Analysis of Learning Difficulties Using the Certainty Of Response Index of Thermodynamic Material

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Abstract Most students have difficulty learning in all schools, some know concepts, do not know concepts and misconceptions. Misconceptions experienced by students often occur in abstract material (difficult to do experiments). The purpose of this study is to describe the level of learning difficulties in the Thermodynamics material using the method of certainty of response index (CRI). Respondents in this survey study were 143 high school students in Pekanbaru. Data obtained from this study in the form of a percentage of the level of difficulty of student learning outcomes based on: a) Know the concept, b) Don't know the concept, c) Misconceptions. Based on data analysis, the average percentage of misconceptions on Thermodynamics material is students who know the concept of 10.45%, misconceptions of 54.67% and do not know the concept of 34.88%. Legal Material I Thermodynamics

Keywords: Misconception Analysis, Thermodynamics, Certainty of Response Index

1. Introduction

Learning difficulties experienced by students, one reason is misconception. Misconceptions can come from students, teachers, textbooks, context and teaching methods (Paul Suparno, 2013). During this time to find out misconceptions on students one of them through interviews. Because, the instrument for evaluating misconceptions has not yet been developed (NSTA, 2013). Misconceptions can occur when students are trying to shape knowledgeare forming knowledge by translating new experiences in the form of initial conceptions (Hakim et al, 2012). Misconceptions occur because of inconsistencies in trust. Therefore, it is important to note that misconception depends on what context it is in (Sepehr Foroushani, 2019)

Physics learning requires students' ability to understand concepts and problem solving (Putri et al, 2017). One of the material learned in physics is Thermodynamics. Thermodynamics is a combination of theory and calculation, so a good conceptual understanding of the material is needed. This material has a broad range of concepts as well as overlapping understandings in certain concepts. For example, determining heat as energy transfer from one object to another as a result of temperature differences (Young dan Freedman, 2004).

Based on the results of research conducted by Indana Zulfa (2013), it was found that from 132 students who were used as research samples found 64.95% of students experienced misconceptions effort and process in Thermodynamics, 31.07% misconceptions about Law I Thermodynamics and 3.98% misconceptions about the second law of Thermodynamics.

To determine students' learning difficulties, as well as to distinguish students from knowing concepts, misconceptions and not knowing concepts, an analytical method known as CRI (Certainty of Response Index) was developed. which is a measure of the level of confidence or certainty of students in answering the questions given (Saleem Hasan, 1999). CRI (Certainty of Response Index) is usually

based on a scale given in each answer to a question. Students who know the concept, misconceptions and do not know the concept can be distinguished by comparing the correctness of students' answers with the level of CRI (Certainty of Response Index) confidence index answers given in the question (Sapriadi, et al., 2019).

CRI (Certainty of Response Index) is often used in survey methods, especially asking respondents to give their degree of confidence to choose and distinguish knowledge, concepts and well-formed laws in themselves to determine the answer to a question. The CRI (Certainty of Response Index) is usually based on a scale, typically one to six (1-6).

Based on the description that has been stated that using the CRI (Certainty of Response Index) method can determine student learning difficulties.

2. Methodology

This study uses a survey method because it wants to get a picture of the conditions of learning difficulties that occur in students of SMA 9 Pekanbaru. Data collection techniques used in this study are to use test techniques. The test instrument used in the form of multiple choice tests is accompanied by the CRI (Certainty of Response Index) method. According to Sukardi (2008) each item used has four answer choices. Analysis of the data used in this study is based on students' answers from the tests given. The research data analysis techniques through several stages, first determine the value based on CRI criteria, then students are grouped into 3 categories: students who know the concept,do not know the concept and misconceptions. The CRI (Certainty of Response Index) scale used refers to the scale arranged as in Table 1(Saleem Hasan, 1999).

Table 1. CRI criteria

CRI	Criteria
1	*(Totally guessed ansnwer)*
2	*(Almost guess)*
3	*(Not Sure)*
4	*(Sure)*
5	*(Almost certain)*
6	*(Certain)*

Based on Table 1. it can be seen that the CRI scale (1-6) where the CRI value (1-3) states that students answer it with an unsure answer and the CRI value (4-6) states the student answers with a confident answer, so the categories of understanding in Table 1. were changed to as in Table 2.

Table 2. Criteria for Student Learning Difficulties

Level 1	Level 2	Level 3 Grade (CRI)	Decision
Correct	Correct	Sure	Know The Concept
Correct	Correct	Not Sure	Don’t Know The Concept
Correct	Incorrect	Sure	Misconception
Correct	Incorrect	Not Sure	Don’t Know The Concept
Incorrect	Incorrect	Sure	Misconception
Incorrect	Incorrect	Not Sure	Don’t Know The Concept
Incorrect	Correct	Sure	Misconception
Incorrect	Correct	Not Sure	Don’t Know The Concept

(Yudi dan Andi, 2015)

The second stage of the analysis results is made in the form of a percentage, with the formulation:

$$Percentage\ of\ \ a\ criterion = \frac{The\ Number\ of\ \ Students\ in\ a\ criterion}{The\ Number\ of\ \ Students\ All} x100\%$$

The third stage determines the category of students 'learning difficulties based on the results of students' answers from the calculation analysis according to the categories of learning difficulty levels in Table 3.

Table 3. Category Percentage of Learning Difficulty Levels

Percentage	Category
0 – 30%	Low
31% - 60%	Medium
61% - 100%	High

(Istighfarin, dkk 2015)

3. Result and Discussion

Based on the research results students are grouped into 3 categories: students know the concept, misconceptions and do not know the concept. After students are grouped based on learning difficulties, then the number and percentage are calculated. The number and results of these categories can be seen in Figure 1.

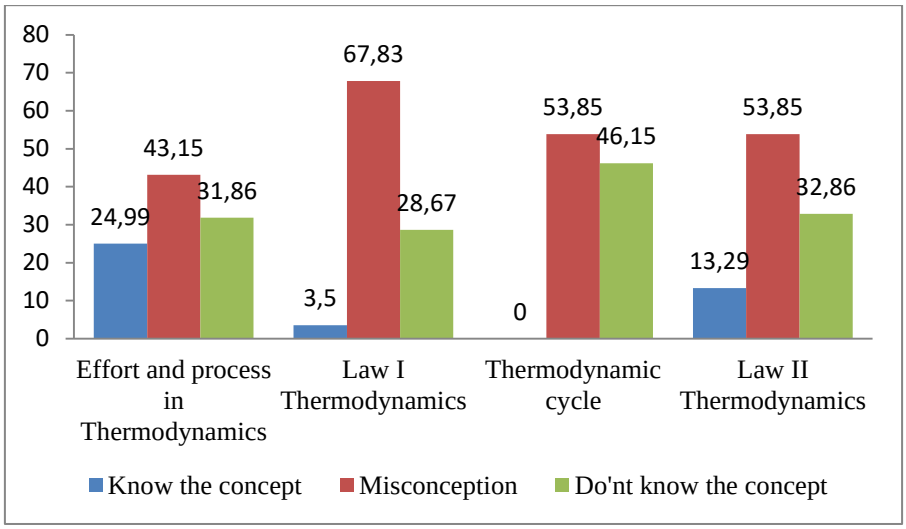

Figure 1. Grouping levels of student learning difficulties per concept

From Figure 1 it can be seen that the average student who knows the concept is 15 people (10.45%), the average student who doesn't know the concept is as many as 50 people (34.88%) and the average student who misconceptions is 78 people (54.67%) with a sample of 143 students.

Difficulties of student learning on the concepts of thermodynamics are different. The following is an analysis of student learning difficulties per concept.

First, the effort concept and thermodynamic process of 143 students, the number of students who know the concept numbered 36 people, students who misconceptions numbered 62 people and students who do not know the concept numbered 46 people. The percentage of students learning difficulties in effort and processes in Thermodynamics can be seen in Figure 2.

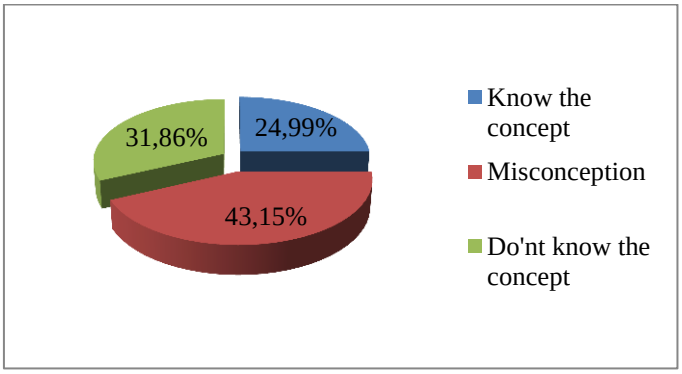

Figure 2. Percentage of student learning difficulties in endeavors and processes in Thermodynamics

The questions presented on the effort analysis of a process are based on diagrams (P-V). Figure 2 shows that 24.99% of students know the concept of being able to answer correctly. As many as 43.15% of students misconceptions because they have not been able to interpret the diagram (P-V) properly, students answer (a) 0 J, the reason the student is due to the fixed volume a-b process called the adiabatic process, so that the gas does not do business or the amount of effort is equal to zero and gives a high degree of CRI (6). As much as 31.86% of students did not know the concept with the answer (b) 6J, some students reasoned that the fixed volume a-b process was called the isobaric process. Among the causes of concept errors in students are students lacking in learning, paying less attention to the teacher and not daring to ask questions when there are concepts that are not yet understood (Suroso, 2016)

Second, the concept of law I Thermodynamics, the number of students who know the concept is 5 people, students who misconceptions are 97 people and students who do not know the concept are 41 people. The percentage of students learning difficulties in Law I Thermodynamics can be seen in Figure 3,

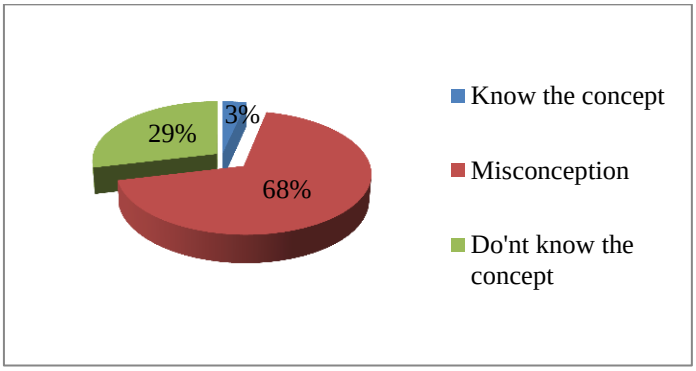

Figure 3. Percentage of students' learning difficulties in Law I Thermodynamics

The problem presented is in the form of a picture of gas heating regarding thermodynamic law I. Students are asked to calculate changes in energy based on the picture. Figure 3 shows that students who know the concept of 3.05% answered correctly. Students who experienced misconceptions on this concept were in the high category at 67.83%. This is because in determining the positive value of a work (business). According to Moran and Shapiro (2014) if W> 0 (W is positive) then the work is done by the system, whereas if W <0 (W is negative) then the work is done on the system. students answer incorrectly and give high degrees (6. Students who do not know are 25.57 because the answer ΔU is affected by the heat of the system and the effort absorbed by the system, therefore choosing the answer (e) +3600 J adds heat and effort without regard to the sign agreement.

Third, the concept of the Thermodynamic cycle, none of the students knows the concept. As many as 77 students experienced misconceptions and as many as 66 people did not know the concept. The percentage of students learning difficulties in the Thermodynamics cycle can be seen in Figure 4.

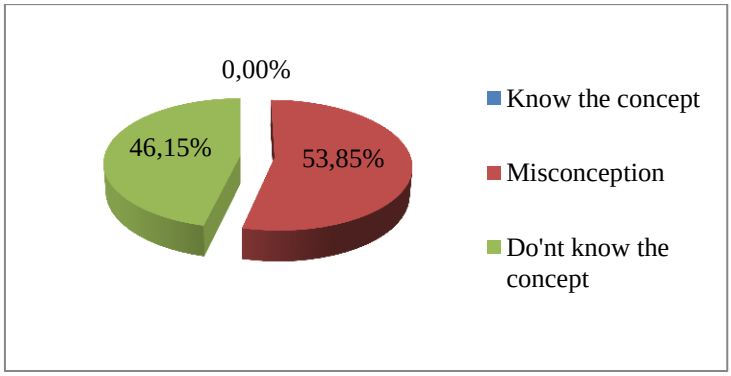

Figure 4. Percentage of students learning difficulties in the Thermodynamics cycle

The problem presented about the calculation of the efficiency of a carnot machine in the form of a statement regarding the work done by the carnot machine, Students count calculate the efficiency of the Carnot engine. Figure 4 shows that students' understanding of this concept is the lowest because no single student can answer correctly. 53.85% of students experience misconception, students answer (c) 60% for reasons of efficiency is the desired output in the form of effort divided by entering the form of heat absorbed by 100%, student answers are correct but the choice of reasons is wrong, this is because students assume that the heat released is the same as the heat absorbed so they choose the answer. According to Young and Freedman (2002) efficiency is the output in the form of effort divided into the form of heat multiplied by 100%. 46.15% of students who do not know the concept of the cause because students are not able to write what is known and asked into the symbol of Physics in the problem correctly caused students to forget, do not understand the symbol of Physics in the problem (Suroso, 2016)

Fourth, the concept of law II Thermodynamics, the number of students who know the concept is as many as 19 people, students who misconceptions are 77 and students who do not know the concept are 47 people from 143 students. The percentage of students learning difficulties in Law I Thermodynamics can be seen in Figure 5.

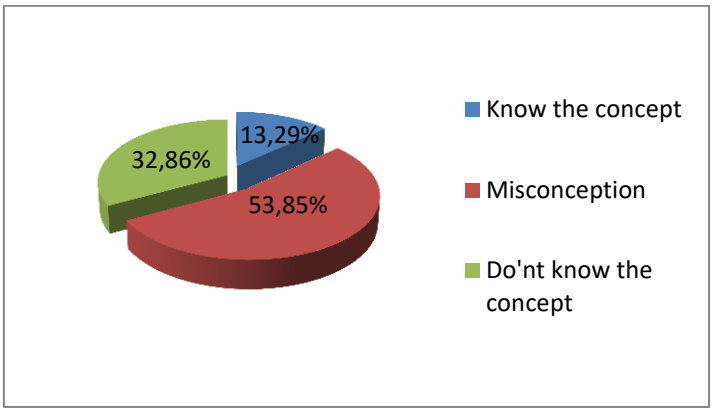

Figure 5. Percentage of students learning difficulties in Law II Thermodynamics

Questions presented about the carnot engine process in a diagram (P-V. students are asked to choose the appropriate process in the diagram. Figure 5 shows that 13.29% of students knew the concept of being able to answer correctly. 53.85% of students experience misconceptions because they have not been able to interpret the diagram (P-V) properly, this is the same as the concept of business and thermodynamic processes. As many as 31.86% of students did not know the concept caused by misinterpretation of the graph (P-V) in the isothermal and adiabatic process (Khairul et al, 2017)

4. Conclusion

Based on the results of the study, it was found that the level of learning difficulties of SMA Negeri 9 Pekanbaru students using the CRI method in the Thermodynamics material are students who know the concept of 10.45% in the low level category, do not know the concept of 34.88% and 54.67% misconceptions in the medium level category.

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