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Analysis of Students' Understanding of Motion Concept with Video based Learning Assisted by Tracker Software

Nur Utami Amaliah, I Wayan Darmadi, and Sahrul Saehana*
Physics Education Study Program, Universitas Tadulako, Indonesia
sahrulsaehana@gmail.com

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Abstract

This study aims to determine and analyze students' understanding of the motion concept taught with video-based learning assisted by Tracker Software. The subjects of this descriptive qualitative research were 30 students from 10th grade at SMA Negeri 5 Palu. The instruments in this study were multiple-choice tests and interviewed guide. Multiple-choice tests are used with reasons and are equipped with a Specific Response Index (CRI). It was given before and after video-based learning assisted by Tracker Software applied. To add the information about students' understanding, the interview with a few respondents was done. Respondents were selected based on subjects' written test results in the high, medium, and low categories. They also were interviewed related to their conception and certainty of their answers. In learning by using video-assisted by tracker software, the student also employed the worksheet in experimenting. The results showed that a conceptual understanding of student motion on the initial test could be categorized as low. After using video media that is assisted by Tracker Software, students' conceptual understanding increases. Thus, the teacher can use video media and software to teach physics concepts that can be directly observed and displayed using mathematical and graphical representations.

Keywords: Understanding; motion concept; video based learning; tracker

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INTRODUCTION

Physics is a part of natural science that explains phenomena that occur in the universe and presented with facts, concepts, principles, and laws. Therefore, studying physics at school must emphasize more on the process of extracting the concept so that it can be interesting for the students (Annisa, Lesmono, & Yushardi, 2020). The reality shows different that learning physics in class is more related to formulas and theories written in the handbook. Therefore, students tend to memorize physics concepts and have a low conceptual understanding (Viajayani, Radiyono, & Rahardjo, 2013).

Bloom, Engelhart, Furst, Hill, & Krathwohl (1956) define concept understanding as to the ability to capture ideas such as being able to express a

concept into a more understood form, to provide interpretations, and to apply it. This explains that understanding concepts in physics learning is important to make students learn optimally and be able to get good learning outcomes. Through understanding these good concepts, misunderstandings can be avoided.

The misconception is an effect of a lack of attention to the understanding of physics concepts (Halim, Yong, & Meerah, 2014). It refers to a concept that is not appropriate in scientific understanding or understanding received by experts. Common causes of misconceptions come from various things, such as preconceptions, abilities, stages of development, interests, and ways of thinking (Nirmayanti, J, & Saehana, 2019). Preconception is the concept of physics built by students' selves through informal learning to give meaning in everyday experiences (Suparno, 2013).

Suparno (2013) stated that revealed from 700 studies on physics concepts, and there were 300 of them in mechanics; 159 concerning electricity; 70 about heat, optics, and material properties; 35 about the earth and outer space; and ten studies of modern physics. This shows that mechanics is at the top of the findings of physics misconceptions. The concept of mechanics includes the concept of motion; vector; force, mass, and weight; Newton's Law; Work, conservation of energy and momentum; and fluid mechanics.

Motion is one phenomenon in the concept of mechanics that can be found easily in everyday life. As stated by Firdaus, Setiawan, & Hamidah (2017), kinematics is a concept that takes up a large part of real-world activity. However, this phenomenon is difficult to analyze directly because it occurs quickly, and not much information can be obtained so that students become mistaken in interpreting it (Habibbulloh & Madlazim, 2014).

Tracker Software is a program of video analysis specifically used in physics learning (Agustin, Dirgantara, & Nuryantini, 2017). This software can help students analyze everyday motion phenomena recorded in video media (Giannakos, Sampson, Kidziński, & Pardo, 2016; Gustafsson, 2013). This also facilitates students to interpret the phenomenon of motion around them (Aravind, 2016; Wee, Chew, Goh, Tan, & Lee, 2012).

The novelty in this research is a qualitative study conducted on students who are taught with video media assisted by Trackers Software. In this qualitative study, students' understanding of concepts taught using videos containing free-fall motion and parabolic motion in everyday life aided by a tracker software is described and then analyzed. The percentage of students who understood the concept after using a video-assisted by the tracker software was also determined and discussed. This study analyzes the student understanding in motion concept after video-based learning assisted by the tracker software was applied. The benefit of this research is to provide information about students' conceptual understanding of motion who taught with video media assisted by Trackers Software, as well as providing information that can be used to improve and understand physics learning programs in secondary schools, by the motion concepts.

METHOD

This descriptive research is tried to describe the student understanding of motion concept when video-based learning assisted by Tracker Software applied. This research was conducted in the second semester of 2017/2018 in MIPA 4 class X, SMA Negeri 5 Palu.

The research subjects were all students of class X MIPA 4. The subjects are 30 students. The research location was chosen based on conformity with the research criteria, where students have learned the concept of kinematics motion. Also, preliminary observations with physics teachers were considered in the selection of research locations. The preliminary observations indicate that student learning outcomes are low (seen from daily test scores), so the teacher assumes that students' understanding of a concept is low.

The study was conducted by providing a test of understanding the concept of motion. In addition, student worksheets are also used when practicing using video media assisted by Tracker Software. Interviews were conducted with several students who were chosen to be respondents. In this study, a conceptual understanding of tests and interviews were conducted two times. The first test was done to know the student's initial conception, and the second is to find out the student's understanding of the concept after video-based learning assisted by Tracker Software was done.

The concept understanding test is an open-minded multiple-choice test with the selection of the Certainty Response Index (CRI) scale. The CRI scale used was scale 6 (Salem *et al.*, 1999). The CRI scale is presented in Table 1.

Table 1 The scale of Certainty Response Index (CRI)

CRI	Description
0	*(Totally Guessed Answer)*: if answering the question the percentage of guessing elements 100%
1	(*Almost Guess)*: if answering the question the percentage of guessing elements 75% - 99%
2	*(Not Sure)*: if answering the question the percentage of guessing elements 50% - 74%
3	*(Sure)*: if answering the question the percentage of guessing elements 25% - 49%
4	*(Almost Certain)*: if answering the question the percentage of guessing elements 1% - 24%
5	*(Certain)*: no element of guessing (0%)

Concept understanding test data is made in a matrix form based on a combination of right-wrong answer choices, right-wrong reasons, and high-low CRI scores. Then the determination or classification of students who understand the concept, do not understand the concept, and misconceptions are based on the determination that has been developed by (Hakim, Liliasari, & Kadarohman, 2012). The description of determination students' conceptions is presented in Table 2.

Table 2 Description of determination students' understanding

The Answer	Reason	CRI	Description
Wrong	Wrong	< 2.5	don't know the concept
Wrong	Right	< 2.5	don't know the concept
Wrong	Wrong	> 2.5	Misconception
Wrong	Right	> 2.5	Misconception
Right	Wrong	< 2.5	don't know the concept
Right	Right	< 2.5	Understand the concept, but not sure of the choice of answers
Right	Wrong	> 2.5	Misconception
Right	Right	> 2.5	Understand the concept

RESULT AND DISCUSSION

Student initial understanding

In this study, students who were taught using video-assisted software trackers had never followed the learning

of the concepts of free fall and parabolic motion.

Based on the analysis results, the percentage of students' initial understanding of the concept of parabolic motion was obtained by 1.67%. Meanwhile, the percentage in the concept of free fall motion is 13.33%. The results of the initial understanding analysis can be seen in Table 3.

Table 3 Analysis of student initial understanding (Before video based learning assisted by tracker software applied)

Concept	Understand the concept (%)	Don't know the concept (%)	Misconception (%)
Parabolic Motion	1.67	41.67	56.67
Free fall Motion	13.33	50.00	36.67

Based on this data, it is known that the students' initial conceptual understanding of motion is low, both in the concept of parabolic motion and free-fall motion. The reasons for the lack of understanding of the concept were explored at the time of the interview. The initial interview shows the cause of the misunderstanding due to students' initial preconceptions that are wrong and problems of understanding, as shown in Figure 1 (problem number 1 in Figure 2).

Kutipan wawancara dengan R-11 (Versi Bahasa Indonesia)

Peneliti	:	Perhatiakan grafik pada nomor 1! Grafik mana yang merupakan grafik kecepatan terhadap waktu untuk suatu benda yang mengalami gerak vertikal ke atas?
Responden	:	Bagian A.
Peneliti	:	Mengapa memilih A?
Responden	:	Kalau setahu saya, GLBB, itu gerak vertikalnya yang ke atas. Benda itu bergerak vertikal ke atas, kecepatannya diperlambat. Jadi, grafiknya mengarah ke bawah.
Peneliti	:	Bagaimana dengan pilihan B?
Responden	:	Kalau B itu kecepatanya yang tinggi dan akhirnya perlahan berhenti
Peneliti	:	Bagian C, bagaimana?
Responden	:	Itu yang semakin cepat kak. Semakin jauh, semakin cepat.
Peneliti	:	Kalau bagian D atau E?
Respondent	:	Kalau bagian D kayaknya sama dengan B. Kalau E, saya tidak tahu.

Interview quote with R-11 (English Version)

Researcher	:	Pay attention to the graph at number 1! Which graph is a velocity graph against time for an object experiencing vertical upward motion?
Respondent	:	Part A.
Researcher	:	Why choose A?
Respondent	:	As far as I know, GLBB, that is vertical upward motion. The object is moving vertically up, the speed is slowed. So, the graph is pointing down.
Researcher	:	What about choice B?
Respondent	:	If B is a high speed and finally slowly stops
Researcher	:	Part C, how?
Respondent	:	That is getting faster. The further away, the faster.
Researcher	:	What about parts D or E?
Respondent	:	If part D is the same as B. For E, I don't know.

Figure 1 Interviewed transcript before the treatment

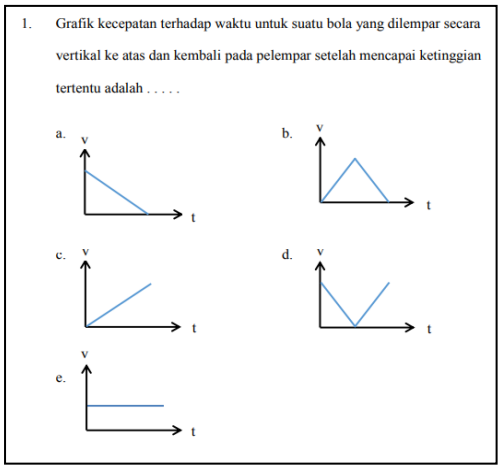

Figure 2 Problem number 1

Applying video based learning assisted by Tracker Software

Video-based learning assisted by tracker software was done about three times to the student. In this study, the student analyzes the video about the motion by using tacker software. The analysis result shows the relation between the parameter in the motion (Richtberg & Girwidz, 2019). The video analysis by using tracker was shown in Figure 3. Figure 3 shows the results of the parabolic video analysis with tracker software. The velocity of the object in the vertical direction (vy) has the lowest

value (zero) when it is at the peak shown in the figure.

Figure 3 Video analysis using tracker software for parabolic motion

Student understanding after video based learning assisted Tracker Software applied

From the data in Tables 3 and 4, it can be seen that students' understanding of the concept of parabolic motion has increased from 1.67 to 18.33%. On the other hand, students' understanding of the concept of free fall motion also increased from 13.33% to 68.33%. The results of the analysis of student understanding after using video media assisted by Tracker Software can be observed in Table 4.

Table 4 Student understanding after using video based learning assisted by tracker software

Concept	Understand the concept (%)	Don't know the concept (%)	Misconception (%)
Parabolic Motion	18.33	28.33	53.33
Free fall Motion	68.33	26.67	5.00

Tabel 4 shows student understanding of the free-fall motion concept was better than the understanding of the parabolic motion concept. It may cause the phenomenon is more usual in their daily life. The results obtained in this study are in line with the findings of Susanti et al. (2018).

On the other hand, video-assisted Tracker Software to reduce the lack of concept and misconception. This happens through observation of the phenomena displayed by the video and then analyzed using tracker software. Thus, students can add knowledge and correct wrong concepts. However, the decreasing of misconceptions in the parabolic motion concept was not significant.

The interview about problem number 1 (Fig. 2) was also done after the treatment using video-based learning, and it was found that the student understanding was increased, as shown in Figure 4.

Kutipan wawancara dengan R-11 (Versi Bahasa Indonesia)

Peneliti	:	Grafik mana yang menunjukkan hubungan kecepatan terhadap waktu pada benda yang mengalami gerak parabola, jika ditinjau dari arah vertikalnya?
Responden	:	Pada saat praktek yang D.
Peneliti	:	Alasannya?
Responden	:	Kalau gerak parabola itu, pertama bendanya dilempar jadi kecepatannya berkurang. Semakin bendanya ke atas semakin melambat, sampai akhirnya mencapai titik tertinggi dimana kecepatannya nol. Setelah itu kecepatannya bertambah lagi menjadi lebih cepat sampai menyentuh tanah.
Peneliti	:	kalau grafik A, B, C dan E?
Responden	:	Saya lupa kak.

Interview quote with R-11 (English version)

Researcher	:	Which graph shows the relationship of speed to time in objects undergoing parabolic motion, if viewed from the vertical direction?
Respondent	:	At the time of practice that is D.
Researcher	:	The reason?
Respondent	:	If the satellite dish moves, first the object is thrown so the speed decreases. The more the object is going up the slower, until finally reaching the highest point where the speed is zero. After that the speed increases even faster until it hits the ground.
Researcher	:	What about graphs A, B, C and E?
Respondent	:	I forgot.

Figure 4 Intervied transcript before the treatment

According to Halim et al. (2014), the cause for the misconception is some students still maintain the wrong initial understanding, students do not know how to interpret the graph correctly, and there are mistakes when analyzing the Tracker Software. Also, misunderstanding is also caused by the appearance of unclear analysis results in the Tracker Software, and the lack of student attention when doing practical work.

Before and after using the video-based learning assisted by Tracker Video, students in the category of misconceptions generally have initial false preconceptions and maintain these conceptions. This explains that initial student concepts greatly influence students' understanding of concepts in the future. As stated by Suparno (2013), conceptual understanding is influenced by initial preconceptions, abilities, stages of development, interests, and ways of thinking. This research fo but is more likely to be in students' initial preconceptions.

CONCLUSION

The study of analyzing the use of video-based learning assisted Tracker Software has been done. Understanding of student concepts has increased both in the concept of free fall and parabolic motion. On the other hand, the number of students who do not understand concepts and misconceptions has decreased. This is because video analysis with tracker software can help students in learning, especially understanding physical quantities such as position and speed.

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