniques because it can describe the substance of the questions asked (Meirianti, 2018). Asking questions is the same as promoting independent thinking and involving students in innovative learning processes (Aziza, 2021). In this case, the teacher must be sensitive to the condition of students so that they can position students as someone who can ask questions and able to answer scientific questions as a way to build knowledge and skills (Meyer, 2014). Creating teacher and student interactions in the learning process through questions is interpreted as the beginning of the emergence of ideas or ideas to support and help

students develop the ability to interpret, clarify ideas and respond to responses in discussions (Haverly et al., 2020).

Asking questions is a basic skill of a teacher. In teaching, if the questions are well structured by the teacher, students can explore the subject thoroughly and can promote learning gains. For example, providing challenges by asking questions trains students mentally in learning and facilitates in receiving complete and complete information. Meanwhile, Cotton (2001) indicated that asking questions that involve low-level cognitive thinking processes or rote learning is more effective when the teacher aims to convey factual knowledge and transfer knowledge into students' memory. While effective questions that can be applied at the elementary school level are a combination of high-level and low-level questions (Cotton, 2001). In preparing questions, the teacher can use the revised Bloom's taxonomy table as a reference in formulating questions that aim to bring up certain cognitive processes in students. Based on the Revised Bloom's taxonomy initiated by Anderson and Krathwohl (2001) divides the cognitive domain for learning into six levels, namely remembering, understanding, applying, analyzing, evaluating, and creating. If traced, the lowest order of cognitive processes is remembering. In asking questions in the form of memory/memorization the teacher can ask the information obtained based on factual data. Meanwhile, to ask questions that aim to gain understanding of the material, the teacher can use questions that ask students to provide examples, classify items, summarize information, and/or draw conclusions. For questions relating to application, students must be able to carry out a step or process procedure both mentally and physically into a certain condition or situation. For the ability to analyze, students can group a material into its constituent parts to determine the causal relationship. The analytical question that can be asked is to organize the parts in the constituent structure, distinguish relevant and unrelevant information, or deconstruct the values and biases of an underlying problem. Furthermore, evaluation requires the formulation of values based on certain standards or categories of an existing value. In asking evaluation questions, students are faced with criticizing a work or product, determining the feasibility of a process or product for a particular problem, or checking for inconsistencies in theories or concepts. The last of the highest order of this cognitive process is to create. In asking creative questions, students are challenged to be able to produce a work or product based on the results of their creative thinking (Tofade et al., 2013). The following is a description of the classification of questions on the level of students' cognitive processes and actions to achieve mastery of concepts in learning.

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Tabel 1. Classification of questions based on the dimensions of cognitive processes

Dimensions of Cognitive Process	Cognitive level	Indicators	Sample question
Remembering	Lower-Order Thinking Skill	Recognizing, identifying, recalling, showing, stating, explaining	What is the meaning of weather?
Understanding	Lower-Order Thinking Skill	Interpret, exemplify, classify, summarize, conclude, compare	Give examples of human activities that can be done in hot weather?
Applicating	Lower-Order Thinking Skill	Implement, use, prove, manipulate, practice	Based on data from the Meteorology, Climatology and Geophysics Agency (BMKG) it was notified that in the Java region there would be extreme weather throughout the month of July. What should vegetable farmers do to avoid crop failure?
Analyzing	Higher-Order Thinking Skill	Distinguishing, organizing, deconstructing, analyzing, selecting, integrating	In the transition season, often someone with a weak immune system is exposed to influenza. Try analyzing the symptoms of influenza!
Evaluating	Higher-Order Thinking Skill	Coordinate, evaluate, assess, criticize, test, detect	What do you think about the government regulations regarding the delay of domestic flights to Papua for one week due to bad weather this October!
Creating	Higher-Order Thinking Skill	Creating hypotheses, designing, constructing, formulating	Make a picture poster to raise funds for humanitarian aid for the landslide disaster in Sumedang!

Questions related to mastery of concepts can be measured properly by paying attention to each indicator on the instrument that can measure the characteristics of the dimensions of students' cognitive processes. Instruments must be conceptually structured, consistent and statistically reliable (DeCapua & Wintergerst, 2005). Assessment begins with recognizing that all steps in assessing have limitations (Porter, 2021). To overcome this, the test instrument must be developed with careful planning to measure conceptual understanding and develop higher order thinking skills (Aizikovitsh-Udi & Cheng, 2015). According to King, et.al. (2010) stated that students can be given unusual problem-based questions to practice higher order thinking skills so that they are able to solve problems based on the context of their knowledge and experience (Nofiana et al., 2014). In general, the teacher's perception in asking questions hopes that students learn by building meaning from the concepts that have been studied, incorporating new content or concepts into existing mental representations, because improving thinking skills simultaneously increases knowledge and content or concepts as well (Brookhart, 2010).

Understanding differences in the types or levels of questions affect subsequent student responses and interactions (Ertmer et al., 2011), meaning that teachers can direct the involvement of the quality of student responses or answers to high-level questions.

In general, teachers ask questions during the learning process, but the Read-Answer-Discuss-Explain-Create (RADEC) learning model presents pre-learning questions before the learning process begins in class, with the intention that students can learn and understand the content or concept first. . Students' exploration of the concept of subject matter becomes more flexible and students are trained to read various reading sources related to the material to be studied. This will strengthen the understanding of concepts to build their own knowledge. The research on the development of pre-learning question instruments aims to determine (1) the characteristics of the concept mastery-oriented pre-learning question instrument capable of supporting the implementation of the RADEC learning model (2) the feasibility of the pre-learning question instrument as a starting point for students to master the learning concept (3) student responses to the pre-learning question instrument.

The role of teachers who are innovative and creative should be able to support learning that should be able to deliver success to their students. The selection and application of learning models is also suspected to have an effect on the success of students' learning. This is also in line with the opinion of Ceran (2020) which states that the development of conceptual understanding is a process, and for a deep understanding process it can be realized by compiling the right concept. A significant effort to achieve this is by building supportive teaching methods and environments (Aydin Ceran & Ates, 2020). Conceptual understanding is the ability of students to understand the relationship of concepts to each other so that it can be applied to solve problems (Holme et al., 2015). Therefore, it is necessary to realize that each student has different intellectual characteristics and learning environment so that the RADEC learning model is able to facilitate students to be able to develop their cognitive processes in accordance with learning objectives. The RADEC learning model is an alternative learning model that is appropriate to apply and in accordance with conditions in Indonesia (Pratama et al., 2020). The sequence of learning steps is easy to remember and easy to implement by the teacher.

Understanding students' conceptions can be influenced by various factors, including based on their level of knowledge. The research conducted by Ceran & Ates (2020) revealed that the level of conceptual understanding as measured by measurement techniques was adjusted to the cognitive level of students (Aydin Ceran & Ates, 2020). In line with this, Macana & Rogayan (2019) stated that science teachers can use Sci-vestigative Pedagogical

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Strategy (SPS) to improve students' conceptual understanding including their concepts and content knowledge; depth in topic; and transfer and connection and to develop their higher order thinking and questioning (Macanas & Rogayan, 2019). In fact, teachers still measure the level of students' conceptual understanding by giving questions that involve low levels of thinking, this is in accordance with Abosalem's research (2015) which states that most teacher-made tests measure lower levels in Bloom's taxonomy (Abosalem, 2015). Meanwhile, the ideal of learning in elementary school requires students to be able to have mastery of concepts by involving higher-order thinking skills. It turns out that there has been no development of questions that facilitate concepts for higher-order thinking in mastery. At the end of the learning activities the teacher provides reinforcement as the final touch of mastery of concepts during the learning process. Learning reinforcement can be used to integrate key elements of previously studied material into a concept to produce effective answers (Zhang et al., 2019). In other words, it can be stated that applying the RADEC model by teachers can be used as an alternative solution in developing 21st century skills and developing character for students at the elementary school level (Handayani et al., 2019).

METHOD

In general, the participants characteristics involved consisted of academics, teachers and students. The academic participants have the following criteria; 1) Lecturer status at public or private universities, 2) Expertise in Basic Education, 3) More than 2 years teaching experience. Furthermore, the teacher participants who were included in this study had the following criteria; 1) Status as a class teacher in elementary school, 2) More than 2 years teaching experience, 3) Last education Bachelor of Education, 4) Have high motivation and dedication to the development of educational progress. Meanwhile, the students involved have the criteria as students in te fourth grade of elementary school. Meanwhile, the number of participants who were included in this study were 3 academics, 3 teachers and 30 fourth grade elementary school students.

The validation measuring instrument in this study was made through adjustments based on the context of the study on the chosen theme, basic competence, level of cognitive development, and the age of the students. The format used makes it possible for participants from academics and teachers to put a check mark in one of the columns that describes the criteria for the questions that are appropriate or suitable for the aspects being studied. The following is an example of an instrument validation construct table.

Table 2. Instrument Validation Construct

Basic Competencies	Indicator	Question Number	Description		
			in accordance	not suitable	not in accordance
Science 3.5 Identify various energy sources, changes in energy forms, and alternative energy sources (wind, water, solar, geothermal, organic fuels, and nuclear) in everyday life.	3.5.1 Identify various sources of energy in daily life	1	☐	☐	☐
	3.5.2 Give examples of the benefits of changing forms of energy in everyday life	2	☐	☐	☐
	3.5.3 Prove that there is a change in energy	3	☐	☐	☐
	3.5.4 Differentiating alternative energy sources	4	☐	☐	☐
	3.5.5 Evaluating the use of alternative energy sources for daily life	5	☐	☐	☐

This study uses the instrument development method and the validation method by adapting the instrument development process proposed by DeVellis. The basic reasons for choosing this research method because the stages of the process are selective in measuring instruments and are effective in being able to be developed and adapted. The process involves eight steps which are grouped into two phases, namely the development and validation phases (DeVellis, 2003).

Stage 1: Development Stage, at this stage the researcher conceptualizes and formulates the process of making pre-learning question items. The first step is analyzing literature studies from various sources, then focusing on developing pre-learning question instruments through group discussions. The literature study that has been carried out is an analysis of the elementary school curriculum which consists of core competencies, basic competencies, indicators and learning objectives. Meanwhile, for the analysis of the need for making pre-learning questions oriented to mastery of concepts, it is adjusted to the cognitive level indicators proposed by Bloom. Then held Focus Group Discussion (FGD) which involved 3 elementary school teachers in preparing pre-learning question instruments and developing an assessment rubric oriented to mastery of concepts to support the RADEC learning model.

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Stage 2: Validation Stage. At this stage the pre-learning questions that have been made are prepared to be validated for 30 students of fourth grade elementary school students. This validation stage includes an important process to ensure that the instrument developed is able to measure what it is intended to measure. The reference is applied in this validity step to predict an event or event or its relationship. The description of the method can be described as shown in Figure 1 below:

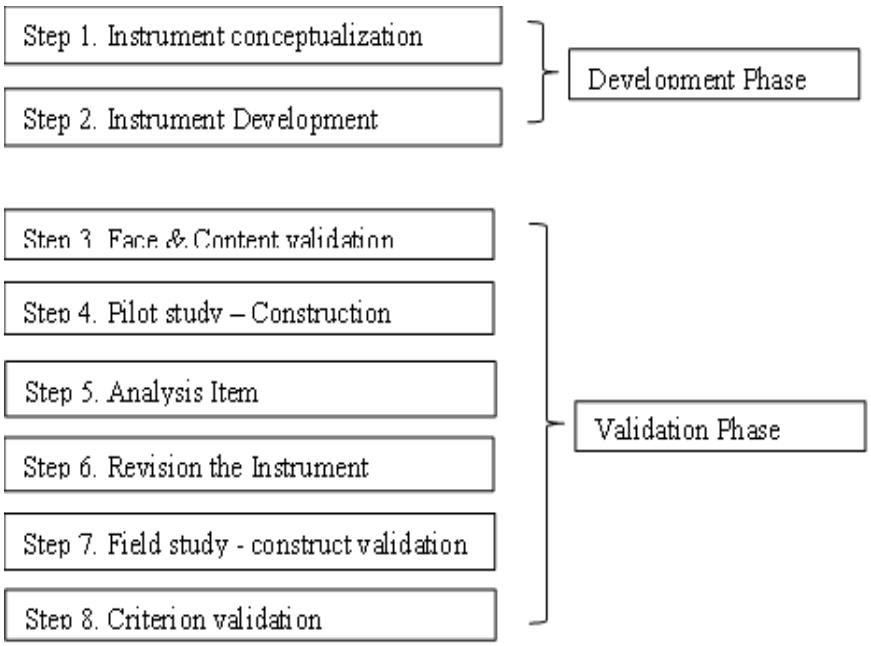

Figure 1. Development and validation of instrument

Data collection in this study uses a validation sheet that has been compiled through the aspects studied, including aspects of material or content, aspects of construction, language and additional rules that explain that the questions do not contain elements that can trigger divisions. The data analysis stage, the researcher first checked the data as a verification of the completeness of the data and the answers from the participants. Furthermore, this study uses the help of the SPSS version 25 in calculating the validity of the questions that have been tested on a limited basis to 30 fourth grade elementary school students.

RESULTS AND DISCUSSION

Results

The results showed that a set of pre-learning questions with the theme of energy that had been tested on 30 fourth grade elementary school students was valid. It can be described in Table 2 below:

Table 3. Test the validity of the pre-learning concept mastery questions

Item	Pearson correlation number	R table	Description
1	.314	0,239	Valid
2	468**	0,239	Valid
3	.408	0,239	Valid
4	.379	0,239	Valid
5	.504**	0,239	Valid
6	.271	0,239	Valid
7	.261	0,239	Valid
8	.248	0,239	Valid
9	246	0,239	Valid
10	.273	0,239	Valid

The validity test of the pre-learning concept mastery questions was processed through SPSS version 25. For n = 30, the r table obtained was 0.239. Table 2 shows that if the value of r count > r table then it is declared valid. Meanwhile, if the value of r count < r table is declared invalid. Thus the results of the validity test indicate that the questions are feasible to use.

Discussion

The questions given in the learning process are a contribution to the provision of subject matter, pedagogical knowledge, practical experience, and the performance of a teacher. One example is that bad things can hinder learning by creating confusion, inspiring students, and limiting creative thinking (Tofade et al., 2013). The question can also be expressed as an assessment of the level of student understanding in mastering the concept, this is based on a goal that can reveal the success or failure of the learning process (Porter, 2021). Actually the expected questions are those that can increase students' understanding and knowledge and can facilitate students' critical and creative thinking. Preparation of pre-learning questions are made and developed for the purpose of measuring teacher readiness in implementing the RADEC model at the Answer stage. There are five constructs that were developed as the core of the instrument based on indicators of concept mastery. Each indicator of mastery of concepts has relevance and is adjusted to the achievement of basic competencies and indicators that have been determined. Although there are improvements in the validation implementation, it does not reduce the essence of the content of the material and the level of difficulty in pre-learning questions. The improvements proposed by the validators can build a better construct and conceptualization, as well as the focus of the results of group discussions contributing to the reinforcement that supports the creation of pre-learning question instruments for mastery of this concept, so that at the stage of development and validation the questions can be measured and feasible to be used.

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CONCLUSION

The application of the RADEC model in learning must be supported by the readiness of the teacher in making pre-learning questions, although the shortcomings and difficulties in making pre-learning questions are felt by the teacher. Therefore, this study discusses the process of developing and validating instruments to prepare pre-learning questions as instruments. The conceptualization stage is the main stage, because this stage is intended to ensure that the items made are represented and can be measured. There are contributions and implications obtained by the teacher are as follows: first, based on good reliability, this instrument can be used in high grade elementary schools. Second, pre-learning questions that have been validated will have an impact on the level of teacher confidence in preparing lessons using the RADEC model. Third, the pre-learning question instrument can be used as a benchmark for the success of teachers in promoting the RADEC model in learning in their classrooms. The suggestion from this research for future researchers is that the model for developing and validating this instrument needs to be designed and re-examined in context if it is applied to a new target, namely at a different level of education.

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