

## ANALYSIS OF LEARNING OUTCOMES AND ERROR IDENTIFICATION IN TEMPERATURE AND HEAT COGNITIVE TES

**Agustina Anggraeni <sup>1)</sup>, Muhammad Junus <sup>2)</sup>, Nurul Fitriyah Sulaeman <sup>3)</sup>**

<sup>1,2,3</sup>Faculty of Teacher Training and Education, Mulawarman University

email: [agstnaanggrn09@gmail.com](mailto:agstnaanggrn09@gmail.com)

### *Abstract*

*Cognitive ability is the student's mastery of the mental realm. This study aimed to determine student learning outcomes and what factors caused students to solve cognitive test questions on temperature and heat material. The type of research is descriptive quantitative research. The population in this study were students in class XI IPA at SMA Negeri 2 Bontang, amounting to 3 classes with a total sample size of 30 students in class XI IPA 1 and 30 students in class XI IPA 2. Data collection was used to test techniques in the form of 10 essay questions to determine learning outcomes. The results showed that student learning outcomes in solving cognitive test questions on temperature and heat material at the creating level (C6) were categorized as lacking because only 30%, at the level of evaluating (C5) and analyzing (C4) 56% and 66% respectively. The cognitive abilities of students at the level of remembering (C1) and understanding (C2) have shown very well because the percentage obtained is relatively high, namely remembering (C1) by 97% and understanding (C2) by 84%. Moreover, students' cognitive abilities at the level of applying (C3) were good because the percentage obtained was 81%. Students' most common error factors when solving cognitive test questions in terms of temperature and heat were misconceptions, strategy errors, errors in using data, and calculation errors. Error factors that often appear, especially in concept errors, need to get more attention to support students' learning physics.*

**Keywords:** *Cognitive ability, Identification of students error factors, Learning outcomes*

### 1. INTRODUCTION

Physics is a discipline science that is quite closely related to the world of technology. Apart from that, Physics to be a deep fundamental science development of science and science technology (Maharta, 2003). Besides contributing to new technology, learning Physics too can foster positive values, namely training to think logically and analytical; train rigor and critical thinking (Sutrisno, 2009).

One of the main goals in Science education is helping students understand the essential materials in science. However, in reality, studies show that students have difficulty in developing an understanding of these concepts. This problem is encouraging that the importance of developing activities that can help students understand science

better again (Sulaeman & Nuryadin, 2017).

The Organization Economic Cooperation and Development (OECD) organization has announced the PISA score (Programme for International Student Assessment) for Indonesia in 2018 in literacy, mathematics, and science. The PISA measurement aims to evaluate the education system by measuring student performance in secondary education, especially in three main areas: mathematics, science, and literacy. For almost the last 20 years or so, PISA releases the results of literacy skills science learners around the world. Indonesia has always been in bottom order. It shows that the quality of science learning in Indonesia is far below that of OECD member countries (Setiadi, 2014). Country PISA Results from Indonesia in 2018 for

literacy category, Indonesia obtained an average score of 371 and is ranked 74th far below Thailand, where it is ranked 68th, Malaysia is ranked 58th, while Singapore is ranked as the second. Meanwhile, for PISA results on proficiency science, the State of Indonesia has a score of an average of 396 was ranked 71<sup>st</sup>, namely under Thailand's ranking is ranked 54th and Malaysia is ranked 49<sup>th</sup> (OECD, 2019).

One of the participants' abilities learners who must be developed in Science learning is an understanding concept, very concept understanding important for students because mastery of concepts can make it easier for learners to learn. Every lesson emphasizes mastery of concepts so that students have a good basic provision for achieving other basic abilities such as reasoning, communication, connection, and problem-solving (Nurjamilah et al., 2017).

Cognitive abilities are mastery of students in the cognitive realm. The cognitive realm contains behavior emphasizing intellectual aspects, such as knowledge, and thinking skills which include remembering (C1), understand (C2), apply (C3), analyze (C4), evaluate (C5), and create (C6). The first level is called Lower Order Thinking Skills, and the following three levels are Higher Order Thinking Skills (Anderson & Krathwohl, 2010).

Measurement of cognitive abilities becomes the focus of many researchers in physics education (Nurjamilah et al., 2017). However, interviews with some physics teachers claim that students still have difficulty in solution to the problem. It is reflected in the current student disability solve a physics problem given by the teacher, and students still run into the wrong with no follow the troubleshooting steps problem correctly and adequately. This matter is one of the factors that make students experience errors in solve the problem. Another cause trouble solving problems on students is weak understanding of physics principles and

rules, students do not understand the questions, and students do not have enough motivation (Ikhwanuddin, 2010).

This research was carried out to know the results of learning students in solving cognitive tests on the material temperature and heat and what kind of error course was done by students in solving cognitive test questions on temperature and heat material.

According to Hastuti et al., (2012), there some kind of student error in solve problems, among others:

- 1) Misconceptions are mistakes that define the principle or formula for answering questions. For example, the student is wrong in explaining the meaning of heat. Students answered that heat is energy heat is transferred from that temperature high to low temperature. Answer which should be, heat is energy heat transfer from that object high temperature to a temperature object low. (the student's fault is no mention the word "thing").
- 2) Error using data: no using the data it should used, error entered data into physics symbols, and add to data not required in an answer question. For example students are wrong in determining what is being asked of questions, such as using the finger symbol finger with the cross-sectional area figure.
- 3) Calculation error is an error in count, like adding up, subtracting, multiplying, and dividing. For example, students miscalculate.

$$1015 - 5$$

Students answer:

$$1015 - 5 = 1$$

The answer should be:

$$1015 - 5 = 1010$$

- 4) Strategy mistakes and strategy mistakes are an error in taking steps to solve the problem, thus causing trouble for students themselves and

are of no use in problem-solving. For example, the students wrote :

$$m_{\text{cold water}}, T_{\text{cold water}}$$

Meanwhile, when answer, students use for example,

$$m_1, m_2, T_1, T_2$$

And so on, so that causes the student to be wrong and the answer is wrong.

- 5) The question was not responded. That is, with no response questions, students do not answer the question given.

## 2. RESEARCH METHODS

The type of research used was a research descriptive quantitative, namely research done aims to explain a phenomenon by using numbers that describe the subject's characteristics under study factual, systematic, and accurate.

The population in this study was a student of class XI IPA SMA Negeri 2 Bontang, amounting to 30 for each class. Samples were used in one of the class XI IPA The selected SMA Negeri 2 Bontang use *Cluster Random Sampling*.

The technique used in this data collection was by using test questions. Before the test is given to students, the test sheet was first consulted with the supervisor, and revisions were made according. To know the instrument's validity, then content validation with use method *Expert Judgment*, where two people experts would be consulted regarding the test and scoring rubric had been developed. The first expert is one of the Education lecturers Physics named Mrs. Shelly Efwinda, M. Pd, and the second expert is one of the Physics subject teachers at SMA Negeri 2 Bontang, namely Ms. Dian Mufarida, M. Pd. A validation sheet given to the validator, then the validator provided an instrument assessment by marking tick on the rows and columns that were accordingly and writing revised points if there is a deficiency. Next, test questions are given to students. After that the data was collected by using a scoring rubric, then following with analyzing the test

results of students by using an identification rubric error to know the level cognitive abilities and cognitive levels owned by students. Result data analysis was presented in the form of numbers and descriptions.

The data was obtained from the results of the tests that have been done. After participants students did do the questions given, then the students' answers would be corrected by researchers using the rubric in the appendix assessment and then carried out calculation Magnitude percentage the ability of learners in solve test questions with using the percentage formula:

**Final Grade (NA) = the number of scores obtained by students: maximum score x 100%**

The formula to use for determining the percentage of achievement mastery learning. After the result data learning was analyzed, it must be known cognitive ability level group learners to know cognitive ability level group learners. The author uses value classification, namely :

**The percentage of completeness of learning =  $\Sigma TBN \times 100\%$**

Information:

$\Sigma TBN$  = The number of students who completed

$N$  = Number of Students

Table 1 Classification of Values

Numbers	Criteria
86-100	Very Good
66-85	Good
46-65	Enough
<45	Less

Source: Suharsimi, 2014

On the technicality of this data analysis, after known the results of cognitive tests, next is looking for identification error factor, using

attachment rubric identification of the available error factors, by giving a checkmark by the criteria in each question by the answer students. It is used for know what kind of factors are influence student error with how to examine the answers one by one learners

effect of heat and heat transfer which includes thermal characteristics of a material, capacity, and conductivity at daily life, answer sheets Physics test students show results that some mistakes are made by students in solve the problem. Then on analysis of the types of errors that students make on each question number. Based on processing cognitive ability test data then the following results are obtained:

**3. RESULTS AND DISCUSSION**

Based on the results of the analysis of temperature and heat material at KD 3.5, namely analyze the

Table 2 Results of the percentage of students' cognitive abilities

No	Cognitive Domain Level	Question Number	Percentage
1	Given C1	1 & 2	97%
2	Understanding C2	3	84%
3	Applying C3	4 & 5	81%
4	Analyze C4	6 & 7	66%
5	Evaluating C5	8	60%
6	Creating C6	10	30%

Source: Results of Cognitive Data Processing Ability (2020)

Based on the data above, the average ability of Cognitive students in class XI IPA 1 and XI IPA 2 at the level of recall (C1), understand (C2), apply

(C3) categorized as very good, meanwhile at the analyzing level (C4), evaluate (C5), and create (C6) categorized as less (Figure 1).

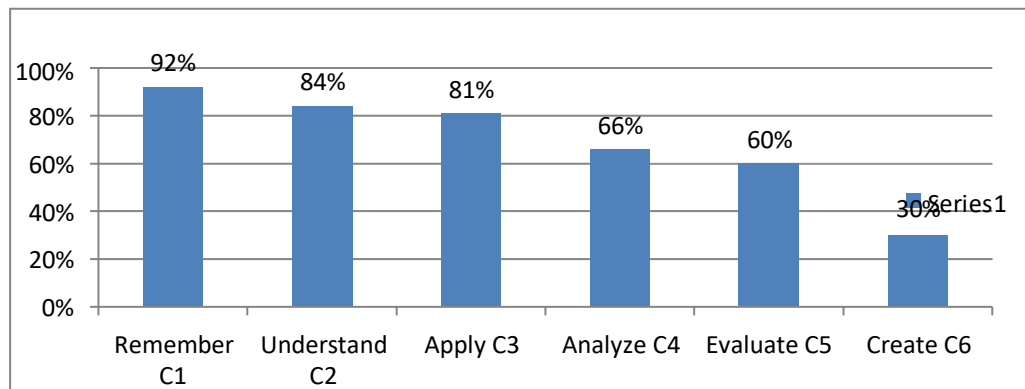


Figure 1 Results of Students' Cognitive Ability Analysis

Based on Figure 1, it can be seen that learners' cognitive abilities on the level of C1 are more significant than that with the cognitive domains C2, C3, C4, C5, and C6.

1. Remember (C1)

The above data obtained the result that cognitive abilities learners to level considering (C1) of 97%. From the results of this study show that the ability of learners on recall

rate (C1) is categorized as very good.

2. Understand (C2)

Based on the above data obtained, cognitive abilities learners understand levels (C2) of 84%. From the results, this research shows that the ability of learners on level understand (C2) categorized as very good

3. Apply (C3).

Based on the above data obtained, cognitive abilities participants student for remember apply (C3) of 81%. From the results of this study show that the ability of learners on level apply (C3) categorized as good.

4. Analyze (C4)

Based on the above data obtained, cognitive abilities participants students remember analyzed (C4) by 66%. This study shows that the ability of learners on level analyses (C4) is categorized as good.

5. Evaluate (C5).

Based on the above data obtained, students' cognitive abilities for evaluation (C5) by 56%. This study shows that the ability of learners on level evaluate (C5) is categorized as sufficient.

6. Create (C6)

Based on the above data obtained, cognitive abilities learners create levels (C6) by 30%. This research shows that the ability of learners on creation rate (C6) is categorized less.

Based on the results, most of the students in class XI IPA at SMAN 2 Bontang has not yet mastered it cognitive level questions C4 to C6 on temperature and heat material, students lack practice questions, students are not careful in reading the purpose of the question, and lack of practice questions inside solve a variety of questions.

#### 4. CONCLUSION

Based on research results and data analysis done, it can be concluded that students' learning outcomes in solving test questions cognitive on the material temperature and heat at the level of remembering (C1) and understanding (C2) show excellent criteria. The cognitive abilities of students on the level of applying (C3) are good. Meanwhile, the participants' cognitive abilities students at the level of analyzing (C4), evaluate (C5), and create (C6) categorized as less. When

viewed from mastery of the initiated cognitive level from C1-C6 indicates that the level cognitive possessed by students still at the *low order* level *thinking*, which is between C1-C3. The most common type of error done by students in solve cognitive test questions temperature and heat material in between is a misconception, a mistaken strategy, miscalculations, and errors using data

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