Analysis of student’s conceptual understanding on the work and energy of online hybrid learning

I Zulfa1,a, S Kusairi1,b, E Latifah1,c, and M N R Jauhariyah2,d

1 Physics Education Program Study, Graduate Program, Universitas Negeri Malang, Indonesia
2 Physics Education Program Study, Physics Department, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, Indonesia

E-mail: a indinazulfa94@gmail.com, b sentot.kusairi.fmipa@um.ac.id,
ceny.latifah.fmipa@um.ac.id, d mukharryotinjauhariyah@unesa.ac.id

Abstract. Conceptual understanding is needed for students to build correct knowledge. This study aims to identify the student’s understanding of work and energy concepts in online hybrid learning. This research is a quantitative research by using descriptive method (descriptive-quantitative) that in the data analyzing using amount of size or frequency. The results showed the understanding of the students' initial concepts on the work and energy as a whole including in the sufficient category. Besides, it is obtained that students are adept at using mathematical formulas to do work and energy, but still difficult to understand the concept of physics. The results of the analysis also showed that students responded well to online hybrid learning.

1. Introduction
The rapid development of information and communication technology encourages various educational institutions to utilize online learning system. Online learning answers the weaknesses of traditional teaching which requires face-to-face teaching that requires a lot of time and is less flexible [1]. But, the most significant complaints directed at online courses are the lack of students-teacher interaction [2] and the loss of a sense of community [3]. Some researchers not only applied online learning system [1,4,5], but also developed online assessment used website [6-9] or even used a formative assessment based mobile learning approach to improve the student’s learning attitudes and achievements [10]. Gok find that the paper-based homework did not lead to difference in conceptual learning, but there was a significant difference in students’ homework performance in favor of the web-based homework group [11]. To overcome complaints against online learning and strive to improve student performance in today's learning using online learning, hybrid learning was developed.

Online hybrid learning is a combination of face-to-face learning in the classroom with online learning using the internet or so-called e-learning [1]. Online hybrid learning can improve the effectiveness and flexibility of learning [12,13]. Although some studies show that the effectiveness of learning using online hybrid systems tends to be the same when compared with conventional or classical learning, but the advantages that can be obtained with e-learning is in terms of flexibility [8,11]. Through online hybrid learning, materials can be accessed anytime and anywhere [12]. Teachers have more time to interact with students, besides that the material can be enriched with various learning resources and can be updated quickly by teachers [14]. The availability of online discussion in the learning process is very helpful to overcome the students difficulties often faced [12].
The use of online hybrid learning can be an effective tool in physics learning [15-16]. Physics teaching with problem-based hybrid learning can effectively improve the critical thinking skills of students of SMAN 1 Singaraja [17]. Online hybrid learning helps teachers explain learning materials in more detail. Especially in complex materials such as work and energy [18]. Online hybrid learning can also be used to evaluate students' conceptual understanding [19]. This can make it easier for teachers to know the level of student's understanding concepts. Understanding concepts is an important element in physics learning. Students with good conceptual understanding will have the ability to solve problems well [20]. Identifying which concepts and theories students learn well, and with which they have difficulties, can guide teaching and curriculum development [21].

Based on the description of the importance of student's understanding concept, this paper will describe students' understanding concept of work and energy in online hybrid learning. This study is expected to provide an overview of students' conceptual understanding of work and energy.

2. Research Methods

This research used descriptive-quantitative analysis, that is a quantitative research by using descriptive method when analyze the data using amount of size or frequency. Descriptive research is a method that aims to describe or give an overview of the object under study through data or samples that have been obtained [22]. Descriptive-quantitative analysis is performed to describe data in the form of numbers, the data analyzed in this study are scores obtained by students from the initial knowledge check, quiz 1, and quiz 2. The research subjects used consisted of 29 students of SMAN 1 Bangkalan. Data collection is carried out in the even semester of 2017/2018. Learning applied to students is online hybrid learning on work and energy materials, students do face-to-face learning in the classroom along with online learning or e-learning.

E-learning used in this study is moodle. Moodle in design resembles the order of the way the teacher teaches with formative assessment. There are several things in moodle that enable students to build their knowledge such as questions to check students' initial knowledge, learning materials of work and energy quizzes, discussion forums, self-assessments and various learning videos that can support students' knowledge (see Figure 1).

Understanding the concept of students can be seen in the answers to the questions on the initial knowledge check, quiz 1 and quiz 2. Before the learning in the classroom begins the teacher instructs the students to open the moodle and do initial checks on the knowledge they have. Preliminary knowledge checking questions consist of 5 true-wrong questions. From these activities teachers can know the difficulties experienced by students, so that teachers can respond to student difficulties appropriately during the learning process in the classroom.

After the students carry out the learning, students are directed to complete the quiz questions contained in the moodle in accordance with the time specified. The quiz consists of quiz 1 and quiz 2 each containing 5 multiple choice questions. Quiz 1 contains about the matter of work while the quiz 2 contains the matter of energy (see appendix).

After implementing the learning, students are given a questionnaire to find out the student's response to the learning experience using hybrid online. The questionnaire consisted of 2 sections, the first part of the students directed to respond to the statement by using the scale option 1 to 5. While in the second part is the essay-shaped questionnaire.

Data obtained from initial knowledge checks, quiz 1, quiz 2, and first section questionnaire scores were analyzed on a quantitative basis. Any student answers on quiz 1 and quiz 2 will count the correct answers and wrong answers. The wrong and correct score is then made in percentage with the help of excel, then calculated the average score for each student on quiz 1 and quiz 2 as well as the average score of the questionnaire obtained by the student, so that can be seen the level of understanding concept.

Data analysis techniques refer to the formula [23], namely: 

\[
\% = \frac{\text{getting score}}{\text{maximum score}} \times 100\% 
\]

The percentage calculation is then categorized by Table 1.
Figure 1. Some features in Moodle that enable students to build their knowledge.

| Percentage (%) | Criteria  |
|----------------|-----------|
| ≥85            | Very Good |
| 70-85          | Good      |
| 55-70          | Enough    |
| 40-55          | Less      |
| ≤40            | Very Less |

3. Results and Discussion

The results of the student's answer analysis on the initial knowledge check, can be seen in Table 2, from the analysis can be seen the tendency of choice of student answers on each question.

| Material | Number of item test | The percentage summation of students answer (%) | The percentage average of true answer (%) |
|----------|---------------------|-----------------------------------------------|------------------------------------------|
| Work     | 1                   | True  | False | Do Not Answer | Total percentage |
|          |                     | 65.5  | 27.6  | 6.9            | 58.6             |
|          | 2                   | 51.7  | 41.4  | 6.9            |                  |
| Energy   | 3                   | 93.1  | 0     | 6.9            | 71.3             |
|          | 4                   | 65.5  | 27.6  | 6.9            |                  |
|          | 5                   | 55.2  | 37.9  | 6.9            |                  |

Total percentage | 64.9
The percentage of the students' lowest correct answers on work material is in question number 2 which is 51.7%. The following statement on problem 2 "Roni pushed the cabinet very heavy with all his strength, but the cabinet did not shift at all. From the event, Roni can be said to make efforts against the closet". Some students consider the statement to be true, but the statement is false. A person is said to make an effort in physics if the object given by that person's style is displaced. Students are still struggling to understand the different concepts of work in physics with the concept of work in everyday life.

The percentage of students' lowest correct answers on energy matter is in question number 5 which is 55.2%. The following statement on question number 5 "Genset Engine can create electrical energy". Some students assume that the statement is true, but the statement is false. Under the law of conservation of energy that energy can not be destroyed or created, energy can only be changed from one form to another. So the genset machine does not create energy, but converts mechanical energy into electrical energy. The low percentage of answers in this statement indicates that students are still having trouble understanding energy conservation laws.

The overall percentage of mastery of students' concepts on work material and energy is 64.9%, it indicates that the mastery of students' concept on work material and energy is still included in the sufficient category.

Further analysis of student answers on quiz 1 and quiz 2 can be seen in Table 3.

| Material     | Number of item test | The percentage summation of students answer (%) | The percentage average of true answer (%) |
|--------------|---------------------|-------------------------------------------------|------------------------------------------|
| Quiz 1 (Work)| 1                   | 100                                             | 0                                        |
|              | 2                   | 100                                             | 0                                        |
|              | 3                   | 100                                             | 0                                        |
|              | 4                   | 100                                             | 0                                        |
|              | 5                   | 100                                             | 0                                        |
| Quiz 2 (Energy)| 1               | 96.5                                            | 3.4                                      |
|              | 2                   | 96.5                                            | 3.4                                      |
|              | 3                   | 93.1                                            | 3.4                                      |
|              | 4                   | 96.5                                            | 3.4                                      |
|              | 5                   | 93.1                                            | 3.4                                      |

The results of this analysis indicate that almost all students choose the correct answer, even all students answered correctly in the first quiz that discusses the work material. This happens because students have received learning materials and energy both in the classroom and using e-learning. Besides the question on quiz 1 only contains a matter of the count that can be solved by the formula. Here are the questions on quiz 1 and quiz 2 (appendix).

Based on the exposure can be seen that almost all students proficient using mathematical formulas in answering the matter of physics. The average analysis of the first section of the questionnaire can be seen in Table 4.

Based on the results of the analysis can be seen that students provide a fairly good response to learning using hybrid online. This can be seen from the score percentage of the overall response of students amounted to 67.01%, this value belongs to the category quite well.

From the analysis of the students' answers to the essay questionnaire, it is stated that some students do not really use e-learning, some students argue that learning is better done face-to-face, they also argue that the explanation and command of e-learning usage is still less clear, students are confused, this is what caused the student's response is still categorized enough.

However, some students also argue that online hybrid learning has several advantages such as new learning methods, learning time that is used more flexibly, can explain physics concepts that are difficult to explain without using media, follow the modern era, and include everything from literature, learning videos, questions, and more.

Students also respond that learning using hybrid online needs to be developed in other lessons not only in physics to more easily understand the concepts and time spent in learning more flexibly.
Table 4. The percentage of students responses about online hybrid learning

| Statement                                                                 | Percentage (%) |
|---------------------------------------------------------------------------|-----------------|
| The idea of using physics learning with an online hybrid is a good idea to help students learn physics                      | 56.7            |
| The idea of using physics learning with online hybrids caused to improve my study time in physics lessons                   | 60.0            |
| With the study of physics with online hybrid, I became excited to attend physics lessons                                     | 56.7            |
| With the learning of physics using hybrid online I can know the difficulty of learning that I have                           | 76.7            |
| When the results of the problem on my e-learning is bad, I am moved to prepare myself for learning                          | 93.3            |
| The problem I encountered in working on the matter was to encourage me to discuss and ask the teacher                        | 76.7            |
| Learning with hybrid online is useful to overcome the difficulty of learning physics                                        | 63.3            |
| Video in e-learning helped me deepen the concept of physics                                                               | 73.3            |
| Videos in e-learning are easy to understand                                                                               | 56.7            |
| I really use video in e-learning to learn                                                                                | 56.7            |
| **Total percentage (%)**                                                 | **67.01**       |

Based on the analysis that has been done can be seen that most students are adept at using mathematical formulas to solve work and energy problems, while students are still difficult to understand the concept. The results of this study in accordance with the results of research conducted by Kim & Pak that students consider physics is a collection of numbers with no physical meaning, so that many students are mathematically advanced physics without mastering the concept [24].

Some things that can lead students to be proficient in using mathematical formulas but still difficult to understand the concept of physics such as students only focus on the learning process is just oriented to exercise questions [25]. In addition, students are not much involved in the process of constructing a concept in their mind [26].

The weakness of this research lies in conducting research. The time used for research is very short i.e. 2 weeks so it does not give a big impact on students’ concept understanding. In addition the instructions used to direct students to access online learning are still less clear. Suggestions for further research is necessary to do research with a long time span so that the effects of treatment can be seen clearly. Giving orders using e-learning must be specified so the students not confuse.

4. Conclusion
Based on the results of the analysis and discussion, it can be concluded that the student’s understanding of work and energy as a whole produces an average of 64.9% and included in the category enough. Besides, it is obtained that students are adept at using mathematical formulas to solve the problems of work and energy, but still difficult to understand their physical concept. In addition, students provide a fairly well-responded response to online hybrid learning.

References
[1] Potter J 2015 *J. Instructional Pedagog*. 17 1.
[2] Fann N 2001 *Bus. Educ. Forum* 46.
[3] James M 2001 *Bus. Educ. Forum* 56.
[4] Liaw SS 2008 *Comput. Educ.* 51 864.
[5] Ivleva NV and Fibikh EV 2016 *IOP Conf. Ser. Mater. Sci. Eng.* 122 012008.
[6] Dahalan HM and Hussain RMR 2010 *Procedia-Soc. Behav. Sci.* 9 244.
[7] Demirci N 2006 *TOJDE* 7 105.
[8] Bonham SW, Titus A, Beichner RJ, and Martin L 2000 *J. Res. Comput. Educ.* 1 1.
[9] Wang TH 2018 *Eurasia J. Math. Sci.. Tech. Educ.* 14 1791.
[10] Hwang GJ and Chang HF 2011 *Comput. Educ.* 56 1023.
[11] Gok T 2011 *Int. J. Phys. Sci.* 6 3778.
[12] Sukawijaya I MG and Sudiarta IGP 2018 *J. Phys.: Conf. Ser.* 1040 012030.
[13] Kurniawati IL, Amarlita DM, and Iskandar SM 2015 *Bimafika: J. MIPA, Kependidik. Terap.* **7** 793.
[14] Karabulut-Ilgu A & Jahren C 2016 *Adv. Eng. Educ.* **5** 1.
[15] Sadaghiiani HR 2011 *Phys. Rev. Spec. Top.- Phys. Educ. Res.* **7** 010102-1.
[16] Demirci N 2010 *TOJET* **9** 156.
[17] Sujanem R, Poedjiastuti S, and Jatmiko B 2018 *J. Phys.: Conf. Ser.* **1040** 012040.
[18] Ornek, Funda, Robinson RW, Haugan PM 2008 *Int. J. Environ. Sci. Educ.* **3** 30.
[19] Wang TH 2008 *Comput. Educ.* **51** 1247.
[20] Silaban B 2014 *J. Penelit. Bid. Pendidik.* **20** 65.
[21] Zuza K, Cock MD, Kampen PV, Bollen L, Guisasola J 2016 *Eur. J. Phys.* **37** 065709.
[22] Sugiyono 2013 *Metode Penelitian Kuantitatif, Kualitatif, dan R&D* (Bandung: Alfabeta)
[23] Arikunto S 2015 *Dasar-dasar Evaluasi Pendidikan Edisi 2* (Jakarta: Bumi Aksara)
[24] Kim E and Pak SJ 2002 *Am. J. Phys.* **70** 759.
[25] Usman *J. Sains Pendidik. Fis.* **8** 1.
[26] Husein S, Herayanti L and Gunawan 2015 *J. Pendidik. Fis. Tekno.* **1** 221.
Appendix

Item test for Quiz 1

1. Sebuah balok bermassa 1 kg di atas lantai licin. Jika gaya mendarat 2 N digunakan untuk menarik balok, maka tentukan usaha yang dilakukan agar balok berpindah sejauh 3 m!

Select one:
- a. 6 Joule
- b. 3 Joule
- c. 4 Joule
- d. 2 Joule
- e. 8 Joule

2. Sebuah balok ditarik oleh gaya sebesar 120 N yang membentuk sudut 37° terhadap arah horizontal. Jika balok bermassa sejauh 10 m, tentukan usaha yang dilakukan pada balok!

Select one:
- a. 960 Joule
- b. 940 Joule
- c. 900 Joule
- d. 980 Joule
- e. 920 Joule

3. Sebuah lemari dengan berat 50 kg di dorong dengan gaya 20 N. Hitung usaha yang bekerja pada lemari jika lemari berpindah sejauh 25 m!

Select one:
- a. 200 Joule
- b. 350 Joule
- c. 300 Joule
- d. 500 Joule
- e. 400 Joule

4. Sebuah balok bermassa 10 kg ditarik dengan gaya 50 N sehingga berpindah sejauh 10 m. Jika α = 60° dan gesekan antara balok dan lantai dialikan, berapakah usaha yang dilakukan gaya tersebut?

Select one:
- a. 350 Joule
- b. 250 Joule
- c. 300 Joule
- d. 400 Joule
- e. 200 Joule
Sebuah benda diberi gaya dari 3 N hingga 8 N dalam 5 sekon. Jika benda mengalami perpindahan dari keududukan 2 m hingga 10 m, seperti pada grafik, maka tentukan usaha yang dilakukan!

Select one:
- a. 44 Joule
- b. 49 Joule
- c. 56 Joule
- d. 50 Joule
- e. 45 Joule

Item test for Quiz 2

Seorang anak yang massanya 40 kg berada di lantai 3 sebuah gedung pada ketinggian 15 m dari atas tanah. Hitung energi potensial anak jika sekarang anak tersebut berada di lantai 5 dan berada 25 m dari atas tanah!

Select one:
- a. 12000 Joule
- b. 6000 Joule
- c. 2000 Joule
- d. 20000 Joule
- e. 10000 Joule

Peluru yang massanya 500 gram di tembakkan sehingga peluru bergerak dengan kecepatan 10 m/s. Tentukan energi kinetik peluru tersebut !

Select one:
- a. 25 Joule
- b. 30 Joule
- c. 250 Joule
- d. 300 Joule
- e. 350 Joule
Sebuah benda bermassa 10 kg bergerak dengan kecepatan 20 m/s. Dengan mengabaikan gaya gesek yang ada pada benda. Tentukan perubahan energi kinetik jika kecepatan benda menjadi 30 m/s!

Select one:
  a. 3000 Joule
  b. 2000 Joule
  c. 3500 Joule
  d. 4000 Joule
  e. 2500 Joule

Sebuah mobil bermassa 5.000 kg sedang bergerak dengan kelajuan 72 km/jam mendekati lampu merah.

Tentukan besar gaya pengereman yang harus dilakukan agar mobil berhenti di lampu merah yang saat itu berjarak 100 meter daripada mobil! (72 km/jam = 20 m/s)

Select one:
  a. 100 N
  b. 1000 N
  c. 10000 N
  d. 100000 N
  e. 1000000 N

Benda 10 kg hendak digeser melalui permukaan bidang miring yang licin seperti gambar berikut!

Tentukan usaha yang diperlukan untuk memindahkan benda tersebut!

Select one:
  a. 600 Joule
  b. 300 Joule
  c. 1200 Joule
  d. 900 Joule
  e. 1400 Joule