The Effect of Problem-Based Learning Model to Student Learning Outcomes on Colloid Topic

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Abstract. This research aimed to determine the effect of the problem-based learning model on students' learning outcomes on the colloid topic. This research applied an experimental method with a quasi-experimental design using a pretest-posttest control group design. The sample in this study was conducted in one of the SMA in The Bone Bolango district. To determine the effect of the problem-based learning model on students' learning outcomes in the colloid topic, the researcher used a test in the form of an essay with five questions that have been tested for validity and reliability. In the meantime, the hypothesis testing in this study was carried out by employing a t-test. The results of hypothesis testing obtained that the tcount value of 7,7 was higher than 1,67649. Where H_0 was rejected and H_a was accepted. Thus, it could be concluded that the problem-based learning model affected students' learning outcomes in the colloid topic.

1 Introduction

Education is important in human life because education provides provisions in the form of knowledge and skills. So that a person's personality is formed having potential in spiritual, personality, intelligence and noble character. And guarantee the life of the nation and state.

Education is expected to improve human resources. One of the current educational problems is students' lack of involvement in the learning process. Lack of involvement of students in the learning process due to the use of learning models that are less effective or only teacher-centred learning, so students are less active in the learning process.

Learning is a process of behaviour that is improved through stimulation. Learning involves various elements in the form of the physical and psychological conditions of the learner [1].

Learning can be influenced by many factors, one of which is the teacher's understanding of learning because the teacher can influence the intelligence and skills of students. It is clear that a teacher not only directly conveys material or transfers knowledge, but before teaching, a teacher must know how to design and choose a strategy for delivering material, which includes learning methods, learning models and techniques.

Learning is a reciprocal process between teachers and students to realize learning objectives[2].

Learning outcomes are changes in a person's behaviour covering the cognitive, affective and psychomotor fields[3]. Learning outcomes are the abilities students acquire after going through learning activities[4]. Learning outcomes to reveal students' abilities in the form of numbers as in the opinion [5] that learning outcomes are the value of students' abilities in the form of numbers after learning. The purpose of using numbers in the test results is to determine students' absorption after receiving the subject matter[6].

In general, two factors influence student learning outcomes, namely internal and external factors. Internal factors influence students from within, such as a lack of motivation to learn, students being less active in the learning process, students paying less attention to the topic being explained and the low level of student mastery of a topic. At the same time, external factors influence students from outside the student, such as families who pay less attention to their children at home, the environment that cares less about education, inadequate facilities and infrastructure and most importantly, the learning model applied by the teacher[7].

Based on observations and interviews with one of the chemistry teachers in class XI IPA at SMA Negeri 1 Suwawa, the teacher stated that many students had difficulty understanding chemistry lessons. Also, students were not active and not enthusiastic about participating in chemistry lessons. Many students think learning chemistry is very difficult, impacting student learning outcomes. Almost all students scored below the minimum completeness criteria at the time of the test. So it is necessary to apply a learning model involving students so that students are more active and learning

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outcomes can increase. One way to encourage students to be enthusiastic about learning chemistry is to apply a problem-based learning model.

Problem-based learning is a learning model that presents contextual problems to promote student learning. In the applied lesson, Problem-Based Learning, students solve real problems in groups[8]. The learning through group collaboration is better than the individual model[9].

Problem-Based learning is a learning model that uses problems in everyday life in the form of natural phenomena as contexts or topics for learning to problem-solving, acquiring essential knowledge and concepts from learning topics, training independent students and applying new knowledge to problems encountered, and reflecting on what has been studied[10]. The goal of the PBL learning model is to develop critical thinking models for solving problems and mastering learning topics. The PBL model allows students to analyze, experiment, make references and draw conclusions while investigating problems[11].

PBL Model is effective because students can find solutions and solve problems independently to increase their understanding of mathematical concepts [12]. Applying this model can change students' thinking patterns from low to high based on their cognitive level. As explained by Rahayu and Adistana (2018), the highest level of the cognitive domain after learning is that students can solve problems. [13].

Problem-based learning usually consists of 5 stages, which begin with an orientation of the student's problems, organization of the student's learning, the direction of individual and group research, development and presentation of work, and analysis and evaluation of the problem-solution process[14].

Based on the description above, the problem in this research is whether there is an influence of the learning model*Problem Based Learning* on student learning outcomes on colloid topics at SMA Negeri 1 Suwawa. Based on the problem formulation above, this study aimed to determine the effect of the learning model*Problem Based Learning* on student learning outcomes on colloid topics at SMA Negeri 1 Suwawa.

2 Method

This research is experimental. This type of research is quasi-experimental. This study uses the design *pretest-posttest control group design.*

2.1 Type of Research

This study uses a quantitative approach.

2.2 Subject

The population of this study was all students of XI IPA class of SMA Negeri 1 Suwawa in the flat term of the academic year 2021/2022, a total of 84 students consisting of 3 classes. The sample in this study was class XI IPA, totalling 29 students and XI IPA 2, totalling 27 students. Sampling is taken by *simple random sampling*.

2.3 Procedures

This study used two classes, namely class XI IPA 1 (experiment) and class XI IPA 2 (control). The experimental class uses a problem-based learning model, and the control class uses a conventional.

2.4 Data, Instruments and Data Collection Techniques

The instrument used in this study was a test consisting of 5 essay questions for each pretest and post-test. The test used first is to test the reliability and validity. Validity was carried out by two chemistry lecturers and one chemistry teacher. The purpose of doing validity and reliability is to see if the tests used are valid and reliable. To test the validity of the questions in this study, the Likert Scale was used as the assessment medium, as shown in Table 1 [15].

Table 1. Score Likert scale

Qualitative assessment	Value weight	Quantitative assessment
Strongly agree/very valid	5	84% - 100%
Agree/Valid	4	68% - 83%
Simply agree/quite valid	3	52% - 67%
Disagree/less valid	2	36% - 51%
Invalid	1	20% - 35%

The analysis technique for the feasibility test in this study uses the results of the rating equation:

$$HR=\frac{\sum \text{validation score}}{\sum \text{highest score}} \times 100\% \quad (1)$$

Information:

HR = percentage of validation results of questions

$\sum$ validation score = total validation score

$\sum$ the highest score = total highest score of all questions

Test the reliability of learning outcomes tests using the formula*Alfa Cronbach*

$$r_{11}= \left|\frac{n}{n-1}\right| \left|1-\frac{\sum S_i^2}{S_t^2}\right| \quad (2)$$

Information:

r_{11} = Question reliability

n = the number of students

Sx_i^2 = total score variance for each item

s_t^2 = variants total

The benchmarks for the interpretation of reliability are as follows:

$0,00<\alpha \leq 0,20$: very low level of reliability

$0,20<\alpha \leq 0,40$: low level of reliability

$0,40<\alpha \leq 0,70$: moderate level of reliability

$0,70<\alpha \leq 0,90$: high level of reliability

$0,90<\alpha \leq 1,00$: very high level of reliability

2.5 Data analysis technique

The data analysis technique used in this study is first to calculate the average value of the two samples. From the data obtained, it then carried out the normality test, homogeneity test and hypothesis testing.

1. The normality test aims to check whether the data collected is normally distributed. To know that the sample data taken from the population is normally distributed, it is used with a test *Lilyfors*.
2. A homogeneity test is carried out to ensure the sample has a homogeneous variance. Homogeneity test of variance (F-test), with homogeneous sample criteria if $F_{count} < F_{table}(F\ a_{(dk1,dk2)})$, with $\alpha = 0.05$ (Sugiyono, 2016).
3. Hypothesis testing is a form of quick answers to the questions contained in the problem formulation. The hypothesis to be tested is H_0: the Problem-Based Learning Model has no influence on student learning outcomes on colloid topics at SMA Negeri 1 Suwawa. H_a: there is the influence of the Problem-Based Learning Model on student learning outcomes on the colloid topic at SMA Negeri 1 Suwawa.

Test the hypothesis using the t-test. T-test is a statistical test used to test a difference or similarity between two conditions/treatments or two groups by comparing the averages of the two groups. The test criteria: If $t_{count} > t_{table,}$ face H_0 rejected, and H_a accepted. This means there is an influence between the independent variables on the dependent variable (Ghozali, 2016).

3 Result and Discussion

This study is a quantitative study to investigate the effect of problem-based learning model on the academic performance of students in colloid subjects at SMA Negeri 1 Suwawa. The sample used in this study was 59 students consisting of 29 students in the experimental class (XI IPA 1) and 27 in the control class (XI IPA 2).

Pretest or initial test aims to determine students' initial knowledge and courage in answering questions about a topic that has not been taught. Based on the data obtained, the average initial test for the experimental and control classes can be presented in Table 2.

Table 2. Pretest scores for the experimental class and the control class

Class	Average value
Experiment	41,8519
Control	38,1481

After using the Problem-Based Learning Model and conventional Learning, a post-test is used to find out students' knowledge. Based on the obtained average post-test, experimental and control classes can be presented in Table 3.

Table 3. Average post-test experimental and control classes

Class	Average value
Experiment	84,8148
Control	63,33

Hypothesis testing requirements are first carried out to test the normality and homogeneity of the data. The results of the normality test and homogeneity test can be seen in Table 4 and Table 5.

Table 4. Normality Test

	Data	L_{count}	L_{table}	Conclusion
Pretest	Experiment	0,1441	0,166	Normal
	Control	0,1205	0,166	
Posttest	Experiment	0,1586	0,166	Normal
	Control	0,1437	0,166	

They are testing for normality using statistical tests*Lilyfors*with level $\alpha = 0.05$. The data can be normal if hypothesis H_0 where is $L_0 < L_{table.}$

Table 5. Homogeneity Test

Class	F_{table}	F_{count}	Conclusion
Experiment and control	1,9	1,59	Homogeneous
Experiment and control	1,9	1,55	Homogeneous

Test the homogeneity of the data *pretest* and *post-test* in the experimental and control classes. The test results for both classes obtained $F_{count} \leq F_{table,}$ where to *pretest* of 1.59 and the *post-test* of 1.55 while the value of $F_{table}$is 1.9 to F_{count}obtained is smaller than $F_{table.}$ Based on the test results, it can be concluded that the data pretest and post-test of both classes are homogeneous.

The normality test and homogeneity test are carried out and have been normally distributed. The data is homogeneous. Then hypothesis testing is carried out to see the effect of the Problem-Based Learning Model on student learning outcomes in colloidal topics using the t-test. The t-test data can be seen in Table 6 below:

Table 6. Hypothesis Testing Results

Data Group	Rate-rate	Variance	t_{count}	t_{table}
Experiment	84,8148	77,849	7,7	1,6747
Control	63,33	121		

The calculated data show the value of $t_{count} > t_{table,}$ namely 7.7 > 1.6747, which means H_a accepted and H_0 rejected. This can be seen in the average value of learning outcomes in the experimental class of 84.8148, while in the control class, the average value is 63.33. So it can be concluded that the Problem-Based Learning Model influences student learning outcomes in colloidal topics.

Learning activities in the experimental class follow the syntax or learning steps, namely giving problems to students, starting with showing the video as an apperception concerned with colloidal topics as an introduction so that students get an idea of the topic they will learn. Furthermore, students are grouped and given student worksheets (LKPD). Then students are encouraged to get the correct information to draw explanations and solutions. This can make students motivated and feel enthusiastic about learning and exploring knowledge in groups to solve problems, and the results will be presented. With Problem-Based-Learning, when learning activities in groups, each member is responsible for success in learning. So that each member becomes active and participates in activities so that good cooperation is established for the group's success in answering questions.

This follows research [16], which states that Problem-Based Learning can improve students' physics learning achievement rather than conventional learning. Problem-Based learning also stimulates and challenges students more, encouraging them to be independent in setting their learning goals[16]. Research [17] states that Problem-Based Learning can improve learning outcomes and students' science process skills. Research [19] also states that Problem-Based Learning can encourage students to be more active and improve student learning outcomes. The research conducted [18] showeincreased student learning activity and results in Solubility Topic and Solubility Product of Class XI IPA MAN 2 Pontianak using Problem-Based Learning.

4 Conclusion

Based on the results of data analysis and discussion, it can be concluded that there is an influence of the learning model *Problem Based Learning* on student learning outcomes on the colloid topic in SMA Negeri 1 Suwawa. The difference in the average value of student learning outcomes in the experimental class was 84.8148, while the average value in the control class was 63.33.

This is based on the results of hypothesis testing and the differences in student learning outcomes in the experimental and control classes. Hypothesis test results in 7.7> 1.67469 mean H_a accepted, and H_0 rejected.

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