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Analysis of Students' Critical Thinking Ability in the Class IV Science Learning Process of Elementary Schools Through Mini Turbine Wind Power Plant Learning Media

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Abstract: Wind turbines work by converting wind into electrical energy. The moving turbine is exposed to the kinetic energy of the wind, while simultaneously driving a generator that can produce electricity. Wind electric energy is a simple, economical and non-polluting energy system. Several factors influence the performance of a wind turbine, such as wind speed, number of angles, and angle shape. The amount of wind power that can produce several coil (N) revolutions also affects the performance of the turbine. If the wind used is large, the pressure or movement made by the turbine will also be greater, so that the number of rotations produced will also increase, thus producing large amounts of electrical energy. The aim of this research is to help students think critically about natural science material. Carrying out this research is expected to be able to find out the character of students in learning, how students think about the material presented, and to find out how teachers provide natural science learning by involving learning media as a tool to help understand the material. The research method developed is Research and Development (RnD). The research model we use is to show how the media works to help explain electrical energy science material.

Keywords: Critical thinking; Education; Natural sciences

Introduction

Education is the most important aspect in the advancement of science and technology (Sugiyarti et al., 2018). The aim of education in Indonesia in Article 3 CHAPTER III of Law No. 4 of 1950 is to form capable human beings who act responsibly towards the nation and state and are democratically responsible. So from this goal, it is hoped that Indonesia will have an education system that produces students who are able to contribute and be responsible for the welfare of themselves, society and their homeland. Currently, the education system requires students to master the 4C skills which were introduced in 2000 by the United States in the Partnership for 21st Century Skills (P21). 4C consists of 4 components, namely Creativity, Critical Thinking, Collaboration, and Communication. Indonesia began introducing and implementing 4C in 2013, specifically in the 2013 Curriculum which was designed to improve students' abilities to think critically, creatively, be skilled in communicating and working together. Of these four components, they are very supportive in efforts to improve critical thinking skills.

There are several definitions of critical thinking. Critical thinking according to Firman et al. (2021) is a persistent and active activity carried out with full consideration regarding beliefs or whatever is seen. The meaning of critical thinking is making reasonable judgments and opinions (Bayer Sr, 1995). Bayer Critical thinking is an effort to observe something, from

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activities in daily life to writing a statement, idea or idea (Angelo, 1995; Filsaime, 2008; Scriven et al., 1996).

The need for electrical energy continues to increase along with meeting life's needs. The supply of electrical energy sources in Indonesia is currently starting to experience limitations. At a certain time the existing power plants are no longer able to supply electrical energy (Sumarno, 2019). Wind energy is a renewable energy source that has great potential in Indonesia to be developed as a substitute for fossil energy which is increasingly depleting (Gianto, 2019; Hidayatullah et al., 2017; Hiendro et al., 2021; Pramono et al., 2010). The use of wind energy is greatly influenced by fluctuating wind speeds, resulting in fluctuating output voltages (Firmansyah et al., 2021; Maulana et al., 2019; Shuhufam et al., 2021).

According to Clement (2011), and Hanggoro et al. (2017) critical thinking is one of the components which is a process of searching, generating, analyzing, collecting and conceptualizing information which becomes the ability to increase each individual's personal creativity. Thinking functions as a process of forming a disciplined, intelligent character, carrying out various experiments to increase experience and self-confidence (Gischa, 2022). The learning system is increasingly developing along with changes in the curriculum which also follow developments and educational needs in Indonesia, thereby enabling students to become more capable, active both in groups and individually, actively exploring and understanding scientific concepts. Critical thinking is very necessary in solving a problem, so that critical thinking skills can produce a decision. Basically, critical thinking is a high-level part of thinking which has an important role in a learning process, especially science learning.

According to Af'idayani et al. (2018) and Rahayu et al. (2018) that Natural Sciences (IPA) is concerned with natural phenomena. Science is not only about mastering a collection of concepts and facts, but also about the process of discovery. As in the implementation of the 2013 curriculum which contains basic science competency material that students must master, with an integrated learning model. There is a lot of knowledge that can provide an understanding of the reasoning and interrelationships of almost all problems related to nature. The science group not only appreciates a formula, but also studies about objects and living creatures in Winaputra in Samatowa (2011). One subject that involves a lot of experimentation and a high level of understanding is science. Therefore, the process can be assisted by using media, with the aim of facilitating the learning process and students' thinking abilities. Susanto (2013) students need to develop critical thinking. Students who have critical thinking skills also have the ability to obtain and process the information they obtain (Wardani et al., 2018; Zubaidah, 2020). Students will find it easier to find solutions when they are in difficult situations, and train them to think independently. It is necessary to develop an attitude, demands or challenges for students that can be obtained from everyday life and the surrounding environment. The development of critical thinking in the learning process needs to be mastered by teachers. Teachers also need to pay attention to choosing the right media, so that learning activities can be realized well and appropriately.

One of the things that teachers need to pay attention to in an effort to train critical thinking skills according to Arief in Susanto (2013) in previous research reading sources states that there are several stages for training students' critical thinking, including: Analyzing, namely the skill of observing and describing a component that has been obtained. Synthesis, namely the ability to combine several parts into one new thing. Skills in knowing, understanding, then solving problems. Inferencing skills, where the human mind works to reach new understanding. Evaluation. Students have the ability to assess to be able to observe and give a value or score to something that has been observed. Critical thinking can also be said to be an effort to develop one's potential. According to Lestari et al. (2019), Sulistyowati (2012), Ihsan et al. (2019) in connection with the expectation that students have the ability to manage cognitive skills so that they can easily improve their critical thinking competencies in their future learning. In the process, development needs to be balanced or supported by external factors, one of which is the use of learning media. Providing science or science materials is an effort to develop the most basic learning materials in the current era of education.

According to Wahyu et al. (2020), learning media also functions as a way to provide information about learning concepts that are well received. Making media also requires ideas and critical thinking processes to provide more mature learning patterns (Dewanti et al., 2023). The need for a learning center can facilitate and increase students' interest in studying and understanding subjects. What tools can be used to transmit messages to achieve learning goals, so it is necessary to apply learning media that can improve students' critical abilities. One of the science learning media used in the physics learning process for power plants using alternative energy requires direct, contextual objects. The science media can be used in the form of objects in the form of artificial objects and can be obtained or made from used items so that they are easily accessible. This is an advantage of making learning media which utilizes items that are not used and are

suitable for use. The creativity of a teacher is demanded in learning that will be taught to students (Ivannuri et al., 2022), because teacher creativity is very important in learning, and teachers are required to demonstrate and demonstrate this creative process (Afriyanto et al., 2017). Djamarah (2020) in this case the authors want to test the level of critical thinking of class IV students regarding the physics of electricity generation using alternative energy, by using auxiliary media, namely mini turbines for alternative wind power plants. It is hoped that this experiment can produce a comparison or study of students' levels of critical thinking before and after the trial of using learning media.

Method

Research and Development is the method used in this research. Research and development is a process or steps to develop or perfect an existing product, which can be accounted for (Hardiansyah et al., 2022). This research begins with device development using new product development or product development and improvement. According to Sugiyono (2017) R&D is a research method used by researchers to obtain the production results of a new product and then prove the effectiveness of the product. R&D helps in the development of models in the field of education, and is included in multi-stage research. In the process, researchers must carry out three stages. In the R&D implementation process, several methods are used, namely: descriptive, evaluative and experimental. Descriptive research methods are used for formative research to collect data regarding facts. Evaluative methods are used to ignite the product development testing process. And experimental methods are used to test the effectiveness of the products produced. R&D research and development is used to produce a product and test its effectiveness. In the process of developing learning materials, preparation and conceptualization are required using the ADDIE development model.

Based on the aim of this research, it is to describe a situation in which the availability and use of grade IV science learning media in Surabaya City elementary schools. Basically, this R&D research requires quite a long time, which is carried out over 3 meetings. Each session consists of 45 minutes of learning. The sample for this research is one class consisting of 5 students. Researchers conduct observations and interviews with research subjects who can monitor the availability and use of science learning media. So the author only uses this method to determine students' critical thinking abilities before and after using simple wind power generation media. This research focuses on the application of electrical material learning media to students which is created in the media of mini electric generator turbines.

The data collection technique used in this research is the triangulation technique which describes students' critical thinking abilities from a summary of the results of measurements, observations and interviews. According to Sugiyono (2018) in Pranata et al. (2022) Vol. 4 No. 4 interpreting triangulation as a data collection technique which relates to several data from existing data collection and sources. In this technique, one of the critical thinking tests was developed according to Bloom (1956), which emphasizes that the assignment indicators consist of C1 remembering, C2 understanding, C3 implementing, C4 analyzing, C5 evaluating, and C6 synthesizing. Therefore, triangulation in this research uses source and time triangulation.

Result and Discussion

In conveying learning messages, intermediaries are needed so that value and transfer of knowledge can occur on target (Doyan et al., 2023). Learning media is a physical tool that is used and utilized to convey the content of learning material (Alika et al., 2021). Understanding of learning is greatly influenced by the learning media used. The effectiveness of a learning media will influence students' ability to think critically. Critical thinking refers to the ability to analyze information, determine the relevance of the information collected and then interpreted to solve problems (Daryanes et al., 2023). To help the effectiveness of making learning media in the form of mini turbine power generating products with alternative angina energy, a process development model is needed that determines the stages of R&D (Research and Development) research. The model used is the ADDIE development model. According to Sugiyono (2012) the stages in the ADDIE model are as follows.

Analysis

The stage begins with an analysis of learning needs along with other components needed by students, whether trials in limited classes or large classes. This stage is very important to do first by identifying possible problems that may occur (Pramita et al., 2023). The results obtained at this stage are that students' lack of critical thinking skills in understanding the material is still lacking.

Design

At this phase the researcher designs the product that will be developed in accordance with being required (Syukri et al., 2021). Develop a learning design which includes determining the best media,

strategies, assessments and resources for testing in small and large scale classes. Data collection was carried out before the treatment (action) until after the action. The media prepared goes through a validation stage by media experts and material experts to validate the results that will be used in the classroom.

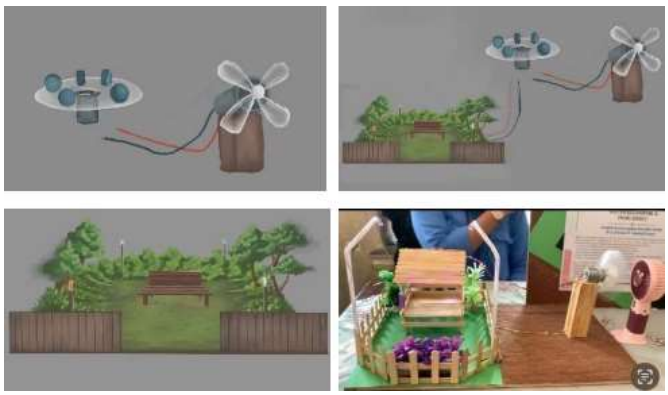

Figure 1. Simple alternative wind power generator mini turbine design

Development

The development stage is the stage of validating the learning media draft by expert validators, peer reviewers, and reviewers (Utari et al., 2023). Making or producing the product and the learning design that will be prepared. This is done in two stages, namely a validation test with experts (media or material). According to Sugiyono (2017) the development stages are as follows:

Implementation

At this stage, develop the implementation of a learning system using learning media. Which at this stage assembles a mini turbine for a wind power generator with the help of a dynamo drive. Then it is adjusted to the function of wind power which can be converted into electrical energy so that it is easy to implement. The implementation is carried out by direct media testing and is linked to science learning about energy. In testing, there are two stages, namely first, content validity is tested by content experts, learning design experts and learning media experts. In the second stage, the practicality of the media is tested by a group of people, small and large groups, as well as teachers from related learning subjects. So the results of this trial are used to start evaluation activities.

Evaluation

At the evaluation stage, the learning carried out aims to improve the needs of the results of the trials that have been carried out. Based on the results of reviews by experts and testers in the field during the implementation stage, there are suggestions and criticisms that have been given by experts and field testers. Next, carry out gradual revision surgery obtained from the respondent's assessment in the form of a statement that must be proven. The aim of this evaluation stage is to prove the feasibility of the final product, worthy in terms of content, design and effectiveness.

Table 1. Pre-test Result

Score	Frequency	Total
70	2	140
50	1	50
60	1	60
80	1	80
Total	5	370
∑	66	

Table 2. Post-test Result

Score	Frequency	Total
80	3	240
70	1	70
60	1	60
Total	5	370
∑	74	

Material Validation Test, this stage aims to prove the material to be used, where validity is tested. This involves material experts and subject teachers. Media Validation Test, to validate the media that will be tested and developed, the media will be tested and developed before the media is used. Design Revision, if media validation has been carried out by experts, and there are things that need to be corrected, revisions can be made to the media design. Product manufacturing, after the expert validation stage has been carried out and declared feasible, it continues with the trial product manufacturing stage. Small Scale Class Trial, at this stage experiments are carried out in class on a small scale to find out the shortcomings of the media. Product Revision, after conducting experiments on a limited scale, it is continued with product revisions to minimize product weaknesses. Product Implementation, once it is felt that all stages have been carried out, the product that has been created can be implemented with students in class. In the observation and research data on students' critical thinking skills using energy science material in class IV elementary school, the researcher used 10 multiple choice questions as questions (pre-test) which were tested on class IV students on a small scale, namely 5 children. The questions are about energy and then experiment with learning media in the form of a mini turbine wind power generator as a simple alternative energy. The pre-test is given before explaining the material using media. Then students are given post-test questions which are given after students receive the

material using learning media. The results obtained are the results of the pre-test given which produces an average value.

Conclusion

Based on the results of this writing, it can be concluded from this research that the creation of learning media in the form of mini turbine power generation products with alternative wind energy. At this stage of creating learning media, a development process model is needed that determines the stages of R&D (Research and Development) research. The model used is the ADDIE development model. According to Sugiyono (2010), the stages in the ADDIE model. Based on observation and research data on students' critical thinking skills using Energy Science material in fourth grade elementary school, researchers used 10 multiple choice questions as questions (pre-test) which were tested on fourth grade students on a scale small, namely 5 children. Questions about energy were then experimented with learning media in the form of a mini wind turbine generator as a simple alternative energy. A pre-test is given before explaining the material using media. Then students are given post-test questions which are given after students receive the material using learning media. The ADDIE development model has the advantage that at all stages it always goes through an evaluation stage first, so that it can minimize errors or shortcomings, no matter how small, from the start. The data collection methods used in this development research are the observation method, interview method and questionnaire method. The observation method is a method used to carry out assessments by making direct and systematic observations. Data obtained using the observation method will be more accurate and difficult to refute because observations are made directly in the field so that the data obtained is in accordance with reality or real. The interview/interview method is a method used to collect data by conducting systematic questions and answers, and the results of the questions and answers must be recorded/recorded carefully and meticulously. The questionnaire method is a way of collecting data by giving respondents a list of questions which are answered in writing. This method is used to measure the feasibility of E-module products from experts (subject matter experts, learning design experts, and learning media experts).

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The authors declare no conflict of interest.

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