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Analysis of the Use of Interactive Multimedia Android Thermodynamics to Reduce Student Misconceptions

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Abstract

This type of research is a qualitative descriptive research. And from the data obtained, the next step is to analyze the data. After analyzing or processing the data, this research continued to look for the percentage of misconceptions and identify other indications that could cause misconceptions in accordance with the research objectives. The object of this research is the concept of thermodynamics. The research was conducted by testing the concept through a misconception test. The data that has been collected is then presented in the instrument data table. In this study, the data collection technique was carried out by using a misconception test. The research instrument used in this study was a pre-test and a post-test related to misconceptions. This misconception analysis table is used to fill in the comparison of the results of the misconceptions at the beginning and at the end, so as to get more information about the findings of the misconceptions. The technique used in this data analysis is qualitative data technique. In this study, analysis was used to find the percentage of misconceptions and the completeness of textbook concepts based on the syllabus, and to find out whether there were other indications that could cause misconceptions. Based on the results of data analysis and discussion, it can be concluded that the overall misconceptions experienced by students in Thermodynamics lectures at the University of Muhammadiyah Makassar experienced a decrease in misconceptions after using the android media terminology, which was in the medium category, especially for the concept of Ideal Gas, Kinetic Theory of Gas, First Law of Gas, Thermodynamics, Second Law of Thermodynamics and Entropy.

Keywords: reduction of misconceptions, thermodynamics learning, multimedia android

Introduction

A concept is an abstraction that represents an object. In the study of thermodynamics, the formation of the concept of matter is very important. If the concepts possessed by students have been successful, it can be said that thermodynamics learning has been successful. However, if there is a deviation or conflict between student concepts and scientific concepts, then the thermodynamics learning is said to be unsuccessful (Bhakti, Y. B., Astuti, I. A. D., & Prasetya, R. 2022, Sambudi, N. S., & Ramli, R. M. 2021, Turnip, B., Wahyuni, I., & Tanjung, Y. I. 2016). In addition, these deviations or contradictions can cause obstacles to the acceptance of the next concept. Student concepts that deviate or conflict with scientific concepts are called misconceptions (Saputri, A. A., & Wilujeng, I, 2017).

Misconceptions can be caused by many things. This can be related to the conclusion of an expert that the causes of misconceptions can be from three aspects, namely: students, teaching materials, and teaching media. Therefore, it can be concluded that one of the causes of misconceptions is

the teaching media. Teaching media as a thermodynamics learning facility is a very important component in the process of teaching and learning activities. Teaching media are commonly used to help the learning process achieve its goals (Goovaerts, L., De Cock, M., Struyven, K., & Dehaene, 2019).

According to Lestari, Wibowo & Delina (2021) misconception is a concept that is not in accordance with the concept recognized by experts. The occurrence of misconceptions in students will affect the next learning process, because during learning students develop and have the wrong concept. The existence of this misconception, students will also have difficulty accepting new knowledge so that it can hinder the further learning process.

Based on the research results, misconceptions are one of the main sources of difficulty in learning physics, especially thermodynamics. The occurrence of misconceptions can lead to not achieving a learning goal and can indirectly reduce the quality of learning, because during learning students have and develop the wrong concept. The misconceptions experienced by these students must be known by the lecturers themselves. Because with this misconception, students also have difficulty accepting new knowledge so that it can hinder the further learning process. The number of misconceptions experienced by students in studying thermodynamics is due to the large amount of abstract material so that students find it difficult to understand the correct concept (Sambudi, N. S., & Ramli, R. M, 2021).

Many researches on misconceptions have been carried out, there are several techniques used to detect student misconceptions. One of them is a diagnostic test, where there are several forms of diagnostic tests, one of which is the Four-Tier Diagnostic Test. The four tier diagnostic test is an extension of the three tier multiple choice diagnostic test (Atarés, L., Canet, M. J., Trujillo, M., Benlloch-Dualde, J. V., Paricio Royo, J., & Fernandez-March, A, 2021, Candra Dewi, A., Amir, J., & Hamsa, A, 2021). The development is found in the addition of the level of student confidence in choosing answers and reasons. The advantages of this Four tier diagnostic test are that through the four tier diagnostic test the lecturer can: (1) distinguish the level of confidence in the answers and the level of belief in the reasons chosen by students so that they can dig deeper into the strength of students' conceptual understanding, (2) diagnose misconceptions experienced by students. more deeply, (3) determine the parts of the material that require more emphasis, (4) plan better learning to reduce student misconceptions (Liberatore, M. W., Morrish, R. M., & Vestal, C. R, 2017, Turnip, B., Wahyuni, I., & Tanjung, Y. I, 2016).

Based on several explanations about the misconceptions that occur in the field of thermodynamics, the researcher discusses the identification of student misconceptions using the Four-Tier Diagnostic Test on thermodynamics at the Muhammadiyah University of Makassar.

Methodology

This type of research is a qualitative descriptive research. And from the data obtained, the next step is to analyze the data. After analyzing or processing the data, this research continued to look for the percentage of misconceptions and identify other indications that could cause misconceptions in accordance with the research objectives. The object of research, is the concept of thermodynamics. The research was conducted by testing the concept through a misconception test. The data that has been collected is then presented in the instrument data table. In this study, the data collection technique was carried out by using a misconception test. The research instrument used in this study was a pre-test and a post-test related to misconceptions. This misconception analysis table is used to fill in the comparison of the results of the misconceptions at the beginning and at the end, so as to get more information about the findings of the misconceptions. The technique used in this data analysis is qualitative data technique. In this study, analysis was used to find the percentage of mis-

conceptions and the completeness of textbook concepts based on the syllabus, and to find out whether there were other indications that could cause misconceptions.

Results

After analyzing the initial and final tests, then an analysis of the rate of reduction of thermodynamic misconceptions was carried out. For a clearer view of how students' conceptions can be seen in Table 1.

Table 1. The results of the thermodynamic misconception test through the use of android media

No	Concept	Number of Misconceptions (%)	
		Pre-Test	Final Test
1	Ideal Gas	55	9
2	Kinetic Theory of Gas	54	22
3	First Law of Thermodynamics	69	7
4	Second Law of Thermodynamics	57	6
5	Entropy	69	14
Average			

The distribution of scientific concepts and misconceptions in the thermodynamics material in the four tier diagnostic test is presented in Table 1. Each number of questions represents the concepts contained in the thermodynamics material. The number of questions in the following table will be used for further data presentation. To see how students' conceptions change before and after using multimedia android thermodynamics is described in this section. Analysis of changes in student conceptions presented a number of questions given to students, in order to make it easier to analyze changes in student conceptions.

For question number one, when the initial test was conducted, none of the students had a scientific conception. The category of student conceptions based on data analysis was only in the category of lack of understanding (5 people) and misconceptions (25 people). After the application of learning with multimedia android thermodynamics, the students' conceptions have largely changed. Changes in student conceptions occurred from the category of lack of understanding to scientific conceptions (construction), the category of misconceptions to scientific conceptions (reconstruction) as many as 22 people, while students who were initially in the misconception category then used Android multimedia thermodynamics to remain in the category of misconceptions (static) as many as 3 people.

Question number two, when the initial test was conducted, none of the students had a scientific conception. The category of student conceptions based on data analysis was only in the category of lack of understanding (10 people) and misconceptions (15 people). After the use of android multimedia, the student's conception has largely changed. Changes in student conceptions occurred from the category of lack of understanding to scientific conceptions (construction) as many as 6 people, the category of misconceptions to scientific conceptions (reconstruction) as many as 19 people. While students who were initially in the category of misconceptions then after using android multimedia remained in the category of misconceptions (static) as many as 4 people.

Question number three, when the initial test was conducted, none of the students had a scientific conception. The category of student conceptions based on data analysis was only in the catego-

ry of not understanding 3 people and misconceptions of 22 people. After the use of interactive multimedia thermodynamics largely changed. Changes in conception occurred from the category of lack of understanding to scientific conception (construction) as many as 6 people, category of misconception to scientific conception (reconstruction) as many as 19 people. Meanwhile, students who were initially in the category of misconceptions then after using Android multimedia remained in the category of misconceptions (static) as many as 5 people.

Question number four, when the initial test was carried out there was 1 person who had a scientific conception, the category of lack of understanding (14 people) and misconceptions (10 people). After the use of android multimedia, students' conceptions have largely changed. Changes in conception occurred from the category of lack of understanding to scientific conception (construction) as many as 14 people, category of misconception to scientific conception (reconstruction) as many as 9 people. Students who were initially in the category of misconceptions then after using android multimedia remained in the category of misconceptions (static) as much as 1 person. While one person who has a scientific conception from the beginning, then after the use of multimedia android remains in the category of scientific conception.

Question number five, when the initial test was conducted, none of the students had a scientific conception. The category of student conceptions based on data analysis was only in the category of lack of understanding (15 people and misconceptions (10 people). After using multimedia android, students' conceptions mostly changed. Changes in student conceptions occurred from the category of lack of understanding to scientific conceptions (construction) as many as 15 people, category misconceptions to scientific conceptions (reconstruction) as many as 8 people, while students who were initially in the category of misconceptions then after using multimedia android remained in the category of misconceptions (static) as many as 2 people.

Table 2. Results of mapping students' misconceptions in thermodynamics learning

No	Concept	Misconceptions	Correct concept
1	Ideal Gas	the concept of cooling engine performance coefficient. refrigerators and air conditioners that have a performance coefficient in the range of 2 to 6.	The range of performance coefficients of refrigerators and air conditioners should have a range of 5 to 6.
2	Kinetic Theory of Gas	the term heat of a system, not the heat itself	the term heat is actually not quite right; the correct one is heat flow. Based on literature studies and interviews with a team of experts, the term heat is appropriate because its definition is the transfer of energy across the system boundary based on changes in temperature between the system and its environment.
3	First Law of Thermodynamics	Misconceptions are found in the description of CP and CV	The correct concept is that CP and CV are the heat capacities of a gas at constant pressure and constant volume, not the molar capacity of the gas

No	Concept	Misconceptions	Correct concept
4	Second Law of Thermodynamics	Misconceptions are found in the description of CP and CV. CP should be the heat capacity of the gas at constant pressure and not the specific heat of the gas at constant pressure	CV should be the heat capacity of the gas at constant volume and not the specific heat of the gas at constant volume.
5	Entropy	monatomic force energy derived from the concept of addition.	the correct concept is the concept of monatomic energy of matter and not monatomic force energy.

Based on tables 1 and 2, it can be seen that there are still some students whose initial conceptions were misconceptions and then learning using interactive android media remained at their initial (static) conception. This can happen because of several factors, including the student still feels that the conception he had previously was the correct one. Another factor that causes students to be in a static state is that students are less able to conduct experiments in the observe phase so that students do not experience cognitive conflicts.

This is in line with the principle of the conceptual change approach which says that students' misconceptions can be turned into scientific conceptions if: (1) students must become dissatisfied with their conceptions; (2) the new conception must be understandable; (3) the new conception must make sense; and (4) the new conception must be useful. The four characteristics of the conceptual change approach are facilitated by the use of interactive multimedia thermodynamics. After these conditions are met, students can experience a change in conception.

Table 2 shows a decrease in the quantity of students' misconceptions for each concept that has been taught. This can be caused by several factors. Several factors that may cause this are: (1) Instruments on the concept of the law of thermodynamics are more difficult than other concepts; (2) Clarity of the Worksheet used and (3) In terms of the law of thermodynamics using android simulation, not using real practicum.

Based on the exposure to the research results, it is known that all concepts and all validators say that all developed instruments are in accordance with the level of student understanding. This indicates that the instrument factor is not the cause of the decrease in the quantity of students' misconceptions on the concept of thermodynamics in the medium category. For the Worksheet factor, all students when the Worksheet was tested gave a positive response to the Worksheet that was developed. In addition, lecturers have also been given Worksheets to improve the Worksheets to be perfect. Based on this, it can be seen that the Worksheet factor is not the cause of the decrease in the quantity of students' misconceptions in the medium category.

Another factor that causes the concept of the law of thermodynamics for both male and female students to be in the moderate category is because the process of learning the law of thermodynamics uses virtual simulation with android. This is in line with research conducted by Sultan, A. D. (2021), Maruf, M. (2020), Marisda, D. H., Rahmawati, R., Ma'ruf, M., & Samsi, A. N. (2021), Misdi, Hartini, N., Kusriandi, W., & Tambunan, A. R. S. (2020), . Based on the research that has been done, it is concluded that the use of direct practicum is better than virtual practicum to instill concepts in students. Virtual simulation is an alternative step used by teachers if the place where the teacher teaches does not have tools and materials, the material being taught cannot be seen with the human senses and other factors (Nggadas, D. E. P., & Ariswan, 2019).

Because this study only uses one class, of course, some of the causes that have been described cannot be said to be tested. So that it becomes input for further research on the application of thermodynamic android media to reduce the quantity of student misconceptions. In table 2 it can be seen that the application of thermodynamic android media can reduce the quantity of students' misconceptions. From Table 2 it can also be seen that the difference in the decline in student misconceptions is not significantly different, based on data analysis then categorized, it can also be seen that the decline in conception is in the same category.

Conclusion

Based on the results of data analysis and discussion, it can be concluded that the overall misconceptions experienced by students in Thermodynamics lectures at the University of Muhammadiyah Makassar experienced a decrease in misconceptions after using the android media terminology, which was in the medium category, especially for the concept of Ideal Gas, Kinetic Theory of Gas, First Law of Gas. Thermodynamics, Second Law of Thermodynamics and Entropy.

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