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Application of the Collaboration of Problem-Based Learning and Inquiry Learning Models with Macromedia Flash on Students' Learning Outcomes and Learning Activities

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ABSTRACT

This study aimed to determine the used of problem-based learning and inquiry learning model with Macromedia Flash on students' learning outcomes and learning activities. The population in this study was 8 classes of XI Natural Science students of MAN 1 Medan. The sample was 20 students selected based on the homogeneity of the pretest scores and questionnaires. Experimental class that I received the problem-based learning and inquiry learning model with Macromedia Flash, while experimental class II received the problem-based learning and inquiry learning model. The data analysis showed a mean score of 84.25 and 75.25 in experimental class I and II respectively. The results of the statistical test using the right-side t-test for learning outcomes obtained t-count = 4.15 and t-table = 1.686 for α = 0.05. The hypothesis testing for learning activities obtained t-count = 3.15 with t-table = 1.686 for α = 0.05. If the t-count is higher than the t-table, the hypothesis of students' learning outcomes and learning activities is accepted and Ho is rejected. Learning outcomes and learning activities using the problem-based learning and inquiry learning model with Macromedia Flash are higher than those using the problem-based learning and inquiry learning model.

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INTRODUCTION

Chemistry is a science that studies the structure, changes, and properties of matter as well as the energy that accompanies changes in matter. Chemistry science consists of two things that cannot be separated, namely chemistry as a process and chemistry as a product. Chemistry as a process covers the skills and attitudes possessed by scientists to acquire and develop chemical knowledge, while chemistry as a product covers a collection of knowledge consisting of facts, concepts, and principles owned by scientists to acquire and develop chemical knowledge (Suswati, 2021).

Recently, the learning process in senior high school/Islamic senior high school (MA) no longer uses teacher-centered learning but uses student-centered learning. Student-centered learning requires a variety of learning methods so that the teaching and learning process becomes fun and encourages students more active in class.

Based on the results of observations at MAN 1 Medan, students have low learning outcomes in chemistry due to (1) students' low understanding of lessons delivered by the teacher so it is difficult for them to answer questions; (2) no active atmosphere in the discussion, and (3) lack of student involvement. Some students answered questions hesitantly. Even, students have low courage to express opinions and ask questions. It is difficult for students to play an active role in learning as the teaching and learning process is not interesting and less meaningful. Thus, students tend to get bored. Students' low understanding of the concept has an impact on the learning activities resulting in low learning outcomes.

Therefore, a learning model that is in accordance with the characteristics of a scientific approach that can improve learning outcomes and student learning activities is needed. The use of appropriate learning models can encourage students' enjoyment of lessons, foster and enhance student learning activities, and make it easy for students to understand lessons and achieve better learning outcomes.

Learning models that can be used to improve learning activities and learning outcomes are the Problem-based Learning (PBL) and Inquiry Learning models. The use of problem-based learning and inquiry-based learning models is expected to train students to be disciplined and increase their understanding of chemistry, as well as to increase students' activeness in learning activities.

The problem-based learning model is a learning model with student-centered learning. Students are faced with various life problems that they might encounter later in school (Sumiati, 2018). Besides, the innovative and creative Problem-Based Learning (PBL) learning model can increase the activity in class.

This model can lead students to think more responsively, solve problems, especially complex chemical material, and analyze and resolve complicated problems. The PBL model has some benefits for students such as increasing students' ability to think critically and creatively and increasing students' chemistry learning outcomes (Silaban et al., 2020).

Maryati (2018) states that PBL is implemented in core activities in the teaching and learning process. The PBL model consists of 5 learning steps, namely (1) Introducing problems to students, (2) Coordinating students to learn, (3) Guiding students in individual and team investigations, (4) Presenting and explaining findings, and (5) Evaluating the problem-solving process. Therefore, the PBL learning model is effective and efficient to improve students' learning activities and learning outcomes, especially in chemistry subjects.

The inquiry learning model is a learning model that can change the way students learn to become more active, skilled, and directly involved in the learning process. Students are directed to understand the materials by analyzing the problems given by the teacher and finding answers to the problems themselves. In selecting problems, teachers adapt the problem to familiar contexts for students. So that students are encouraged to find relationships between the material and the phenomena of everyday life (Mutia et al., 2020).

Fenica et al. (2017) reveal that the inquiry learning model can increase student learning activities because everything from finding problems to solving problems is done by students with the guidance of the teacher. Thus, students find their answers to the problems which indirectly can change the notion that chemistry is difficult to learn.

The collaboration of the problem-based learning model with the inquiry learning model will produce students who develop according to their own abilities by involving their minds and being self-motivated so that they can solve problems (Siregar, 2014). The problem-based learning which is integrated with the inquiry learning model has a positive impact on students with low activity and learning outcomes. It will invite students to be directly involved and active in the teaching and learning process.

Octavianti (2014) explains that learning methods require media to help accelerate the achievement of learning objectives. The media functions as a communication process that carries information from the source (teacher) to the recipient (student). One of the functions of the media is the function of attention, which is to stimulate students' thoughts, feelings, attention, and willingness so that it can encourage the learning process (Arsyad, 2009). However, few teachers use media.

One of the media that attract students' attention, increases student learning activities, and overcome student learning boredom is animation media, namely Macromedia Flash.

Macromedia Flash is an application program that allows for application creation. This program is used by animators to create interactive and non-interactive animations such as animations on web pages, animated cartoons, and others. Macromedia Flash is a standard vector-based application program for professional authoring tools to create attractive animations and bitmaps for animated logos, movies, games, menus, and web applications (Daryanto, 2013). Munandar et al. (2021) reveal that Macromedia Flash learning media has been proven more effective than independent learning and has better performance than without the use of media.

Based on the elaboration above, it is important to identify (1) how to optimize chemistry learning through problem-based learning models on student learning outcomes and learning activities. (2) how to optimize chemistry learning through inquiry learning models on student learning outcomes and learning activities. (3) How to maximize student learning outcomes and learning activities through collaboration of problem-based learning and inquiry learning model, and (4) Can the use of Macromedia Flash media in chemistry learning maximize learning outcomes and learning activities?

This study aims to (1) identify whether the chemistry learning outcomes who were taught using the collaboration of problem-based learning and inquiry learning models with Macromedia Flash are higher than those who were taught using the collaboration of problem-based learning and inquiry learning models and (2) identify whether student learning activities that are taught by a collaboration of problem-based learning and inquiry learning models with Macromedia Flash are higher than those that are taught by collaboration model of problem-based learning and inquiry learning models only for ksp materials

METHODS

This study was conducted at MAN 1 Medan. The population in this study was all students from the XI Natural Science Class with a total of 8 classes. Each class has an average of ± 40 students. This study involved two classes determined by random sampling technique (probability sampling) as samples. The first class, namely XI Natural Science 8 is experimental class I. The students in this class received materials with the collaboration of Problem-Based Learning and inquiry learning models with Macromedia Flash. The second class, namely XI Natural Science 6 as experimental class II. The students in this class received materials with the collaboration of Problem-Based Learning and inquiry learning models.

The students who were selected as samples have relatively homogeneous status in terms of pretest scores, joining tutoring courses, additional tutoring at school, the number of books used by students, study time, and parents' occupation obtained through the questionnaire. This study used both test instruments and non-test instruments. The test instrument was the pretest and posttest to measure the chemistry learning outcomes. The pretest was given to the sample before treatment to identify the homogeneity and normality or the similarity of the characteristics of students. Posttest was given after completing the treatment to identify the learning outcomes. The non-test instrument was an observation sheet of student learning activities. The score for learning activities was measured and observed directly by observers. The assessment aspect used a rating scale with four levels. In this study, each class was divided into eight groups so it required 3 observers. One observer observed 3 groups at the same time. Score 1 means never, score 2 means sometimes, score 3 means often, and score 4 means always. The equation for activity score is as follows.

$$\text{Activity Score} = \frac{score\ obtained}{maximum\ score} \times 100 \qquad (1)$$

The categorization of learning activities into low, medium, and high categories was based on the following percentage:

Table 1. Score Categories of Student Learning Activity

Percentage	Category
0% - 33%	Low
34% - 67%	Medium
68% - 100%	High

Descriptions :

X_1 = Learning with the collaboration of Problem-based learning and inquiry learning model with Macromedia Flash

X_2 = Learning with the collaboration of Problem-based learning and inquiry learning model.

T_1 = Pretest score of experimental class I at the beginning of the study

T_2 = Pretest score of experimental class II at the beginning of the study

T_3 = Pretest score of experimental class I at the end of the study

T_4 = Pretest score of experimental class II at the end of the study

Data were analyzed both qualitatively and quantitatively. The qualitative analysis used the content validity of the learning outcomes test instrument, while the quantitative analysis was to select suitable items as test instruments with consideration of validity analysis, level of difficulty, discriminating power, constructor, and reliability of the test instrument by testing the test items on a sample of XII Natural Science 3 of MAN 1 Medan. The scoring technique for the student learning outcomes instrument was giving a score of 1 for the correct answer and 0 for a false answer.

Before testing the hypothesis, the data have to meet the requirements of analysis, namely normality, and homogeneity. The normality of the data was tested using the Chi-Square Test (x2) by comparing the standard curve (A) with the normal curve formed from the collected data (B). A homogeneity test was carried out to have the same variance among members of the group if the variances are the same. The hypothesis test was to test whether the truth can be accepted or rejected by using the right-side t-test.

RESULT AND DISCUSSION

This study obtained the learning outcome and learning activity data. This is an experimental study involving two classes consisting of experimental class I and experimental class II. Experimental class I was given a collaboration of problem-based learning and inquiry learning models with Macromedia Flash, while experimental class II was given a collaboration of problem-based learning and inquiry learning models.

In both classes, 3 stages of activity were carried out, namely pre-test, learning, and post-test. The pre-test was to determine students' initial abilities and test the sample requirements (normality and homogeneity). The post-test was to determine the final ability of students after receiving the learning treatment.

Learning outcomes

Based on the calculation results obtained statistical data on learning outcomes in experimental class I and experimental class II as presented in Table 3.

Table 3. Summary of Descriptive Statistics on Pretest and Posttest

Statistics	**Pre-test Data**		**Post-test data**	
	Experimental I	**Experimental II**	**Experimental I**	**Experimental II**
Mean	32.25	32.75	84.25	75.25
Standard deviation	5.10	5.34	7.12	6.58
Variance	20.13	23.67	50.72	43.36
Minimum score	10	20	70	65
Maximum Score	45	50	95	90
Total Score	589	602	1685	1505

Based on Table 3 above, showed that the difference in the mean score in the pretest and posttest in experimental class I and experimental class II, or it can also be presented in the form of Figure 1 below.

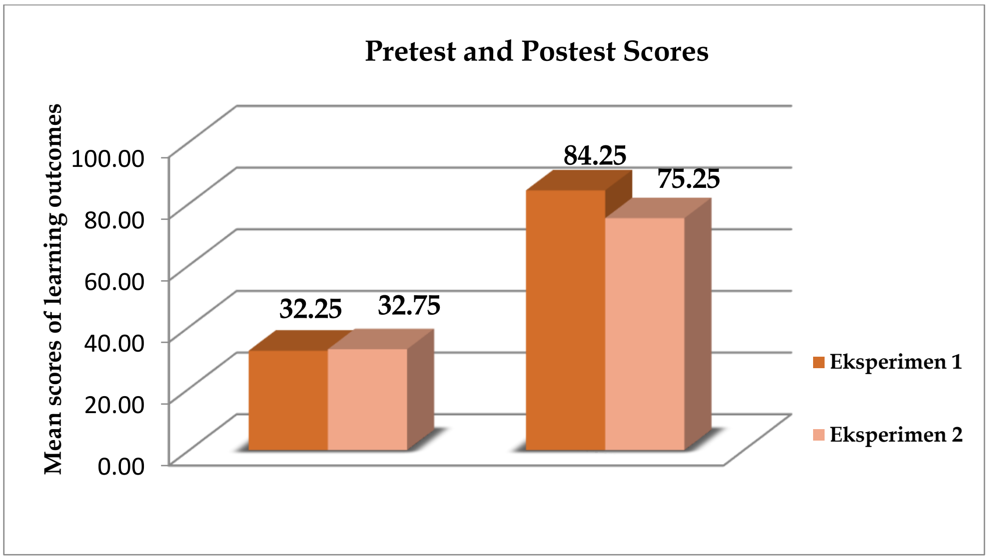


Figure 1. Mean Scores of Pretest and Posttest in the Experimental Class I and Experimental Class II

Learning activities

This study assessed student learning activities from the beginning to the end of the treatment. Data were collected by 3 observers.

Table 4. Mean Score for Learning Activities

Class	Aspect of assessment	Mean Score of Learning Activities in Each Meeting		
		1	2	3
Experimental I	Learning	64.29	75.54	82.85
Experimental II	activities	63.04	72.50	78.21

Based the data above, it can be illustrated into the following diagram:

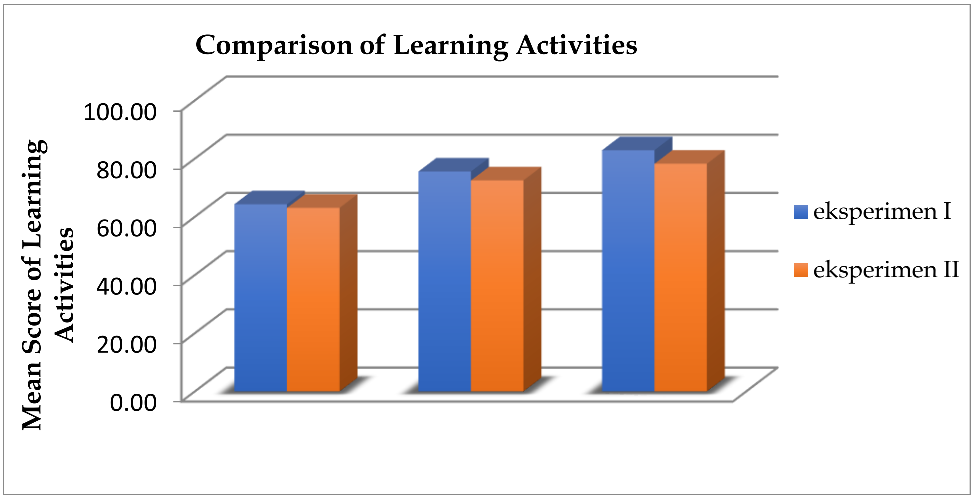


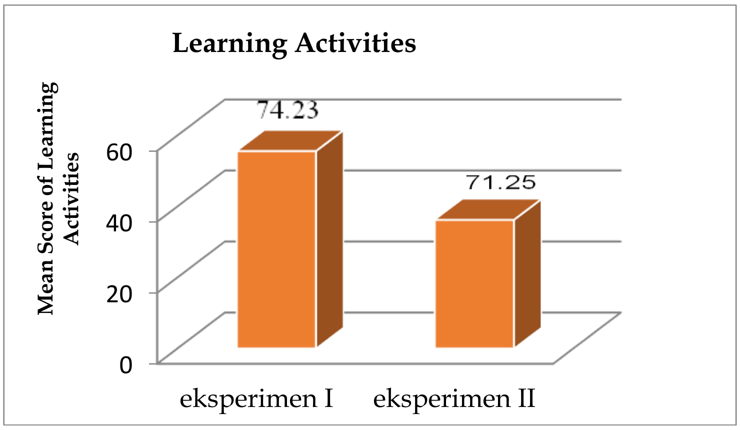
Figure 2. Mean score diagram of learning activities in experimental class 1 and experiment II in each meeting

The statistical data on student learning activities in the experimental class I and experimental class II are summarized in Table 5.

Table 5. Descriptive Statistics Summary of Student Learning Activity Scores

Data	Statistics	Class	
		Experimental I	**Experimental II**
Learning activities	Mean	74.23	71.25
	Standard deviation	2.71	3.24
	Variance	7.35	10.48
	Minimum score	69.05	65.48
	Maximum score	79.76	78.57
	Total score	1484.51	1425

Based on Table 5, the difference in the mean score of learning activities in experimental class I and experiment II is also presented in a diagram in Figure 3.



a

Figure 3. Mean Score Diagram of Learning Activities in the Experimental Class I and Experimental Class II

The distribution of frequency and percentage of learning activity scores in experimental class 1 and experimental class II are divided into three categories, namely high, medium, and low categories.

Table 6. Distribution of Frequency and Percentage of Learning Activity Scores

Score range	Category	Experimental I		Experimental II	
		F_0	Percentage (%)	F_0	Percentage (%)
71-100	High	18	9.4	10	0
40-70	Medium	2	90.6	10	40.6
0-39	Low	0	0	0	59.4
Total		20	100	20	100

Based on Table 6, learning activities use collaboration between problem-based learning and inquiry learning models with Macromedia Flash with a range of 71-100 with 18 high categories, 40-70 with 2 low categories, and 0- 39 with 0 of a low category. Meanwhile, learning activities use the collaboration of problem-based learning and inquiry learning model with a range of 71-100 with 10 high categories, 40-70 with 10 medium categories, and 0-39 with 0 low categories.

Hypothesis I

After finding that the learning outcome data are normally distributed and homogeneous, a hypothesis test was carried out using one-sided statistical tests, namely the right-hand t-test. This test aims to find out whether the hypothesis is accepted or rejected. If the t-count is higher than the t-table, then the alternative hypothesis is accepted and the null hypothesis is rejected. The data from the hypothesis test results can be seen in Table 7 below:

Table 7. Results of Hypothesis Testing for Learning Outcomes

Learning outcome data		t_{count}	t_{table}	Notes
Experimental I	**Experimental II**			
$\bar{X}$ = 84.25 S^2 = 50.72	$\bar{X}$ = 75.25 S^2 = 43.36	4.15	1.686	Ha is accepted

The one-sided t-test analysis (right side) obtained t-count > t-table with $\alpha = 0.05$. It means that Ho is rejected and Ha is accepted indicating that the learning outcomes of students who receive materials with the collaboration of problem-based learning and inquiry learning model with Macromedia Flash are higher than those with the collaboration of problem-based learning and inquiry learning model, especially for the Solubility and Solubility Product materials.

Hypothesis II

After finding that learning activities are normally distributed and homogeneous, a hypothesis was carried out using a statistical test, namely the one-sided t-test (right-hand test). This test aims to determine whether the hypothesis is accepted or rejected. If the t-count is higher than the t-table, then the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted. The results of the calculation of the hypothesis test are presented in Table 8.

Table 8. Results of Hypothesis Testing for Learning Activities

Learning activities data		t_{count}	t_{table}	Notes
Experimental I	**Experimental II**			
$\bar{X}$ **= 74.23** S^2 **= 7.35**	$\bar{X}$ = 71.25 S^2 = 10.48	3.15	1.686	Ha is accepted

Based on the results of the calculation above, the t-count is higher than the t-table, so Ho is rejected and Ha is accepted. Thus, it can be said that the learning activities of students who receive materials with the use of the collaboration of problem-based learning and inquiry learning models with Macromedia Flash are higher than students who receive materials with the use of the collaboration of problem-based learning and inquiry learning models.

The results of this study are in line with Silalahi (2014) and Sinaga (2014) that students' chemistry learning outcomes taught using the problem-based learning and inquiry learning model with computer media showed a better improvement. Besides, Silaban (2020) also revealed that an increase in student chemistry learning outcomes taught using the problem-based learning and inquiry learning model with computer media obtained an increase of 0.83 higher than those who are taught by using the problem-based learning and inquiry learning model with an increase of 0.52.

Theoretically, the philosophy of learning using the collaboration of problem-based learning (PBL) and inquiry learning model provides a direct experience for students in learning because they learn themselves and pay attention to every important variable during learning (Silalahi, 2014). The collaboration of the problem-based learning and inquiry learning model helps students develop according to their own abilities by involving their minds and being self-motivated so that they can solve problems (Siregar, 2014). In practice, learning using the collaboration of problem-based learning and inquiry learning model requires students to realize that many things in the surrounding environment need to be analyzed for causes, especially those related to chemistry subject. Therefore, students have to think at a higher level to analyze the problems given in the invention process.

During the learning process, the observer assessed the learning activities in experimental class I and experimental class II. experimental class I and experimental class II received the same treatment in terms of learning models. The average achievement of the activity of experimental class I was 74.23, which was higher than that of experimental class II, with 72.25.

This means, Ha is accepted and Ho is rejected that "student learning activities that are taught with the collaboration of problem-based learning and inquiry learning models with Macromedia Flash are higher than those who are taught with the collaboration of problem-based learning and inquiry learning models". It is because learning in experimental class 1 with the help of Macromedia Fllah can stimulate students in learning and analyzing problems based on the material and knowledge they have so that new knowledge will be formed. Thus, they will be more active in learning as seen in experimental class I.

Macromedia Flash was used to create a fun and easier learning process by presenting animations. Macromedia Flash also displays some solubility problems and solubility products in everyday life. Thus, it is not only entertaining but also can also increase student activity because it encourages students to solve the problems that are displayed. In experimental class II, the researcher only used learning models so students tended to be more passive and only listened to explanations and directions from researchers.

The results are in line with Asiyah (2013) that the use of Macromedia Flash can increase student activeness. Besides, it is similar to Nasution (2013) that student learning activities increase with the help of Macromedia Flash. The activeness of students in the teaching and learning process is one of the keys to the achievement of educational goals. In learning it is necessary to have activity because in principle learning is doing, doing to change behavior into an activity. It means that there will be no learning if there is no activity. Therefore, activities are important principles in teaching and learning interactions. In the learning activities, students as subjects must be active or it can be said that learning needs activities. The collaboration of problem-based learning (PBL) and inquiry learning model with Macromedia Flash places students as the center of activity in which students do not only learn about something but also actively find, do, pay attention/observe, and experience a learning activity. The learning outcomes and learning activities for the Solubility and Solubility Product materials can be maximized by using the collaboration of problem-based learning and inquiry learning model with Macromedia Flash.

CONCLUSION

Based on the results of the study, it can be concluded that (1) the learning outcomes of students who are taught with the collaboration of problem-based learning and inquiry learning model with Macromedia Flash is higher than those who are taught with collaborative problem-based learning models and inquiry learning model (2) student learning activities that are taught using the collaboration of problem-based learning and inquiry learning models with Macromedia Flash is higher than those who are taught using the collaboration of problem-based learning and inquiry learning models.

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