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The Effect of Web-Assisted Problem Based Learning Model Towards Physics Problem Solving Ability of Class X Students

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Abstract. This research aimed to determine the effect of web-assisted PBL model towards problem solving ability of class X students. This research was an experiment research or experiment study on two sample groups namely the experiment group and the control group. The research design was True Experimental with the Post-Test-Only Control Design form. This experiment research was conducted in class X MIA of SMAN 2 Yogyakarta. The samples used in this study were 30 students of class X MIA 8 as the experiment group and 30 students of class X MIA 9 as the control group. Based on the results of the Independent Sample T-Test, the two sample groups seen from Sig. (2-tailed) were worth $0.000 < 0.05$, so H_0 was rejected and H_1 was accepted. The results of the effect test were calculated using Cohen'd Effect Size to determine the magnitude of the problem solving ability effect between the experiment class and the control class. The study was concluded that the web-assisted problem based learning model had a huge effect on the problem solving ability of class X students.
Keywords: Problem Based Learning, web, Problem Solving Ability

1.   Introduction

Education is the most important thing in developing a nation. Education functions as the ability developing, and character and nation building to educate the life of the nation [1]. Education has influenced the personality development of individuals or communities in dealing with the developments and challenges nowadays and in the future. Carrying out education to the finest quality should be considered by all parties.

Human being life has entered the 21st century (2010-2035). The 21st century science and technology has developed rapidly. The development of science and technology requires people to prepare their resources to face challenges and be able to compete. In the 21st century, education role is very important in preparing the future generations who have good learning skills and innovation, are able to use the technology and information media, and can work and survive using the skills they have for life [2]. Therefore, the education system is applied through developing the 21st century students' abilities.

In developing ability to face the 21st century challenges, students are asked to have the ability to solve problems [3]. Problem solving ability is one of the aspects of thinking skill or way of thinking in the 21st century. Problem solving requires special skill and ability that each student has, which may be different between one student and another in solving problems [4]. Problem solving ability is generally a human cognitive structure [5] in the form of mental process activities which include identifying, understanding, completing, and evaluating [6]. Problem solving development is carried out through a scientific process, the students will find information to solve problems with scientific procedures.

Through problem solving, the students can recognize new knowledge that may not have been encountered before.

One of the learning models that is able to improve or develop students' problem solving ability is Problem Based Learning (PBL) model [7]. The PBL presentation begins with the presentation of problem or situation in the real world then the students find the concepts, facts, principles, or theories [8]. PBL directly involves the students to learn actively because they have to find solutions through investigations in order to solve the problems presented. The role of teachers in PBL is only guiding, helping, directing, and motivating the students to solve the problems [9].

In the implementation of PBL models, the students need information in the form of electronic and non-electronic media [10] to overcome the problems that arise due to limited time and place or other facilities [11]. The media is used to facilitate learning activities that are in line with the nation development. In this 21st century, the students are also required to be able to search for technology and information literacy. Information technology offers alternative ways to carry out learning activities by utilizing the internet, such as website assisted learning [12,13,14]. Websites can be used in learning activities because of the easiness of accessing information through the internet, both through portable hardware (computers) and movable hardware (laptops, smartphones), and it also can be done anywhere, anytime, and by anyone [11]. The website presentation also contains two or more contents in the form of texts, images, videos and others, so that students become more interested in using it [13].

Physics is one of the subjects in senior high school (SMA). As stated in the 2013 Curriculum, the objectives of physics learning are mastering physical concepts and principles, as well as having skills in developing knowledge and self-confidence [14]. This goal means physics learning includes mastering the attitudes, knowledge, and skills in students. The learning concept in the 21st century is that the aspects of students' skills must be focused on the students. Focusing the way of thinking in the 21st century can be applied through problem solving on the physics material, like Harmonic Vibration material. This subject contains problems that exist in the surrounding environment, so that it can be applied in problem based learning to determine the ability of the senior high school students.

Based on the description above, this paper discusses the effect of using web-based problem based learning (PBL) model on problem solving ability of class X senior high school students. The purpose of this paper is to determine the effect of problem solving ability of class X senior high school students using web-assisted PBL model.

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 is an experiment research or experiment study of two sample groups, namely the experiment group and the control group. The research design used true experiment with the Post-Test-Only Control Design form. The design in this experiment research is presented in Figure 1.
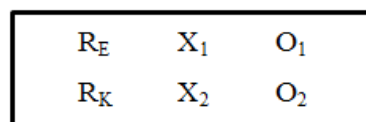
$$
\begin{array}{ccc}
R_E & X_1 & O_1 \\
R_K & X_2 & O_2
\end{array}
$$

Figure 1. Research Design

Where, R_E is the experiment group which is randomly selected, while R_K is the control group which is chosen randomly. X_1 is the web-assisted PBL model treatment, while X_2 is the treatment of learning model used in SMAN 2 Yogyakarta. Meanwhile, O_1 is the experiment group post-test, and O_2 is the control group post-test.

This experiment research was carried out at SMAN 2 Yogyakarta which is located in Bener Street No.30, Tegalrejo, Yogyakarta. The population of this study was all students of class X of SMAN 2

Yogyakarta in academic year 2017/2018 which were spread in 9 classes. The main characteristic of true experiment is that the sample used in both the experiment group and the control group is taken randomly from a particular population [15]. The sample is taken using random sampling technique. This sample is obtained from choosing 2 out of 9 classes from the population by lottery. The results of the lottery used as the research samples were class X MIA 8 as many as 30 students as the experiment group and class X MIA 9 as many as 30 students as the control group.

Based on its role and function, the variables in the study are divided into two, namely: (1) independent variables; and (2) dependent variables. The independent variable in this study is physics learning using web-assisted PBL for experiment class and without web-assisted PBL for control class. The related variable is students' problem solving ability. The measurement instrument uses a post-test of a test score sheet about description of problem solving ability with the cognitive domain C3 and C4. The material used in this study is simple harmonic vibration. The material selection is based on the class observation results that have not been studied. The instruments used in the learning process are Student Worksheets (LKPD) and exercises published on the website. The learning instrument consisted of RPP, LKPD, exercises, materials, and test questions have been validated by the expert lecturer. The test results of physics problem solving ability in the experiment class and control class are tested in the form of:

2.1 Normality Test
Normality test is used to find out whether the data are normally distributed or not, this test uses the Kolmogorov-Smirnov test supported by SPSS Statistics 21 software. The obtaining of the testing criteria is according to *Asymp results. Sig.* (2-tailed), where if Sig. > 0.05 then the data are normal and if Sig. <0.05 then the data ~~is~~ are not normal.

2.2 Homogeneity Test
Homogeneity test is used to figure out whether the variant comes from homogeneous or heterogeneous population (non-homogeneous). The homogeneity test uses Test of Homogeneity of Variances which is supported by SPSS Statistic 21 software. The result is concluded from Levene Statistic result. If *Sig.* > 0.05 then the variant data are homogeneous, and if *Sig.* < 0.05 then the variant data are heterogeneous.

2.3 Descriptive Test
Descriptive tests were conducted to determine the effect on both classes, namely the control class and the experiment class. Data analysis was carried out using SPSS Statistics 21 software. The data analysis was carried out with the aim of giving meaning to data acquisition, namely to determine the effect of web-assisted PBL model on students' problem solving ability.

2.4 Hypothesis Test
Hypothesis test is used to test whether there is a significant difference between the experiment class and the control class. Hypothesis testing uses the Independent Sample T-Test supported by SPSS Statistics 21 software. The hypothesis test used in this study is as follows:

H_0 : $\mu_1 = \mu_2$: There is no influence of students' problem solving ability between the experiment class and the control class.
H_1 : $\mu_1 \neq \mu_2$: There is the effect of students' problem solving ability between the experiment class and the control class.

Degree of freedom (dk) and significance level in this study use 5% or 0.05. So, the decision making or testing criteria if:

significance > 0.05, then H_0 is accepted, and significance < 0.05 then H_0 is rejected.

2.5 Effect Test

The effect test is used to find out how the web-assisted problem based learning model influences ~~on~~ the students' problem solving ability. This test is done by calculating *Cohen'd's* Effect Size formula [16], as follows:

$$d = \frac{\overline{X_t} - X_c}{S_{pooled}} \tag{1}$$

Where d is the score of effect size. $\overline{X_t}$ is the average score of the experiment class, then $\overline{X_c}$ is the average score of control class. Meanwhile, S_{pooled} is the standard of combined deviation.

$$S_{pooled} = \sqrt{\frac{(n_t-1)S_t^2 + (n_c-1)S_c^2}{n_t + n_c}} \tag{2}$$

Where S_{pooled} is the standard of combined deviation, n_t is the number of experiment class student, and n_c is the number of control class student. Meanwhile, S_t is the deviation standard of experiment class, and S_c is the deviation standard of control class. The criteria for the Effect Size [17] are classified as $d < 0.2$ means high, $0.2 < d < 0.8$ means medium, and $d > 0.8$ means low.

3.   Results and Discussion

Collecting data was carried out in class X of SMAN 2 Yogyakarta on April 25, 2018 and April 30, 2018. The following was the description of the prerequisite test or statistical test, hypothesis test and influence test:

3.1. Normality Test

The results of normality tests are presented in Table 1.

Table 1. Normality Test Results

One-Sample Kolmogorov-Smirnov Test	Experiment Class	Control Class	Conclusion
Asymp. Sig (2-tailed)	0.189	0.111	Normal distribution

Based on table 1 above, it can be seen that ~~test~~ the normality test results of students' problem solving ability seen from the Asymp. value Sig (2-taild) were 0.189 for the experiment class and 0.111 for the control class. Both results show Asymp. Sig > 0.05, which means that the two data come from a population that is normally distributed then being tested for the homogeneity.

3.2. Homogeneity Test

The homogeneity test results are presented in Table 2.

Table 2. Homogeneity Test Results

Levene Statistic	df1	df2	Sig.	Conclusion
2.508	5	22	0.061	Homogeneous (equal)

Based on table 2 above, it can be seen that the significance value of PBL model variable based on the conventional model variable is 0.061. This result means Sig. > 0.05, it is said that the experiment class variable data based on the control class has a homogeneous variance (equal).

The prerequisite test results in the form of normality test and homogeneity test have been fulfilled, the results of the data are normally distributed and homogeneous, then it carried out descriptive tests, hypothesis test, and effect tests. Here are the results:

3.3. Descriptive Test
Descriptive test results are presented in Table 3.

Table 3. Descriptive Test Results

Description	Treatment	
	Experiment Class (N=30)	**Control Class (N=30)**
Mean	77.27	63.30
Median	79.00	57.95
Standard Deviation	6.97	15.07
Variance	48.55	229.86
Maximum Score	89.00	84.00
Minimum Score	53.00	31.58

Table 3 above shows that the mean in the class using web-assisted PBL method is 77.27 higher than the class that does not use 63.30 web-assisted PBL method.

This is in line with the research [18] that has been done that problem based learning is effective to be used to improve problem solving skill. This means problem based learning encourages students in the learning process with optimal learning outcomes [19]. PBL places students as the center of the learning process that will improve their knowledge, skills and understanding. So, the use of PBL method plays an active role in the cognitive, affective, and psychomotor abilities of the students.
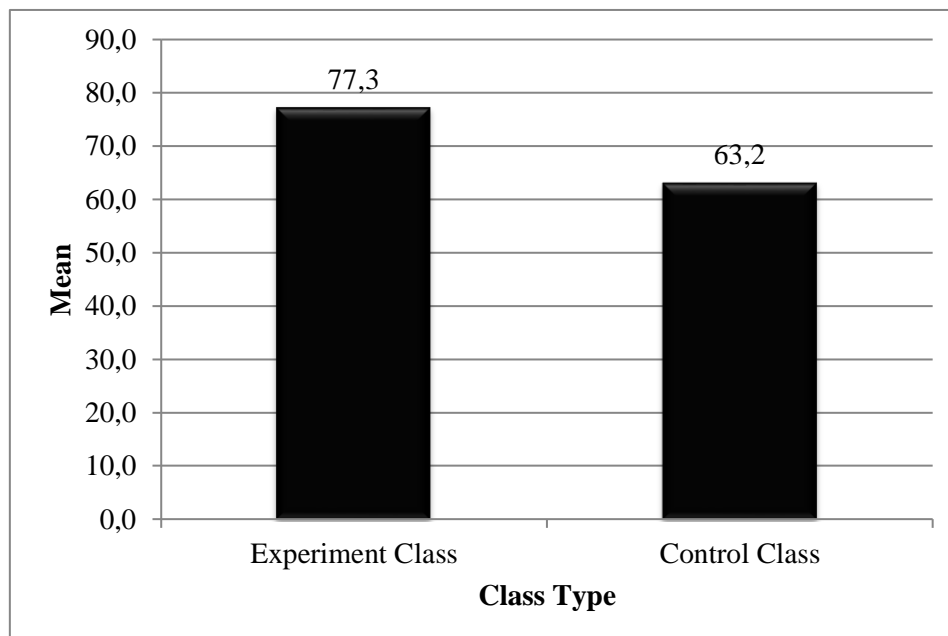

Figure 2. Comparison of Mean Problem Solving Ability Between Experiment Class and Control Class

From the results of Figure 2 above, it can be seen that students' problem solving ability in the experiment class or the treatment of web-assisted PBL learning model is higher than the control class which is not treated with web-assisted PBL learning model. This means that web-assisted PBL model is effective to be used in learning process.

3.4. Hypothesis Test

Hypothesis test results are presented in Table 4.

Table 4. Hypothesis Test Results

Independent Sample T-Test	Equal variences assumed	Equal variances not assumed	Conclusion
Sig (2-tailed)	0.000	0.000	Effect

Table 4 the average calculation test result (independent sample t-test) of problem solving ability between experiment group and control group. The results seen from Sig. (2-tailed) were worth 0.000. It means that $0.000 < 0.05$, so H_0 is rejected and H_1 is accepted. It is said that there is an effect of students' problem solving ability between the experiment class and the control class.

The difference between the experiment class and the control class is influenced by classroom learning activities and students' self-motivation [12]. The students involvement in the discussion of problem based learning activities in the classroom can improve the students' problem solving skills [20]. Through problem based learning, the students learn to experience and relate the knowledge they already have to the material being studied, and the teacher only helps them when they experience difficulties [8]. In addition, web-assisted learning provides a positive response for students [11, 21]. Web-based learning media is considered to be able to overcome the limitations of the teaching and learning process and can facilitate students in understanding physic material [10], effective [13], and feasible to use [21].

3.5. Effect Test

The results of the effect test are presents in Table 5.

Table 5. Effect Test Results

Effect Size	Conclusion
1.2	High effect

Table 5 calculation result of the effect test using Effect Size. The result obtained by the Effect Size is $1.2 > 0.8$ so it can be concluded that there is an influence on students' high problem solving ability between the experiment class and the control class. The magnitude of the influence based on the Effect Size value is in line with the findings [22] which implies that the improvement of problem solving skills of the experiment group is higher than the control group. The same thing [6] is that students' physic problem solving skill using problem-based learning model is better than conventional learning.

4. Conclusion

Based on the data analysis, the research of statistic descriptive test result shows the average score of students' problem solving ability. The score of the experiment class which uses web-assisted PBL model is higher than the control class which doesn't use web-assisted PBL model. The score of the experiment class is 77.27, while the score of the control class is 63.30. It can also be seen from the test results of the *Independent Sample T-Test* value of *Sig.* (2-tailed) 0.00, where this value is smaller than the level of significance so that it is concluded that there is an influence on students' problem solving ability between the experiment class and the control class. The influence of students' problem solving ability between the experiment class and the control class is high. This is seen from the effect test (*Effect Size*) obtained by 1.2 which is bigger than 0.8.

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