The Effects of Web-Assisted Problem Based Learning Model of Physics Learning on High School Students' Critical Thinking Skills

IOP ebooks™

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the collection - download the first chapter of every title for free.

The Effects of Web-Assisted Problem Based Learning Model of Physics Learning on High School Students' Critical Thinking Skills

Rahma Ghalda Alandia[*]**, Jumadi, Insih Wilujeng, and Heru Kuswanto**
Postgraduate Physics Education, Yogyakarta State University, Indonesia

*E-mail: ghaldaalandia@gmail.com

Abstract. The purpose of this research is to determine differences in critical thinking skills outcomes between groups with students who take physics learning with web-assisted problem based learning model with students who take physics learning using learning commonly used by teachers to student of XI class. This research was a quasi-experimental (quasi experiment) with the draft "post-test only control group design". The population in this study is a XI class of even semester in SMA Negeri 2 Yogyakarta, Indonesia. The sample selection is based on the adjustment of the material that is used. The data were taken using the test methods and instruments used for assessment is 8 essay questions with 8 indicators of critical thinking skills tests. Based on the results of hypothesis testing that has been done by t-test sample independent found that there are differences in critical thinking skills outcomes significantly among students who take physics learning with web-assisted problem based learning model. Furthermore, there are effects web-assisted problem based learning model in students' critical thinking skills. This is evident from the high effect size of Cohen's test is included in the high category. Based on this it can be concluded that physics learning with web-assisted problem based learning model influence on high school students critical thinking skills outcomes.

 Keywords: Problem based learning; Web-assisted; Critical thinking skills.

1. Introduction

Learning is an interaction between students and teachers, where there is direct communication in order to achieve certain goals. Learning to be more effective and efficient needs to use in creative and innovative learning models so that learning does not seem monotonous and boring. Monotonous and boring learning can obstruct the process of transferring knowledge from teacher to students. The learning model that can be used is a problem based learning model. The PBL process starts with the presentation of the problems, which students must first understand and interpret in order to get information and knowledge to get solutions from the questions [1]. When using problem-based learning, the teacher encourages students to be involved in learning by solving the problems in real-world contexts and relates them to the material or concepts.

According to 2014, UU Number 59 states that physics is (1) the process of obtaining information with the empirical method; (2) information obtained through investigations that have been arranged logically and systematically; and (3) a combination of critical thinking processes that produce reliable and valid information. Physics is one of the subjects taught at the senior high school, which is useful for developing abilities, one of them is in the ability to think critically. The model that can be used to

improve critical thinking skills is the Problem Based Learning model (PBL). PBL is a learning model that requires students to think critically about a subject by facing real-world problems. PBL is more effective than conventional learning in terms of students' critical thinking skills.[2]

Advancement in science and technology has helped the teaching and learning process. The use of information technology in learning has become a demand. One of technology that can be utilized is the internet. Computer and internet network technology provides benefits for users to do written communication and remote communication. The teacher could design his course with the latest methods and applying them to technology [3]. So that learning will be better. In addition, participants indirectly increase students' skills to use the latest technology [4].

Physics learning is more appropriate if implemented in the natural surroundings directly, but in practice, there are limitations such as limited time available. In studying optical material, teachers need tools to explain the material more clearly to students. Learning media are effective if the learning media can make students enjoy so that students more easily understand the material. Learning media will be better if using technology in accessing information needed by students [5].

Learning media that can be used as learning media using internet technology. Internet-based learning media that can be used is a web. Web-assisted learning media are useful to help the effectiveness of the learning process in improving messages and content. Web-based education technology can contribute to students learning becomes more flexible by choosing the right learning model [6]. So the application of web with problem-based learning (PBL) is considered to be the right choice. Web-assisted learning also has a positive impact when used in conjunction with the Problem Based Learning model. Web-assisted learning media can be used by teachers because it can display other than text, but also display videos to clarify the material [7].

Based on the background above, there is a need for a depth study of the application of physics learning problem based learning model web-assisted in the physics learning process, through an experimental study entitled " The Effects of Web-Assisted Problem Based Learning Model of Physics Learning on High School Students' Critical Thinking Skills ".

The rest of this paper is organized as follow: Section 2 describes the proposed research method. Section 3 presents the obtained results and following by discussion. Finally Section 4 concludes this work.

2. Research Method

This research uses quasi experimental design method (quasi experimental research), since not all variables (symptoms that appear) and experimental conditions can be regulated and controlled. The decision to conduct the research during Semester 2 of the 2017/2018 academic year was for the purpose of making the physics course fit with the material used in the research. The research was conducted at SMAN 2 Yogyakarta which is located at Jalan Bener, Tegalrejo, Yogyakarta. The subjects of this study were students of class XI MIPA 3 and XI MIPA 7 even semester 2017/2018 school year SMAN 2 Yogyakarta. Class XI MIPA 3 as a control class and XI MIPA 7 as an experimental class.

2.1 Research Design

The research used a quasi-experimental research Posttest-Only Control Design. In this design, there are two groups, which is chosen randomly (R). The form of research design can be described in the following Table 1.

Table 1. Research design

Group	Treatment	Post-test
Experimental	X_1	O_1
Control	X_2	O_2

Where:

X_1 : Learning treatment in the form of web-assisted problem based learning model in the experimental group

X_2 : Learning treatment in the form of usual course used by the teacher in the control group

O_1 : test in the experimental group

O_2 : test in the control group

In this research, involves two variables, that is independent variable and dependent variable. The independent variable is physics learning with web-assisted problem based learning model in the experimental group and the control group (learning with the usual course used by the teacher. The variable dependent is the results of students' critical thinking skills in class XI MIPA.

2.2 Data Collection Techniques

The research used test methods for data collection. Instrument test which is used to obtain data about critical thinking skills in this study is a developmental test adapted to indicators of critical thinking skills. The form of the test is an essay. To ensure the content validity of the critical thinking skills test is done by compiling the question plan so that 8 questions are compiled with 8 indicators of critical thinking skills. In maintaining content and construct validity held by assessing the test to two expert lecturers in their fields, while for the validity of items held with statistical testing.

2.3 Data Analysis Techniques

The methods in data analysis are:

1) Test the normality of data distribution aims to find that the sample actually comes from a sample that is normally distributed so that the hypothesis test can be done. This test is using SPSS 19.0 program with Kolmogorov Smirnov.

2) Precondition test consisting of:

This homogeneity test is to find the level of two-side homogeneity taken from separate groups from one population, namely the control group and the experimental group.

3) Hypothesis Test

The hypothesis tested statistically can be formulated as follow:

$$H_0: \mu_1 = \mu_2 \text{ versus } H_1: \mu_1 \neq \mu_2$$

If it is proven that both samples are normally distributed and come from a population with a homogeneous variation, then the t-test analysis (t-test) is used with a significance level of 5%. Decision making or testing criteria if:

Significance >0.05 then H_0 is accepted
Significance <0.055 then H_0 is rejected

If data from the homogeneous population, then the test is independent sample t-test used SPSS 19.0 program with the hypothesis:

H_0= there is no difference in the results of critical thinking skills that are significantly between students who take learning using web-assisted problem-based learning model in physics learning with students that using learning commonly by teachers in students of class XI SMAN 2 Yogyakarta.

H_i= there is a difference in the results of critical thinking skills that are significantly between students who take learning using web-assisted problem-based learning model in physics learning with students that using learning commonly by teachers in students of class XI SMAN 2 Yogyakarta.

4) Determine the amount of effect

The purpose of this research to know how much the effect of web-assisted problem based learning model in physics learning on students' critical thinking skills at class XI of SMAN 2 Yogyakarta, Indonesia. Using effect size to determine there is an effect of a variable to another variable. The formula is:

$$d = \frac{\bar{X}_t - \bar{X}_c}{S_{pooted}} x100\% \tag{1}$$

To calculate S_{pooted} (S_{gab}) is based on the following formula:

$$S_{pooted} = \sqrt{\frac{(n_1-1)Sd_1{}^2 + (n_2-1)Sd_2{}^2}{n_1+n_2}} \tag{2}$$

3. Results and Discussion

This study was conducted in 2 classes, namely the experimental class and the control class. Experimental classes are classes that use web-assisted learning. The material used is optics. On the web contains learning materials equipped with learning videos, practicum sheets and exercise question that contains critical thinking. The example of contents that used in the web are depicted in Figure 1:
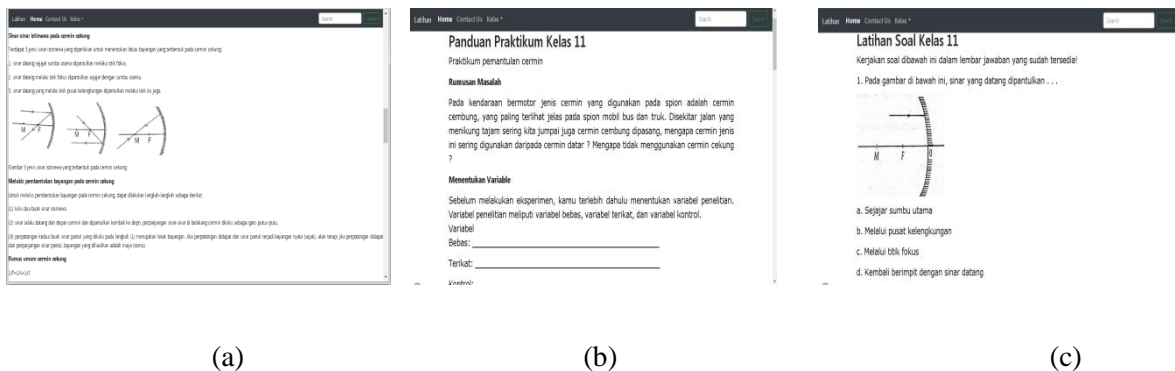

| (a) | (b) | (c) |

Figure 1. (a) materials, (b) practicum sheets, (c) exercises question

The results of the research data are the results of tests of students' critical thinking skills. Test execution was after students carried out the physics learning model of web-assisted problem based learning. The results of the study are presented in Table 2.

Table 2. Test results of critical thinking skills

Component	Experiment	Control
Number of students	27	27
Average	91	80
Highest score	100	96
Lowest Score	81	58

The critical thinking ability test has 8 indicators. To see in detail the test results of each indicator of critical thinking skills are presented in Figure 2.
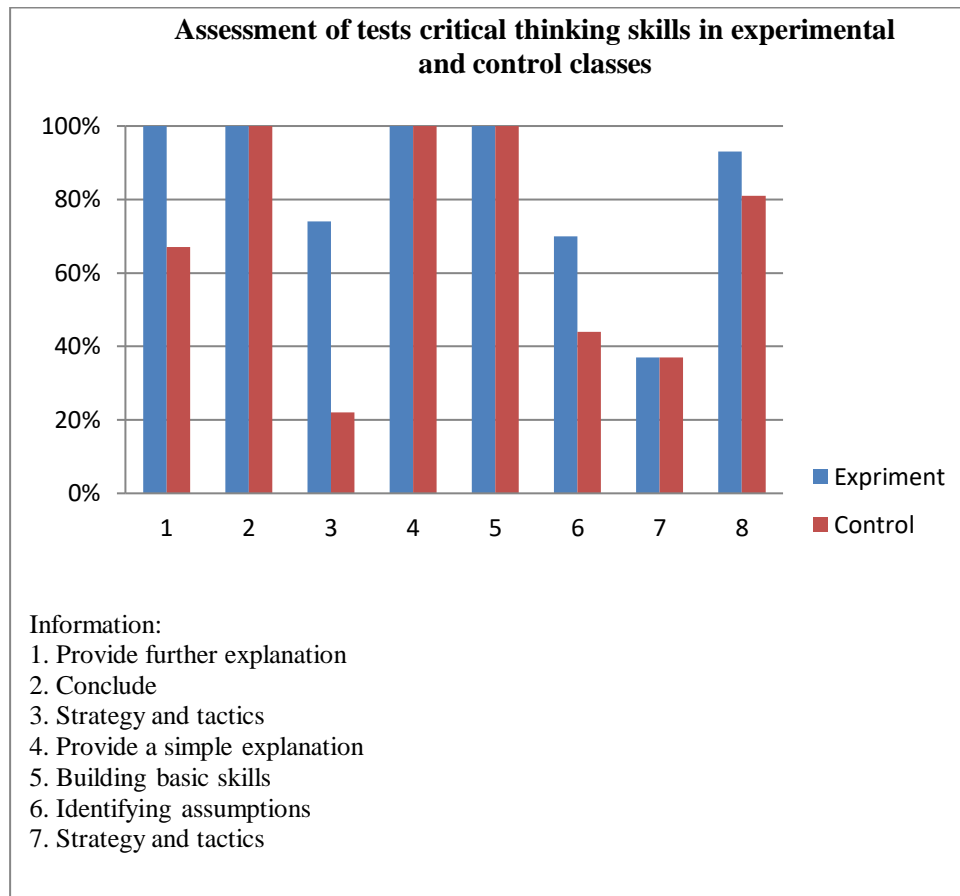
Figure 2. Results Students' critical thinking skills

In order for this research data to be analyzed by inferential statistics in this case, the analysis technique is t test, the data must first fulfill some statistical assumptions. The statistical assumption used in this study is (a) test the normality of data distribution and (b) variant homogeneity test. Normality test is done by testing whether an empirical distribution follows the characteristics of normal distribution or investigates that f_0 (observation frequency) from the symptoms investigated did not deviate significantly from f_h (frequency of hope) in normal theoretical distribution. Data normality test was performed on the results of the test results of the critical thinking abilities of the experimental group and the control group. According to the results of the normality test obtained at significance level 0.081. Because of Sig (0.081>0.05) so the data is normally distributed. The homogeneity of the data was analyzed with a significance level of homogeneous data criteria if the value Sig>0.05. Based on the test results obtained at significance level 0.079. Because of Sig (0.079>0.05) then the data is homogeneous.

Based on these results, since the data were homogeneous, then we carried out *t*-test using an independent sample *t*-test. The test was using the SPSS 19.0 software application to find significant value. The results is significance value or Sig.(2-tailed) 0.00 which has significance value (0.00)< (0.05). Conclusions can be drawn H_o was rejected and H_i was accepted which has meant there are significant differences in the results of critical thinking skills between students who take courses using web-assisted problem based learning model with students who take the course using learning commonly used by teachers in students of class XI of SMAN 2 Yogyakarta.

To determine whether there is an effect of learning by using learning web-assisted problem based learning model has an effect on the critical thinking skill of students in class XI of SMAN 2

Yogyakarta, the Cohen's effect size calculation is used. The Calculation results obtained are 1.3 and can be interpreted according to Table 3 that there is a high effect.

Table 3. Criteria Interpretation of Cohen's values d

Cohen's Standard	Effect Size	Percentage (%)
	2.0	97.7
	1.9	97.1
	1.8	96.4
	1.7	95.5
High	1.6	94.5
	1.5	93.3
	1.4	91.9
	1.3	90
	1.2	88
	1.1	86
	1.0	84
	0.9	82
	0.8	79
	0.7	76
Medium	0.6	73
	0.5	69
	0.4	66
	0.3	62
Low	0.2	58
	0.1	54
	0.0	50

Based on the Table 3 above, it can be concluded that physics learning using web-assisted problem based learning model influences students' critical thinking skills in class XI of SMAN 2 Yogyakarta with higher criteria. Learning that is supported by appropriate media selection can encourage students to be involved in learning [8]. One of the media that can be used is web media. Web-assisted learning media are needed to facilitate and help students in learning Physics [9]. There is a benefit of web-assisted physics learning that can encourage physics learning activities [10].

One of the benefits of learning to use the web is that it can improve students' critical thinking skills. The improvement of critical thinking skills gained by the group of students is also due to the use of problem based learning learning models [11]. The application of the problem based learning model can improve critical thinking skills [12]. In learning to use problem based learning models, students are actively involved in learning by connecting concepts/material learned with daily events. In addition, students are invited to solve the problems given by the teacher. Another benefit of problem based learning model learning is that teachers can avoid boredom and create a pleasant atmosphere [13]. Students are also invited to conduct experiments to prove a theory. So it is expected that students are not sleepy and bored when learning and the material being studied can be easily remembered. This results in students' critical thinking skills can increase. The ability to think critically is useful so that students can be open-minded about the problems that exist in the real world [14].

4. Conclusion

This research has presented the effects of web-assisted problem based learning model of physics learning on high school students' critical thinking skills. Based on the results of the study showed that the use of web-assisted problem based learning model in physics learning provides a positive influence on students' critical thinking skills. For this reason, it is recommended for teachers to use these

learning in physics learning on appropriate material. Students also need to actively participate in learning in order to create conducive learning conditions. Schools must provide more facilities and support in developing critical thinking skills by using learning media and procurement of teaching aids.

References
[1]   Carvalho,Ana 2015 The Impact of PBL on transferable skills development in management education. Innovations in Education and Teaching International **53(1)** 35-47
[2]   Happy,N &Widjajanti,B,D 2014 Keefektifan PBL Ditinjau Dari Kemampuan Berpikir Kritis dan Kreatif Matematis Serta Self-Esteem Siswa SMP *Jurnal Riset Pendidikan Matematika*, **1** 1 2014
[3]   Lee,Tsang-Hsiung., Shen,Pei-Di & Tsai, Chia-Wen 2010 Enhance Low-Achieving Students' Learning Involvement in Taiwan's Higher Education: An Approach Via E-Learning With Problem-Based Learning and Self-Regulated Learning. *Teaching in Higher Education* **15 (5)** 553-565
[4]   Ismail,Nurul S.,Harun,J.,Zakaria,M.A.Z.M dan Salleh, S.M 2018 The Effect of Mobile Problem Based Learning Application DicScience PBL on Students'Critical Thinking. Thinking Skills and Creativity, 28 177-195 (2018).
[5]   Fabian,Khristin., Topping,Keith J.,& Barron,Ian G. 2016 Mobile technology and mathematics: effects on students'attitudes, engagement, and achievement. Journal of Computers in Education **3** 77-104
[6]   Tsai, Chia-Wen., Lee, Tsang-Hsiung.,& Shen, Pei-Di 2013 Developing longterm computing skills among low-achieving students via web-enabled problem-based learning and self-regulated learning. Innovations in Education and Teaching International, 50:2, 121-132
[7]   Karabatak, S., & Turhan, M. 2017 Effectiveness of web-based problem-based school administrator training program and its effect on participants' attitudes towards web-based learning. Pegem Eğitim ve Öğretim Dergisi, **7(4)** 663-712
[8]   Cengiz, T   2010 The Effect of the Virtual Laboratory on Students' Achievement and Attitude in Chemistry.*International Online Journal of Educational Sciences* **2 (1)** 37 – 53
[9]   Kalatting,Sherly.,Serevina,Vina & Astra, I made. 2015 Pengembangan Media Pembelajaran Fisika Berbasis Web Menggunakan Pendekatan Guided Discovery Learning.   *Jurnal Penelitian dan Pengembangan Pendidikan Fisika* **1***(1) 2015*
[10]   Ulva, S. 2017 Developing PBL kit by utilizing blog in order to improve scientific process and problem solving skills in physics learning. *Jurnal Inovasi Pendidikan IPA* **3(1)** 89-100
[11]   Salleh, S. M., Tasir, Z., & Shukor, N. A. 2012 Web-Based Simulation Learning Framework to Enhance Students' Critical Thinking Skills. *Procedia - Social and Behavioral Sciences* **64** 372–381.
[12]   Mahrani,Elly.,Bukit, Nurdin & Sinulingga,Karya 2017 Model *Problem Based Learning* Terhadap Kemampuan Pemecahan Masalah dan Berpikir Kritis Pada Siswa Sekolah Menengah Pertama. *Jurnal Pendidikan Fisika* **6** (2) 2017
[13]   Setyorini,U., Sukiswo,S.E & Subali,B.   2010 Penerapan Model Problem Based Learning Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa SMP.*Jurnal Pendidikan Fisika Indonesia* **7** (2011)
[14]   Saman Ebadi & Masoud Rahimi 2018 An exploration into the impact of Web Quest-based classroom on EFL learners' critical thinking and academic writing skills: a mixed-methods study, *Computer Assisted Language Learning*