International Conference on Science and Applied Science (Engineering and Educational Science) 2016

International Conference on Science and Applied Science (Engineering and Educational Science) 2016 (ICSAS 2016)

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Surakarta, Indonesia
19 November 2016

Preface

International Conference on Science and Applied Science (Engineering and Educational Science) 2016 (ICSAS 2016) was held at the Syariah Hotel Solo, Surakarta, Indonesia on 19 November 2016. The ICSAS 2016 conference is aimed to bring together scholars, leading researchers and experts from diverse backgrounds and applications areas in Science. Special emphasis is placed on promoting interaction between the science theoretical, experimental, and education sciences, engineering so that a high level exchange in new and emerging areas within Mathematics, Chemistry, Physics and Biology, all areas of sciences and applied mathematics and sciences is achieved.

In ICSAS 2016, there are five parallel sessions and five keynote speakers. It is an honour to present this volume of *Journal of Physics: Conference Series (JPCS)* and we deeply thank the authors for their enthusiastic and high-grade contribution. We would like to express our sincere gratitude to all in the Programming Committee who have reviewed the papers and developed a very interesting Conference Program, as well as thanking the invited and plenary speakers. Finally, we would like to thank the conference chairman, the members of the steering committee, the organizing committee, the organizing secretariat and the financial support from the Sebelas Maret University that allowed ICSAS 2016 to be a success.

The Editor of the ICSAS 2016 Proceedings:
Prof. Dra. Soeparmi, M.A.,Ph.D
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Development of two tier test to assess conceptual understanding in heat and temperature

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Development of two tier test to assess conceptual understanding in heat and temperature

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Abstract. Heat and temperature is a concept that has been learnt from primary school to undergraduate levels. One problem about heat and temperature is that they are presented abstractly, theoretical concept. A student conceptual frameworks develop from their daily experiences. The purpose of this research was to develop a two-tier test of heat and temperature concept and measure conceptual understanding of heat and temperature of the student. This study consist of two method is qualitative and quantitative method. The two-tier test was developed using procedures defined by Borg and Gall. The two-tier test consisted of 20 question and was tested for 137 students for collecting data. The result of the study showed that the two-tier test was effective in determining the students' conceptual understanding and also it might be used as an alternative for assessment and evaluation of students' achievement

1. Introduction

Heat and temperature concepts are found throughout science curricula in Indonesian, at both the pre-college (elementary school and high school) and college levels. A concept related to head and temperature is directly related to physical environment of living organism. Hence heat and temperature are not directly observable quantities. Concepts developed by students originated from the interpretation of idea gained from everyday experiences [7].

Difficulty understanding of heat and temperature concepts have been investigating by many researchers educational. Many students have not understood even misconceptions about the of temperature and heat concept [10]. Students come to class with an understanding that is not empty, the students came up with a variety of knowledge from everyday life. According to [2], students' understanding of the concept of temperature and heat comes from the experience that they get from everyday life. The concept is related to the temperature and heat are directly related to the environment and daily life. Therefore, the temperature and heat can not be directly observed. The result by Gonen research is student conception and misconceptions were acquired and stored, they occurred without ostensible link between everyday life and school experiences. Gonen found that 41

% students had misconceptions on heat and temperature [4]. Based on student responses to all question Gonen found a general misunderstanding of ideas related to thermal equilibrium, heat transfer and temperature concept. Gonen study finding indicated that even though some student has an accurate understanding of Physical processes, their knowledge of heat and temperature concept should be greater, As a matter of fact, the present study reveals those students misconceptions on related mass and heat, and distinction between temperature and heat and those differences in temperature can lead to transfer of heat energy [4]. In another study on the concept of the Black principle, the students have difficulties in distinguishing between $Q_{deliver}$ and $Q_{receive}$ [11]. Many students confused about the concepts of heat and temperature are the same thing, perception of temperature is only about hot and cold, temperature can be transferred. The student memorized this concept and was not able to make a connection between their knowledge and physics phenomena in everyday life [12].

Every day, children are exposed to colloquial term "heat" as a noun, verb, adverb and adjective and these multiple uses may lead to confusion [3]. A student in high school has also great difficulty with energy concept, and the distinction between heat and temperature [5].

According to Meltzer, physics can also be translated into four representations as follows: verbal representation, diagram or images representation, mathematical representation or mathematical symbols, and graphic representation. Thus, solving the physics problems can be conducted by representing the questions of physics in various forms: verbal, graphic, images or pictorial, and math in the form of formulas [8].

This study has two objectives, Firstly, we developed a two-tier test heat and temperature based higher order thinking skill. Secondly, we used the two-tier test instrument to diagnose conceptual understanding heat and temperature student

2. Method

The method of research is the qualitative and quantitative methods. This research was conducted with 2 phase is development and measurements phases. The first phase of this research is to develop open-ended multiple-choice with reasoning instrument test that will be used to measure students' understanding of the concept. According to Borg & Gall, research and development is a process used to develop or validate the products that are used in education and learning. A step-by-step method using the Research and Development (R & D) by Borg & Gall.

Finally, the instrument two-tier test consisted of 20 items. This instrument is a matter of the type open-ended question or multiple-choice with the reasons. In this instrument, the first tier of each item consist of a content question of four choices, the second part is a reasoning for justification for the answer to the first part. To determine the feasibility of this instrument to be used in measuring the students' understanding of the concept of validity and reliability analysis. Logical validity is done by experts determine with V aiken and to determine the validity of empirically used Quest 1 PL. As for the analysis of reliability of the instruments used Cronbach alpha equation

The Second phase is a phase of measurement. This stage involves 137 students of Madrasah Aliyah. In the analysis at this phase is multiple choice answers and reasons answers written by the students. Description of student understanding of concepts derived from the analysis of the answers, reasons, and explanations are given learners. The students' answers are then analyzed based on the classification of understanding of the concept

3. Result and Discussion

In the first step, we develope two-tier test. In the second step, the effects of the two-tier test were discussed. The result of this study showed that the two-tier test was efficient to determine conceptual understanding heat ant temperature of the student.

Results of the analysis showed the instrument developed is effective to use. The Cronbach alpha reliability coefficient was found 0.73 for two-tier test. The instrument consists of 20 two-tier question with multiple choice and reasoning. Some general findings of heat and temperature understanding learned from research are:

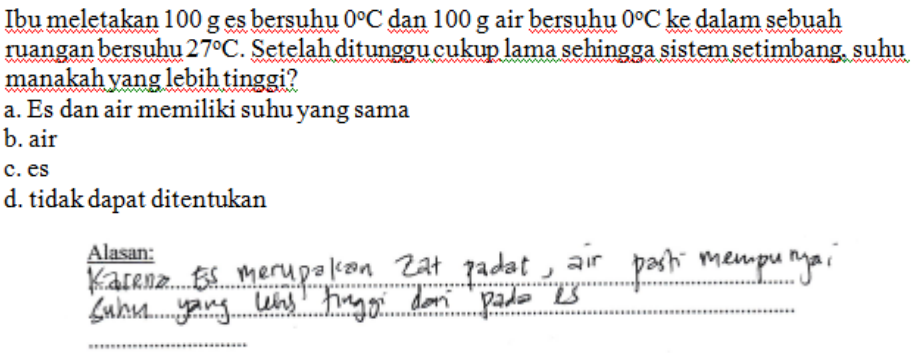
Table 1. Description of student conception of heat and temperature

• **Student Conception**
• **Student Conception of temperature**
1. Temperature obtained by measure
2. Touch and skin can measured temperature
3. Perception of temperature is only about hot and cold
4. Temperature can be transferred
• **Student Conception of Heat**
1. Substance with big masses and big volume is more heat
2. Which substance is hotter have more heat
3. Heat and temperature its same
4. Heat is not energy
5. Cold is not heate (ex; ice)

Table 1 shows some of the students' perception of differences of temperature and heat concept. This study aims to identify students' understanding of heat and temperature concepts, particularly for competence on the difference between heat and temperature. In the early part of this chapter of heat and temperature that is how students perceive their temperature. Based students' answers and interviews found that students consider temperatures obtained through measurement. Touch and skin can measure their temperature.

Perceptions of students so that later dug up again farther it until the present study found some misconception. The concept of temperature is not only expressed in the word "cold" or "hot", but rather through the numbers not rely on taste or touch anyone. The more heat, the heat level is something greater and it can be said the higher temperature. Likewise, the cold something then the temperature will be lower. The human sense of touch can only feel hot and cold but can't determine the degree of hotness or coldness of the object. In this concept, the students did not experience an error. Just need a more in-depth explanation so that students can understand the meaning of hot and cold in the concept that not only acquired the sense of taste alone. Such perceptions will bring improper understanding in students. In accordance with the opinion of Ericson (2000) that the hot word is often used in a variety of functions that affect students' concept and understanding.

The next finding is Heat and temperature is same. According to the student who is the heat flow or temperature instead of energy. This is contrary to the concept of heat. Heat is actually the energy transferred due to temperature differences in the two objects. Based on interviews with students stating that the heat can not be directly measured, but if we mix water from two glasses with different temperature, the water temperature will be warm and they conclusion the transfer is the temperature. Specific case for answer the student like a figure 1.


Ibu meletakan 100 g es bersuhu 0°C dan 100 g air bersuhu 0°C ke dalam sebuah ruangan bersuhu 27°C. Setelah ditunggu cukup lama sehingga sistem setimbang, suhu manakah yang lebih tinggi?
a. Es dan air memiliki suhu yang sama
b. air
c. es
d. tidak dapat ditentukan

Alasan:
Karena Es merupakan zat padat, air pasti mempunyai suhu yang lebih tinggi dari pada Es

Figure 1. Error representation of temperature concept

The question number 1 its measure students' understanding of the concept by giving an example of a phenomenon when two substances included in a system at equilibrium state. These items require students to classify the different concepts of temperature and heat to restate their respective concepts. Results of the analysis showed some students can work on the problems with both (4% Understanding concept and 19% Partial Understanding, 70% of Specific Misconception. On average students answered that the water temperature will be higher than the temperature of the ice as the water directly increase the temperature while ice must undergo a process of melt prior to temperature increases. Most of the students did not review that the final condition of water, ice, and the rooms are in balance so that all students are the process of temperature rise. In the process, it is water temperature increases more rapidly than ice, who must undergo smelting process first. But once the room reached thermal equilibrium with the water and ice will have the same temperature to room temperature.

The findings of this study are most of the students have alternative conceptions about heat and temperature. Many students were confused about the concept of heat and temperature and could not explain the difference between heat and temperature. Some student still regards that the words heat and temperature are the same. The finding was likely similar to the work by Alwan (2011) and Kesidou and Duit (1993). The response suggests that the student does not always distinguish between heat and temperature. They say heat and temperature as a synonymous word that a single concept. We call this concept "hotness". It has some of the qualities that physicists associated with both heat and temperature. In the reason student, many students have opinion that the hotter object must contain heat

The second research question is if we have two substance, if their masses is different which initial temperature are equally put in the same room that has higher temperature and waiting enough time, which substance heat more?

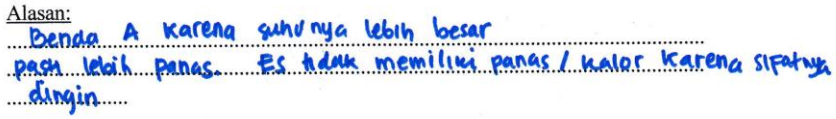


Figure 2. Error representation of heat concept

Based (fig 2) it can be concluded that 54,7 % student is not understanding and 2.98% of the students answered correctly. The initial student assumption that heat of a matter with small mass should be higher, because the volume is small. Some student gives reasons that the heat of substance with small mass should be higher because the volume is small and substance with big mass or big volume takes more heat and substance is hotter its heat is more. Ericson (2000), Gonen (2010) and Alwan (2011) found many student misconceptions about that and the temperature of the body was thought to be related to its size. This study's findings are consistent with Ericson's; Gonen and Alwan.

4. Conclusion

From the analysis and discussion, it can be concluded that the two-tier test can use to determine a conceptual understanding heat and temperature. Two-tier test in this study can help the teacher teach and student learn better because not only measure mathematic skill but its can measure fundamental and the basic concept of heat and temperature, so this instrument can promoting higher order thinking skills.

Many students confused about the concepts of heat and temperature are the same thing. The student memorized this concept and was not able to make a connection between their knowledge and physics phenomena in everyday life.

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