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Analysis of Student's Answer Error on Understanding of Energy Concept in Conceptual Change Text (CCT)-Based Learning

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Abstract: Science learning has been considered a difficult subject for students. This study aims to analyze student error answers on students' science understanding abilities on energy concepts to find out students' difficulties in answering energy concept science questions through Conceptual Change Text (CCT) based learning. This CCT-based learning requires students to be more active in understanding concepts with the help of reading materials that have been provided by the teacher so that students can find concepts independently. The reading material given to students is in the form of reading material about energy. This research was conducted on third, fourth, and fifth-grade elementary school students to determine the level of difficulty at each level. This research method is a qualitative method using grounded theory. The instrument used is a test instrument. Student answer sheets to analyze the types of errors made by students in accordance with the energy concept learning indicators. Based on the results of the survey, data were collected on the average error rate of students in grades 3, 4, and 5 on energy concepts. The data shows that the third grade has an average error of 30.34%, the fourth-grade student's average error is 21.64%, and the fifth-grade student's average error is 14.39%.

Keywords: Analysis; Answer error; Conceptual change text (CCT); Energy concept

Introduction

Science subjects are abstract sciences, and in studying them, they must fully understand according to multiple representations of science (Thees et al., 2020). Multiple representations of science can function as an instrument that provides support and facilitates meaningful learning and deep learning in students (Hochberg et al., 2020). This can make students form a personal understanding of the science concepts that they apply in lessons. Concepts formed by students based on personal understanding can lead to an incomplete or different understanding of concepts from scientific concepts (Falloon, 2019).

Student concepts that are different from the scientific understanding or understanding accepted by experts in a field are called misconceptions (Sukmawati et al., 2020). Misconceptions can take the form of initial concepts, incorrect relationships between concepts, intuitive ideas, or wrong views (Dellantonio et al., 2021). The existence of misconceptions is a source of student difficulties and hinders the learning process, and in the end, can lead to low mastery of concepts and student learning outcomes (Mazana et al., 2020). The misconceptions experienced by students can be seen in students' mistakes in answering questions (Hinchliffe et al., 2018). Therefore, it is important to identify student errors in answering questions. The results of the study found that the misconception experienced by students was that students considered all electrolyte solutions to be ionic compounds with a percentage of 64.7%. Similar research was also conducted on 14 students of class X. The study found that there were misconceptions in understanding the material for electrolyte solutions and non-electrolyte solutions, with a percentage of 38.68% (Sukmawati, 2019).

To change students' misconceptions into good and correct scientific concepts, research on the use of conceptual change texts for science material has been investigated by several researchers on various science

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topics (Nadelson et al., 2018). Research on the material particle model shows that conceptual change texts are able to improve concept understanding (Eshach et al., 2018). However, the increase in understanding of the resulting concepts is still in the low and medium categories, so other efforts are still needed so that the improvement of conceptual understanding can be better. One other effort is the process of using the Conceptual Change Text (CCT) conceptual change text (Suhandi et al., 2020).

Research on the use of conceptual change texts in the learning process has also been investigated by several researchers. In research on solution material and science equilibrium material, it was found that text-oriented learning with conceptual changes was able to improve understanding of concepts (Çaycı, 2018). Conceptual Change Text (CCT) is used with the assumption that students can change existing conceptions, namely beliefs, ideas, or ways of thinking, so that learning is not only gathering new facts or learning new skills but also changing existing inaccurate conceptions (Södervik et al., 2019).

One of these facilities is to use learning module media (Winarto et al., 2020); the learning module is to use a Conceptual Change Text (CCT)-based learning module (Banawi et al., 2019). Based on these problems, it is necessary to develop a Conceptual Change Text (CCT) learning module on material change material to minimize misconceptions about material change material (Al-Saeed et al., 2019).

Method

Grounded Theory Research is a qualitative research procedure that uses several systematic procedures aimed at developing action, interaction, or process-oriented theories based on information obtained from the field (Hlady-Rispal et al., 2021). The purpose of this research is to examine students' incorrect answers in responding to energy concept questions after participating in learning using CCT-based teaching materials. The grounded theory research steps consist of 3 steps in succession, namely: open coding, selective coding, and theoretical coding (Canlas et al., 2020; Daovisan et al., 2020). The following are the stages of criteria in Grounded Theory research: 1) Appropriate (fit), the theory produced is in accordance with reality and is suitable for the field under study. 2) Understood (understanding), the resulting theory describes reality (reality) and is comprehensive so that it can be understood by the individuals being studied or by researchers. 3) Applicable universal (generality), the resulting theory covers a variety of diverse fields so that it can be applied to phenomena in various contexts. Supervision (control), the resulting theory, has hypotheses that can be used in systematic guiding activities to retrieve actual information that only relates to related phenomena.

The population in this research are all students from Public Alementary School in Indramayu with the same category. Considerations for selecting elementary school students as research subjects are based on: 1) The level of cognitive growth of elementary school students who are still in the transition session from concrete surgery to official surgery so that it is suitable for the application of contextual education. 2) Students in grades 3, 4, and 5 are students who are in high grades, so they are more easily directed to use CCT-based teaching modules.

This research is very important to do as a reference for the level of difficulty experienced by students and the level of misconceptions. By using CCT students are directed to be aware of the concept errors they experience so that it does not become a problem when understanding the next concept. In addition, with this research students are also directed to find concepts independently, are confident and feel the benefits of the new concepts they get.

Result and Discussion

The grounded theory research steps consist of three successive steps, namely: open coding, selective coding, and theoretical coding. These steps are as follows:

Open Coding Session

Researchers carry out early information collection from the results of students' answers to the final test or post-test of energy concept description skills; after that, they analyze student answer sheets in the final test, as well as student opinions in interviews (Aisyah et al., 2023). Each student's answer sheet was analyzed to obtain the types of student errors in responding to the problem of understanding energy concepts. The information is built into early categories about student errors according to the skill markers of the description of the energy concept being studied by sorting the information into types of answer errors.

Selective Coding Session

In this session, researchers carry out an in-depth study of the categories that arise in the open coding session, after which an assessment of these types is attempted, which will then become the core types. In this session, students' answer sheets were analyzed based on the type of error that matched the type of error that the student tried. Researchers choose one of the existing types as the core being studied. All other kinds are connected at the heart of this research, such as causal factors (factors that influence student error in responding and influencing circumstances).

Theoretical Coding Session

In this session, researchers develop theories or conjectures based on the assessment of the categories found in the grounded theory session. Researchers arrange student errors that arise based on markers of expertise in the description of energy concepts, after which they relate to the steps in contextual education. So learning difficulties are obtained in solving problems of the ability to describe students' energy concepts in education. The summary of the results of student errors in the answers to the questions in total is presented in the following table 1.

Table 1. Summary of Student Answer Error Results

Indicator	Number of Questions	Percentage of Student Errors In Learning Using CCT (%)		
		Grade 3	Grade 4	Grade 5
1	1	20.69	22.93	22.81
2	2	17.24	16.39	5.26
3	3	27.59	21.31	8.77
4	4	51.72	14.17	14.04
5	5	41.38	22.95	24.56
6	6	55.17	32.79	26.32
7	7	27.59	18.03	5.26
8	8	34.49	26.23	12.28
9	9	20.69	27.87	19.30
10	10	6.90	13.11	5.26
	Average	30.34	21.64	14.39

If depicted in the graph obtained data as follows (Figure 1).

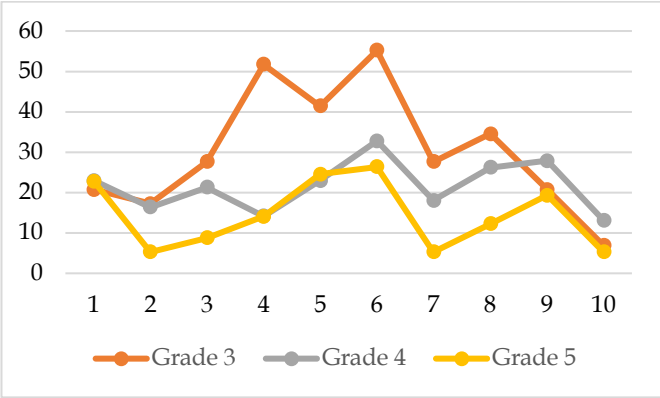

Figure 1. Summary of Student Errors

Based on the analysis results of student response errors, it was found that students still had many errors in energy concept indicators. It was found that indicator number 6 was the indicator that was considered the most difficult by students in grade 3 (55.17%), grade 4 (32.79%), and grade 5 (26.32%). The indicator contains the concept of energy change. The context used in the questions presented is related to material about energy changes that exist in computers. This difficulty occurs because many students are not used to using computers (Efriana, 2021). Choosing an unfamiliar context will make it difficult for students (Bridgers et al., 2020).

Conclusion

Based on the research conducted, it can be seen that students in grades 3, 4, and 5 have difficulty understanding the concept of energy change, because on this indicator students have the highest error rate compared to other indicators.

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