The analysis of heat - temperature misconception and integration with Al Quran

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Abstract. This research analyzed the misconception of heat and temperature material integrated with Al Quran on senior high school students in Banjarmasin. This research used qualitative method. Subjects of the research are student eleventh grade of science program in 16 senior high school of Banjarmasin. Every school was taken one class became subject of the research. This misconception has been analyzed using four tier test. Misconception that identified by four tier test and integrated with Al Quran on senior high school science students in Banjarmasin is the concept of heat transfer, changes in form, heat capacity, and expansion factor. Those concepts have been found not well understood among science students, especially on Black’s Principle, changes in form, and expansion factor.

1. Introduction

Physics depends on the results of experimental observations and quantitative measurements [1]. Meanwhile, physics observes how an object works and finds a basic relationship between causation that explains why the natural phenomenon occurs[2]. This means that physics aims to study the basic laws governing natural phenomena and develop them as a theory to predict the results of subsequent experiments. The construction of complex concepts in physics must be derived from a small student experience [1]. For example the concept of temperature and heat which the students cannot clearly see the temperature and the heat but students should be able to measure them.

However, in reality there are still many students who have not been able to construct their own physics concept so that students have difficulty in understanding physics. Students think physics is a difficult lesson because it uses too many formulas and concept development[3]. Students difficulties in understanding the concept of physics is feared can cause misconception [4]. Defines misconception as a misconception or misinterpretation of a concept [5]. Misconception is a concept that is not in accordance with the concept recognized by experts or also called alternative concepts [6]. Students’ misconceptions can occur in the concept of temperature and heat. The Results of research misconception mentioned that students are wrong in transmitting heat in environment [4], [7]. Students also assume that condensation occurs only in water and the temperature of a substance increases when boiling. Another study conducted states that 18.9% of students experience misconceptions about heat [8]. Students think that temperature is the intensity of the heat and skin can determine the temperature.
Misconception is also possible in high school students in Banjarmasin City. Based on observations in some schools, most students mentioned that heat is the same as heat. Students also say that heat is not energy and boiling is the maximum temperature that can be achieved by a substance. According to Ozkan and Selcuk [9], misconception is a real factor that can affect student failure in academics. Misconceptions can undermine the structure of knowledge already in the minds of students. This can lead to students' understanding of the concept of low temperature and heat [10]. Thus, a deeper analysis is needed to find out what misconceptions occur in the students' temperature and heat matter so that the solution can be determined.

In the learning of physics can also be instilled Islamic religious values that exist in verses of Qur'an. Students can combine physics concepts they learn with the verses of the Qur'an to prove that there is a connection between science and Al Quran. Gagner and Armstrong spiritual intelligence in the ninth intelligence to nine after 8 other multiple intelligences[11]. Religious values found in spiritual intelligence have an important role in achieving learning success. To initiate concepts that connecting the concept of physics with the holy verses of the Qur'an called the integration of Islam and science [12]. The concept of integration of Islam and science is emphasized not only to make students understand the concept of physics alone or students understand the concept of religion alone but also the students are able to prove the application of the concept of physics in the Qur'an. Islam based on the holy verses of the Qur'an, did not justify the separation between science and the holy verses of the Qur'an. Therefore, students are expected to be able to read and understand the meaning of Qur'an verses and can prove by physics through various experiments. The inhabitants of Banjarmasin are predominantly Muslim and have high knowledge about the Qur'an [11]. It is encouraging to hold research on students about the science of the Qur'an and how to understand the concept of physics.

Therefore, the concept of integration of Islam and science should be applied in teaching and learning activities. The verses of Qur'an that indicate the existence of temperature and heat in the earth can be found in Surah Yunus verse 5 with the translation "He who made the sun shine and the moon shine and He appointed places for the moon, so that you know the number of years and time calculation. God Did not create such a thing but by right and explains the signs of His affliction for those who know ". The verse shows that the sun emits its light, while between the sun and the earth is a vacuum of space so that solar thermal energy can reach the earth without intermediate substances. The verse of the Qur'an in verse 5 of Surah Yunus shows the existence of solar energy that is emitted to the earth. In physics, it is known as the heat that travels by means of radiation.

Islam and Science is a unity because epistemologically science is also come from a values in Al-Qur'an [13] Nuryantini is also said it [14] as the result, the good values in Al-Qur'an can be used in Science learning. Physic learning which has an abstract and procedural characters [1] is also can be proved with the fact that is in the values of Al-Qur'an [15] one of the thing that can be used is the used of animation in teaching and learning solar system where the Earth and the other planets are surrounding the sun. So, the learning of Physic can be integrated to Al-Qur'an in the other subject. One of the subject which can be used is the subject of temperature and heat, according to Fatoni [16] it can use a teaching materials which can be applied easier to explain the concept of temperature and Al-Qur'an. The used of teaching material that is integrated with science make a strengthening of physic concept is strong and growing the student’s good attitude or affective [17]. From the result of research from Fatoni [16], Arifudin [18] and [12] indicate that science especially physic can be integrated with Al-Qur'an in order to strengthening the concept of physic and an establishment of student’s affective character.

Science integrated research generally discussed two things, these are literature research and direct integration in a subject [17]. As a result, it needed specific research that discuss integration with the strengthening concept of physic and Al-Qur'an [19]. So, a research is offered to measure a mistakes in physic concept with the analysis in Al-Qur’an’s integration. This research is different from before which only discussed about a strengthening concept or Four Tier Test but also discuss about Four Tier Test and the Integration with Al-Qur’an. This has been said [16] that a recommendation which needed to the next is not only about the development of teaching material but how to the integration is adhere.
Therefore, a research that adhere a physic exercise is conducted then integrated with verse Qauniyah [20]. This is expressed by [13] also need to convince our good integration. So that, this research heads for to analyze misconception to Senior High School Students which use Four Tier Test and analyze the integration with Al-Qur’an verse. So, this research analyze a misconception in subject of temperature and heat along with analyze of an integration in Al-Qur’an verse with temperature and heat subject.

2. Research Methods
A qualitative descriptive approach was used to identify the misconceptions of high school science students on Banjarmasin in the temperature and heat material using four tier test and integrated with the Qur’an verse. The study was conducted on 13 public high schools and 3 Madrasah Aliyah in Banjarmasin. The data obtained in this study are data misconceptions of temperature - heat and integrated verses in the Qur'an. The instrument used in this study is a misconception test using four tier and integration with Al Quran test. Data analysis used criteria answer of four tier test that was developed by Kaltakci, et al [21].

| Tier 1 | Tier 2 | Tier 3 | Tier 4 | Conclusion           |
|--------|--------|--------|--------|----------------------|
| True   | Sure   | True   | Sure   | Understand The Concept |
| True/False | Sure   | True/False | Unsure | Did not Understand the Concept |
| True/False | Unsure | True/False | Sure   | Did not Understand the Concept |
| True/False | Unsure | True/False | Unsure | Did not Understand the Concept |
| False  | Sure   | False  | Sure   | Misconception         |

Data analysis for student’s answer in integrated Al-Quran with physics concepts, used two criteria are understand and not understand concept of integration Al-Quran with physics.

3. Results and Discussion

3.1. Results
The test was developed based on the concept and indicator of temperature and heat integrated with Qur’an. The results are shown in this following figure.

![Understanding of Students in the Material of Heat and Temperature](image-url)

**Figure 1.** Understanding of Students in the Material of Heat and Temperature
3.2. Discussion

3.2.1. The students’ misconception on heat temperature material

Identifying the factors influencing expansion of solid, liquid, and gas

Every substance will expand if it experiences the rising of temperature. The expansion is influenced by some factors, such as temperature rising and coefficient of expansion. Most of all students experienced misconception at 39.15 in this indicator. The student tended to miss the concept rather than didn’t understand and understand the concept. We analyzed that they expected what will happen to the air molecule in the box. The students believed that the air molecule would evaporate or expand. In fact, the air molecule in the metal box still move quickly when heated, thus the air in the metal box expands. About 225 students replied convincingly that the air molecule evaporates or expands due to expansion. In fact, the expansion causes the elevation of molecules’ velocity so the air expands. This proves that students had misconception of air expansion. They believed in the expansion of air molecule when the air is heated.

The understanding concept on indicator analyzing the heat factors and temperature that causes substance changes

In this indicator, students experienced misconception about 40.66%. About 274 students have misconstrued the concept of change of substance. The students were given about graph of temperature change in hot wax liquid below.
The appropriate concept is the change of wax form at point B. When there is number temperature change (temperature in a straight line), then there is a process of change of wax where there are two types of substances in it, namely liquid and waxy solids. The wax liquid begins to turn into a waxy solid. Meanwhile, many students were sure to answer at point C and point D, by reason of temperature changes cause the candle to change its shape. Students thought that when there is a change in temperature, there is a change of the form. In fact, when there is a change in temperature, it does not change the form.

The understanding concept on analyzing the heat capacity of an object
The heat capacity is the amount of heat needed to raise every degree of the temperature of a substance. The average shows that students experienced a concept error of heat capacity about 42.02%. At the problem, was given about various sizes of blocks and given the temperature achieved by each blocks. The students who answered correctly meant that they are able to sort the capacity of the heating from the blocks, began from the largest and they could give the right reasons. The exact reason was that the heat capacity did not depend on the size of an object. Students who experienced misconceptions, they assumed that the larger the size of an object, the greater the heat capacity.

The understanding concept on indicator distinguishing heat transfer
Students experienced many errors in the concept of heat transfer as many as 37.42%. On problem number 16, students were given a problem about ice sheets being heated in water in a test tube. From the student’s answer shows the fastest melting is image A, because the hot ice source close to ice and convection accelerates the melting process. Many students answered confidently picture C, the ice would quickly melt because the conduction that occurred in the lead wire could melt the ice. Meanwhile, the process of convection in water is faster than the conduction process in lead. Another problem about the ice did not melt even though the water above the tube has boiled because conduction did not occur in the metal gauze. This is caused by water convection not transferring heat to the metal gauze. Many students misconstrued because they thought that metal gauze was not able to absorb heat because the metal gauze is an insulator that prevents heat from reaching the ice, so the ice did not melt.

The understanding concept on applying heat transfer to daily life
As many as 45.65% of students experienced misconceptions about heat transfer in daily life. The problem was about heat transfer from room heaters to the man who standing in front of the heating. In this event there was a radiation process, because there was number delivery between room heaters to men. Many students think that during this event there is a process of convection and radiation or just convection. Because, the air is a good conductor. So as the heat transfer from fire to the hand of a child holding an iron rod. This is due to the conduction process, because heat only flows through the iron rod into the child's hand. However, many students answer that there are conduction and radiation processes because heat flows through the iron rod and the surrounding air.

3.2.2. Students' Understanding of the Integration of the Concepts of Temperature and Heat with the Verses of Qur'an
Based on the results of the research with each indicator on each question, there are many verses in the Qur'an found in three research findings, namely students who understand the concept of physics also understand the concept of integration of Qur'an verses; students whose physical misconceptions also understand the concept of integration of Qur'an verses; and students who do not understand the concept of physics also understand the concept of integration of Qur'an verses. From those three research findings, students have understood a lot of verses which are in accordance with the physical concepts and which verses are not in accordance with the concept of physics. Students already understood that there are several verses that are forced by researchers because the proposal already
mentions in each question there are indicators of the Qur'an verses in each question. For an example: A metal box filled with air, placed on a heater and left for a long time.

Air molecules in box X will ...
A. Yawn  
B. Move quickly  
C. Expand  
D. Move closer  
With the integration verse letter Al Hadid verse 25.

From the example question above, students who answered the concept of physics which understood the concept, experienced misconception and did not understand the concept clearly will answer there was no relation. Since the meaning of the verse above did not reflect how the physics concept. So that the concept of integration is not on the question exists but in one physical material. From the temperature and heat material after using some literature, the verse which is in accordance with temperature and heat is the letter Al Humazah with verse

فمن يعمل مثقال ذرة خيرا يره ومن يعمل مثقال ذرة شرا يره

In this paragraph explains the real concept that is in accordance with the heat concept is in the letter Al Humazah verse 8. What described in this paragraph is the same as the heat concept in the Black Principle material. The heat received is the same as the heat released. With the description that what is done as that is also what we will receive on the day of the calculation of our good deeds on the last day. When we do something good it will be rewarded with a lot of goodness. Likewise if the opposite.

From the result of the research about student’s misconception using four tier test to temperature and heat subject, there is a result in the amount of 38.05% students have experience misconception while 38,75% students don’t understand the concept. It can be seen at the picture number 1. This result is affected by students’ ability in analyze the process of expansion that occur in a thing is also measure the capacity of heat in the thing. This is supported by Yolanda’s research [22] that student’s ability in analyze the process of expansion, the measurement of heat capacity until the process so that it needed to student’s ability in analyze the subject of temperature and heat goodly in order to students can understand the concept. It is also explained by The student’s needed ability in analyze the case of temperature and heat[23], [24].

Meanwhile, in misconception analysis with its integration got a data that the student who get the misconception doesn’t experience the process of misconception in Al-Qur’an integration. It is supported by Safa’tun said [19] that integration is not only apply to students who understand the meaning of Al-Qur’an but the integration apply with the application in the daily life and it causes a good attitude [20] and Integration with Al Quran can growth Local Wisom [25]. And also to the students who have the good understanding of concept don’t produce the good integration of Al-Qur’an. So, it can recommended to search the other integration which the result can be result. Students can directly apply the implementation in the daily life in a science manner and in an integration with Al-Qur’an.

4. Conclusion
Misconceptions that can be identified with four tier tests of temperature and heat material that are integrated with Al Qur’an verses in high school / Madrasah Aliyah state students throughout Banjarmasin City are concepts of heat transfer, change in form, heat capacity, and expansion factors. There are no concepts that have been well understood that integrate Al Qur'an verses by Senior high school / Madrasah Aliyah students of Banjarmasin with temperature and heat material after using the four tier test. The concept is not well understood which integrates Al-Qur'an verses by Senior High School / Madrasah Aliyah Banjarmasin students of temperature and heat material after using the four tier test is the Black Principle, changes in form and determination of expansion.
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