The effectiveness thermodynamic learning based on multiple representation toward understanding basic concept of physics education students

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Abstract. This study aims to determine the effectiveness of the application of multi-thermodynamic learning based on the representation of basic thermodynamic concepts in physic education students. The subject of this research is 4th-semester students, there are 32 people. The research design is pre-experimental in the form of one-shot case study. An instrument of collecting data in this research is result test comprehension of the basic concept of student thermodynamic consisting of five question as an indicator of understanding of the concept of Bloom theory. Analysis technique use descriptive analysis by looking at the learning result of understanding the basic concept of student thermodynamics by using absorption criteria and the effectiveness of learning. The results of this study obtained the average value of student absorption of 77.85% with the good category. Indicator with the highest absorption is in the indicator classify with a percentage of 86.85% in the category of very good while the lowest absorption lies in the indicator compare that is equal to 66.55% with enough category. It can be concluded that the application of thermodynamics-based learning multiple representation effectively applied to the material of basic concepts of thermodynamics.

1. Introduction

Learning Outcomes in this thermodynamic course, students are able to: Mastering and understanding units, dimensions and thermodynamic properties, understanding energy interaction, work and changes in system properties, understanding changes in enthalpy to temperature, understanding entropy, carnot cycle and its application, thermodynamic laws. Thermal physics is a branch of physics that studies the properties of matter, in that they depend on temperature, its value changes when the temperature changes, or its value changes when the substance receives heat. With this understanding the scope of the field of thermal physics is very broad. The studied properties can be either macroscopic (usually directly measurable) or microscopic properties [1]. To make learning easier, thermal physics is divided into smaller parts. The macroscopic reviews, called classical thermodynamics, and whose views from a microscopic angle are called statistical thermodynamics. In kinetic theory, the review begins with the nature of a particle, whereas in statistical mechanics a group of particles is examined by means of

statistical means. The microscopic review provides a bridge connecting the macroscopic properties of the substance as a whole to the microscopic nature of the compound [2].

Learning styles are the way students absorb information, for example there are students who are more easily absorbed by verbal learning, but there are students who are easier with image or mathematical learning. Faced with such learning styles it is necessary a learning approach that can convey the material multi representation [3]. One of the best alternative approaches to learning applied in the learning of thermodynamic courses is the multi-based representation-based learning approach. The Most common approach to considering the effectiveness of representations emphasises the sensory channel and/or the modality of the representations (i.e. either auditory/visual, or textual/pictorial [4]. Presenting information in multiple modalities is advantageous to learners who actively process such information. Focuses not on pictures and text, but on depictive (iconic) and descriptive (symbolic) representation [5]. Stages of multi representation approach will be use the six major steps of using multiple representations to teach difficult concepts 1) ask students to observe, 2) teach basic concepts, 3) teach the complex concept, 4) enchance students complex concepts, 5) excercise and apply complex concept, 6) assess student learning [6].

2. Method

This study was conducted in a private university in Jakarta, it began on March 1, 2018 until March 23, 2018. This type of research is pre-experimental with a one-shot case study design. In this research, the implementation phase of the research involves treatment by applying physic-based learning multiple representation (X) and the result after treatment (O), where the result after the studied treatment is the learning result of understanding the basic concept of thermodynamics. Subjects in this study were students of 4th semester academic year 2017/2018. The number of students is 32 people consisting of 7 male students and 25 female students. The instrument of collecting data in this study using achievement test student understanding of the basic concept of thermodynamic with five questions as indicators of understanding of the concept according to Bloom's theory [7]. technique data analysis in this study by using descriptive analysis through the criteria of absorption and effectiveness of learning.

3. Results and discussion

The collected data in this research is a recapitulation of the value of the basic concepts of thermodynamic derived from the test of learning outcomes understanding the basic concept of student thermodynamic after the application of multi-course termodinamika-based representation course. To describe the absorptive and effectiveness of student learning is analyzed based on the value of each indicator of understanding the basic concept of thermodynamic. The results obtained on the absorption capacity of conceptual learning comprehension for each indicator can be shown in Table 1.

Table 1. Ability to understand the concept of student thermodynamic.

No	Understanding Basic Concept of Thermodynamic indicator	Average of student absorption (%)	category	Effectiveness category
1	Explain and exemplify	80,50	good	Effective
2	Clasification	86,65	Very good	Very effective
3	Analysis	76,74	good	Effective
4	Comparing	66,55	Good enough	Good effective
5	Analysis	78,80	good	Effective
Average grade absorbency for all indicator category		77,85	good	Effective

According to Table 1, the students' absorptive capacity for each learning indicator on the aspect of understanding the basic concept of thermodynamic have many variation. They are as follows: very good, good and good enough. The highest absorption of students is in the classification indicator that is equal to 86.65% with very good category while the lowest student absorption lies in the comparing indicator

that is equal to 66.55% with good enough category. Classically, the absorption and effectiveness of learning obtained by students is 77.85% with good and effective category.

Table 2. Absorption Category of Understanding Basic Concept of Thermodynamic.

No	Student Absorption Interval	Student absorption category	Number of student	Percentage
1	85 – 100	Very good	17	53,12
2	70 – 84	Very good	10	31,25
3	50 – 69	Good enough	2	6,25
4	0 -49	Not good	3	9,38

Table 2, it can be seen that the categories of absorption obtained by students on the aspect of understanding the basic concepts of thermodynamics vary. Students who are in the category of very good and good category is more dominant with the percentage of each 53.12% and 31.25%. This difference in absorption is due to differences in the ability of students to receive and absorb the subject matter that has been given. The application of multiples-based thermodynamic learning of representation can be used as an alternative approach to learning. Learning using the MR approach can improve learning outcomes [8] in addition MR can provide insight into student ideas and enhance student learning in physics [8]. Understanding and reconstructing different representations in relation to each other is a very personal process, and even with the same set of representations, students can use it in a very different way [9]. The effectiveness of the various representations can be understood by considering three basic things namely the learning aspects: the design parameters that are to learn with multiple representations; the function of multiple representations in support of learning and cognitive tasks performed by students who interact with many things of representation [10].

4. Conclusions

The results of data analysis and discussion of understanding the basic concepts of thermodynamics in semester 4 students find the best average of the basic concepts of thermodynamics through the representation of multi-category thermodynamic learning well. The things that are one part of the various factors used in the excellent and harmonious categories of the students on the comparison indicator are good enough, so this learning is of course through the thermodynamic learning approach of the various events. On semester 4 materials. Based on the conclusions of the research results, the authors suggest that the application of thermodynamic representation based on multiples can be used as one of alternative methods that can be used for various things. Approach in the representation of multi-thermodynamic based learning.

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References

[1] Anderson L W, Krathwohl D R, Airasian P W, Cruikshank K A, Mayer R E, Pintrich P R and Wittrock M C 2001 *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives, abridged edition* (White Plains, NY: Longman)

[2] Hartini T I 2015 *Termodinamika (Materi kuliah untuk perguruan tinggi program studi pendidikan fisika)* edisi 1 (Jakarta: Uhamka Press) p 1

[3] Goldin G A 2002 Representation in mathematical learning and problem solving *Handbook of international research in mathematics education* 197-218

[4] Ainsworth S 2006 DeFT: A conceptual framework for considering learning with multiple representations *Learning and instruction* **16** 183-198

[5] Schnotz W and Bannert M 2003 Construction and interference in learning from multiple representations *Learning and Instruction* **13** 141-15
[6] Hsu P L 2016 Using multiple representations to teach science *Science Scope* **40** 1-9
[7] Zemansky M W and Dittman R H 1986 *Kalor dan Termodinamika Terbitan Keenam* (Bandung: ITB)
[8] Savinainen A, Nieminen P, Mäkynen A and Viiri J 2013 Teaching and evaluation materials utilizing multiple representations in mechanics *Physics Education* **48** 372- 377
[9] Eilam B and Poyas Y 2010 External visual representations in science learning: The case of relations among system components *International Journal of Science Education* **32** 2335–2366
[10] Ainsworth S 2006 DeFT: A conceptual framework for considering learning with multiple representations *Learning and instruction* **16** 183-198