Analysis of Students' Conceptual Understanding in Physics Learning Through the Application of Virtual Laboratory Media (Phet Simulation) at SMA Negeri 4 Palu

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Abstrak

Penelitian ini bertujuan untuk mengenalisis pemahaman konsep siswa dalam pembelajaran fisika pada materi gerak lurus melalui penerepan laboratorium virtual. Penelitian ini dilakukan di SMA Negeri 4 Palu pada siswa kelas X IPA 5 yang terdiri dari 25 siswa. Penelitian ini merupakan penelitian kualitatif yang datanya diperoleh dari fakta-fakta yang ada, sehingga dalam penelitian ini menggunakan pendekatan deskriptif. Pada penelitian ini menggunakan instrumen pengumpulan data berupa tes pemahaman konsep dan wawancara. Dari 25 siswa peneliti menentukan 2 responden pada tiap kategori tinggi,sedang,dan rendah. Tiap kategori ditentukan berdasarkan nilai standar deviasi pada hasil olah nilai tes pemahaman konsep. Berdasarkan hasil penelitian yang dilakukan bahwa penggunaan media laboratorium virtual dalam pembelajaran fisika memberikan dampak positif bagi proses belajar siswa, hal ini dapat dilihat pada hasil tes akhir yang menunjukkan nilai tes siswa mengalami peningkatan dengan nilai rata-rata 65,2. Secara keseluruhan siswa paham pada konsep hukum newton terhadap GLBB. Sedangkan siswa banyak mengalami salah konsep pada jarak dan perpindahan.

Kata kunci: *pemahaman konsep; laboratorium virtual; gerak lurus*

Abstract

This study aims to analyze students' conceptual understanding in learning physics on straight motion material through the implementation of virtual laboratories. This study was conducted at SMA Negeri 4 Palu on students of class X IPA 5 consisting of 25 students. This study is a qualitative study whose data is obtained from existing facts, so this study uses a descriptive approach. This study uses data collection instruments in the form of conceptual understanding tests and interviews. From 25 students, researchers determined 2 respondents in each category of high, medium, and low. Each category is determined based on the standard deviation value of the results of the conceptual understanding test scores. Based on the results of the study, the use of virtual laboratory media in physics learning has a positive impact on the student learning process, this can be seen from the results of the final test which shows that student test scores have increased with an average value of 65.2. Overall, students understand the concept of Newton's law of GLBB. While students often experience misconceptions about distance and displacement.

Keywords: *concept understanding; virtual laboratory; straight motion*

Introduction

The teaching and learning process carried out by teachers and students both inside and outside the classroom certainly has certain obstacles, especially in physics subjects. In physics subjects, students are not only required to calculate, but also to understand the physical concepts of the material given. Often students make mistakes in understanding the concepts of the physics materials taught. To overcome this is not an easy matter, not only in terms of intelligence and student independence that need to be understood, adequate facilities and infrastructure are also important for handling students.

Every learning requires a method, strategy, and learning media that can give students a positive impression of learning activities. As in the case of physics learning, almost all materials require experiments to support the achievement of learning objectives.

Setiadi and Muflika (2012), found that not all schools conduct practicums, schools that do not conduct practicums are due to a lack of teacher awareness of the importance of conducting practicums, lack of availability of tools and materials needed for practicums, so that students do not have in-depth experience and knowledge. Simbolon and Sahyar (2015), said that in learning activities are still dominated by the role of the teacher, students only listen to the teacher's explanation and only care about the completion of the material. This makes students only able to memorize concepts without understanding the concept as a whole, so that this causes students' conceptual understanding to be low.

One of the efforts that needs to be done is the existence of educational innovation in the form of utilizing media so that students have a complete understanding of the concept of rigid body equilibrium. The limitations of real experiments can be overcome with other types of experiments that can be operated by each student, in the form of virtual experiments. Virtual experiments present virtual practicums that are operated by computers.

The use of virtual laboratories in learning is a simulation used for simple experimental media that certainly helps students understand the concept of rigid body equilibrium material. Active and innovative learning is a supporting factor to improve the student learning process in the classroom. "The increase in concept mastery and creative thinking skills experienced by students after going through the learning process using a virtual laboratory is because students are active in learning the existing concepts" (Hermansya, 2015).

According to Anderson and Krathwohl (2010) a person's ability to process their knowledge in the cognitive process dimension and is an indicator of students' conceptual understanding, including understanding (C2), understanding is the process

of building meaning from material based on what is said, written, and drawn by the teacher. Applying (C3), applying is the process of applying a concept in certain circumstances. Analyzing (C4), analyzing is the process of dividing material into its constituent parts and determining the relationship between parts or the whole.

Conceptual understanding is something that has been patterned in the mind so that it can be expressed verbally or in writing (Jamuri, et al., 2015). Conceptual understanding is very important in the learning process because conceptual understanding is a stage in understanding abstract information which in the process of understanding it must classify an object or phenomenon (Sari, et al., 2016).

Based on problems in learning activities that are not yet optimal so that they affect students' conceptual understanding, the author intends to conduct research by utilizing learning media in the form of virtual laboratories, by conducting simulations as simple learning experiments using virtual laboratories, it is hoped that it can help students improve their understanding of concepts in physics learning.

Methods

This research is a qualitative research where all data are collected based on facts obtained in the field. This research uses a qualitative descriptive approach. This qualitative research intends to analyze students' conceptual understanding in learning physics on straight motion material based on indicators of conceptual understanding through virtual laboratory media-based learning. The subjects in this study were 25 students of class X IPA 5 SMA Negeri 4 Palu. After virtual laboratory media-based learning was carried out, a conceptual understanding test was carried out using essay questions, from the results of the conceptual understanding test, 6 students were selected as respondents who were divided into 3 categories, namely high, medium, and low categories. The determination of this understanding category was obtained from the following average and standard deviation values:

1) Calculating the average value

$$\overline{X} = \frac{\sum Xi}{n} \qquad (1)$$

Information:
$\overline{X}$ = Average grades obtained by students
Xi = The number of marks obtained by students
n = Number of samples

2) Standard Deviation

$$SD = \sqrt{\frac{\sum (Xi - X)^2}{n}} \qquad (2)$$

Information :   SD = Standard Deviation
n = Number of samples

To determine the level of conceptual understanding possessed by students, an instrument is needed that can help determine students' conceptual understanding in learning. The instrument used is a conceptual understanding test which is divided into an initial test and a final test, each consisting of 5 essay questions arranged based on indicators of conceptual understanding according to Bloom, and the next test is an interview test for the six respondents who have been selected. The selection of the instrument in the form of an essay test to see the correct answers to students' answers. So that the level of students' conceptual understanding can be analyzed objectively because in addition to answering essay questions, students also answer individually based on their own opinions. In answering essay test questions, students may have different answers from other students, and their different answers may be equally correct so that the level of conceptual understanding can be easily and accurately identified.

Results

Based on the results obtained after giving the initial test to all class X students of SMA Negeri 4 Palu, the researcher found that out of 25 students, there were 0 people in the high category, 0 people in the medium category and 25 people in the low category, which were grouped as in Table 1.

Table 1. Initial Test Result Data for Ability Classification

Conceptual Understanding Ability	Category	Number of Students
≥ 80	High	0
56-79	Medium	0
<56	Low	25

Based on the results obtained after the final test, it can be seen that out of 25 students, there was an increase and it can be seen that there were 5 students in the high category, 15 students in the medium category, and 5 students in the low category, which can be seen in Table 2.

Table 2. Final Test Results Data for Ability Classification

Conceptual Understanding Ability	Category	Number of Students
≥ 80	High	5
56-79	Medium	15
<56	Low	5

To classify students into high, medium, and low categories by using the method of calculating the average value and standard deviation. The average value obtained is 48 and the standard deviation is 18.11. Based on the formula or calculation used in

determining 6 respondents based on the high category 2 people, the medium category 2 people, and the low category 2 people. The six students who were used as respondents in Table 3.

Table 3. Respondents and Respondent Categories

No	Student Initials	Score	Category
1	R-1	85	High
2	R-2	85	High
3	R-14	65	Medium
4	R-13	60	Medium
5	R-11	35	Low
6	R-23	25	Low

In this discussion, the researcher tries to see the level of conceptual understanding possessed by students before and after conducting virtual laboratory media-based learning represented by six respondents based on the high, medium, and low categories obtained from calculating the average value and standard deviation of the conceptual understanding test results. The level of conceptual understanding of students before and after conducting virtual laboratory media-based physics learning in solving problems is quite diverse. The researcher tries to describe the level of conceptual understanding of students based on the selected respondents.

a. Respondents' Concept Understanding Level High Category
- RT-1

In the initial test, respondents did not understand the concept of each question, which can be seen in each answer written by the respondents. In questions 1, 2, and 4, respondents answered correctly but without proper explanations, in questions 3 and 5, respondents answered incorrectly. In the final test, it can be seen that respondents understood the concept of questions 1 (acceleration), 2 (Newton's First Law of GLBB), and 4 (Newton's Second Law of GLBB), respondents answered the questions correctly and with proper reasons. Respondents did not understand the concept of questions 3 (Accelerated GLBB Graph), and 5 (distance and displacement), answered the questions correctly but with improper explanations.

- RT-2

In the initial test, respondents RT-2 were the same as respondents RT-1, where respondents RT-2 did not understand the concept in all questions, which can be seen in questions 1, 2, and 4 respondents gave the correct answer but were not accompanied by a proper explanation, in question number 3 respondents did not write the answer and in question number 5 respondents answered incorrectly. In the final test respondents understood the concept in questions number 1 (acceleration), number 2 (Newton's First

Law on GLBB), and number 4 (Newton's Second Law on GLBB), respondents answered the questions correctly and with the right reasons. Respondents did not understand the concept in questions number 3 (accelerated GLBB graph), and number 5 (distance and displacement), by answering the questions with incorrect answers.

b. Respondents' Level Of Conceptual Understanding Is In The Medium Category
  - RS-14

In the initial test, respondents had very poor understanding of the concept of linear motion, which can be seen in all the answers written by respondents being wrong. In the final test, respondents had understood the concept of questions 2 (Newton's First Law of GLBB), 3 (accelerated GLBB graph), and 4 (Newton's Second Law of GLBB). Respondents had not understood the concept of questions 1 (acceleration), and 5 (distance and displacement).

  - RS-13

In the initial test, respondents did not understand the concept of straight motion material, where respondents answered questions 2 and 4 correctly but without explanation, and the answers to questions 1, 3, and 5 that respondents wrote were wrong. In the final test, respondents had understood the concept of questions 2 (Newton's First Law), and 4 (Newton's Second Law). Respondents also did not understand the concept of questions 1 (acceleration), 3 (accelerated GLBB graph), and 5 (distance and displacement).

c. Respondents' Concept Understanding Level is Low Category
  - RR-11

In the initial test, it can be seen that the respondents did not understand the concept very well, where the respondents did not answer number 1, then the respondents were wrong in answering each question. In the final test, the respondents still did not understand the concept of the straight motion material, this is because the respondents were not yet able to interpret and explore the questions so that the respondents only answered the questions incorrectly.

  - RR-23

In the initial test, respondents had very poor understanding of the concept, which can be seen from the respondents' answers to 1 and 2 which were wrong, then respondents did not answer questions 3 and 5. In the final test for questions 1, 4, and 5 respondents answered incorrectly, for question 2 respondents answered correctly but without an explanation, for question 3 respondents did not provide an answer. So it can be concluded that respondents still do not understand the concept of straight motion material.

The explanation above illustrates that there are still respondents who do not

understand the concept of straight motion material, this is due to several factors, namely the lack of students' ability to understand the concept, lack of student concentration in learning, and lack of student attention during the learning process.

In this study, a table of initial test results and a table of final test results were used to make it easier to compare the level of understanding of the concept of each student before and after learning virtual laboratory media. In the initial test results table there is an average student score per question item. For question number one, the average value of students' conceptual understanding is 1.4, for question number two it is 1.52, for question number three it is 1.32, for question number four it is 1.76, for question number five it is 1.12. In the final test results table, the average value of students' conceptual understanding on question number one is 1.84, for question number two it is 3.24, for question number three it is 1.64, for question number four it is 3.04, for question number five it is 1.4

Based on the data on the results of students' conceptual understanding, it can be seen that the average value of students' final test is included in the moderate category according to the category of conceptual understanding ability according to Arikunto and it can be seen in the final test that students' overall scores increased after carrying out virtual laboratory media-based learning. Virtual laboratory media is considered appropriate for use in physics learning. In addition to being an alternative to the lack of equipment in the laboratory and being a means of maximizing learning during the current pandemic, it can also hone students' imagination. The use of virtual laboratory media in class X IPA 5 SMAN 4 Palu has a positive impact on the student learning process in the classroom. This can be seen from the results of the comprehension test which shows that many students can answer questions correctly, and can interpret and explore concepts in the straight motion material. Where it can also be seen that many students are in the medium and high categories. This research is supported by research conducted by Jagodzinki and Wolski (2014), in their research that learning using virtual laboratory media has a positive impact on increasing teaching efficiency, students also experience an increase in remembering information and show greater endurance in remembering concepts. Likewise in research conducted by Rindi, et al. (2019) in his research found that in the analysis of student concept mastery it was 0.70 with a moderate classification, so that virtual laboratories can improve the ability to master physics concepts.

Conclusion

Based on the results of the analysis of the linear motion concept understanding test and interviews, it can be concluded that: Students in the high and medium categories have a very good understanding of the concepts in the linear motion material, such as the concept of acceleration, Newton's First Law, Newton's Second Law,

Uniformly Accelerated Linear Motion. However, for question number 5, students misunderstood the concept of distance and displacement. Students in the low category have not understood the concepts in the linear motion material, both in questions one to five. Students understand the most about the concept of acceleration, Newton's First Law, and Newton's Second Law. The understanding of class X IPA 5 students of SMA Negeri 4 Palu on the Straight Motion material through the application of virtual laboratories is quite high. Virtual laboratory media has a positive impact on the teaching and learning process, students also experience an increase in remembering information and show greater endurance in remembering concepts.

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