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Differences in Student Activities and Learning Outcomes with the Application of Problem Based Learning assisted by Real Lab and Virtual Lab Media on Salt Hydrolysis Material

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Abstract: Differences in Student Activities and Learning Outcomes with the Application of Problem Based Learning assisted by Real Lab and Virtual Lab Media on Salt Hydrolysis Material. This research aims to determine the differences in student activities and learning outcomes through the application of problem based learning using real and virtual laboratory media laboratory on salt hydrolysis in SMAN 17 Medan. The sample consisted of two classes, namely class XI IPA 2, totaling 32 people as experimental class I and class XI IPA 5, totaling 32 people as experimental class II Random Sampling is specified. Data is collected using test instruments such as achievement tests and non-test instruments, namely student activity observation sheets. Research data uses statistical analysis of the t test (Independent Sample Test). The prerequisite tests are normality and homogeneity tests. The average value of student learning outcomes based on real laboratories is 87.19 and student learning outcomes using virtual laboratories is 81.09. The average value of student learning activities using real lab and virtual lab media is 84.28 and 78.50 respectively. Based on statistical analysis using the t hypothesis test, the calculated t values for learning outcomes and learning activities were 3.43 and 3.63 respectively. This value is located in the H0 rejection area between -2.042 to 2.042. This result shows that there are differences in student activities and learning outcomes through the application of problem based learning with real laboratory media and virtual media salt hydrolysis subject laboratory at SMAN 17 Medan.

Keywords: Learning Outcomes, Student Learning Activities, Differences, Problem Based Learning, Real Laboratory, Virtual Laboratory

Abstrak: Perbedaan Aktivitas Dan Hasil Belajar Siswa Dengan Penerapan Problem Based Learning Berbantuan Media Real Lab Dan Virtual Lab Pada Materi Hidrolisis Garam. *Penelitian ini bertujuan untuk mengetahui perbedaan aktivitas dan hasil belajar siswa melalui penerapan problem based learning menggunakan media laboratorium nyata dan virtual laboratorium hidrolisis garam di SMAN 17 Medan. Sampelnya terdiri dari dua kelas yaitu kelas XI IPA 2 yang berjumlah 32 orang sebagai kelas eksperimen I dan kelas XI IPA 5 yang berjumlah 32 orang sebagai kelas eksperimen II pengambilan sampel dilakukan dengan purposive sampling. Data dikumpulkan dengan menggunakan instrumen tes seperti tes prestasi dan instrumen non tes yaitu lembar observasi aktivitas siswa. Data penelitian menggunakan analisis statistik uji t (Independent Sample Test). Uji prasyaratnya adalah uji normalitas dan homogenitas. Nilai rata-rata hasil belajar siswa berdasarkan laboratorium nyata sebesar 87,19 dan hasil belajar siswa menggunakan laboratorium virtual sebesar 81,09. Nilai rata-rata aktivitas belajar siswa dengan menggunakan media real lab dan virtual lab masing-masing sebesar 84,28 dan 78,50.*

Berdasarkan analisis statistik dengan menggunakan uji hipotesis t diperoleh nilai t hitung hasil belajar dan aktivitas belajar masing-masing sebesar 3,43 dan 3,63. Nilai tersebut terletak pada daerah penolakan H0 antara -2,042 hingga 2,042. Hasil ini menunjukkan bahwa terdapat perbedaan aktivitas dan hasil belajar siswa melalui penerapan problem based learning dengan media laboratorium nyata dan media virtual laboratorium mata pelajaran hidrolisis garam di SMAN 17 Medan

Kata kunci: *Hasil Belajar, Aktivitas Belajar Siswa, Perbedaan, Problem Based Learning, Real Laboratory, Virtual Laboratory*

▪ INTRODUCTION

As time goes by, education in Indonesia undergoes changes and developments. According to Daryanto (Ramadhani et al., 2016), developments in the world of education, especially developments in science and science and technology have an influence on the teaching and learning process process carried out at school. The development of science and technology in the world of education today is none other than for the realization of national education goals. Improvements in the field of education in the coming years must prioritize on improving the quality of learning. The main problem in learning in school education that is still widely found is the lack of student activeness in learning, thus causing low student learning outcomes. The teaching and learning process activities were initially teacher-centered, where educators prepared and provided as much information as possible to students while students did not actively participate in learning. But now the world of education is in the era of 21st century educational transformation where learning activities take place in two directions and students are required to be active during the learning process.

To encourage students to be active in the learning process, every learning process requires a learning model that is in accordance with the characteristics of the scientific approach. The use of learning models can encourage students to be active and can increase students' interest in the material taught during the learning process, so that students can achieve good learning outcomes and learning objectives can be achieved (Sinaga & Silaban,2020). The main problem in learning in school education that is still widely encountered is the lack of student activeness is about the lack of student activeness in learning so that it causes low student learning outcomes. Teaching and learning process activities that were originally only centered on the teacher (teacher centered), where educators prepare and provide as much information as possible to learners while learners do not actively participate in learning. Meanwhile, students do not actively participate in learning. PBL (Problem Based Learning) is a learning concept that can improve students' critical thinking skills in the era of improve students' critical thinking skills in the current era of globalization.

This learning model begins by raising a problem from the real life of learners, then learners real life, then learners investigate and solve the problem by using a problem-solving approach. The learning model can increase the activeness and creativity of learners compared to conventional learning models (Zahrah et al., 2018). This can be seen from the learners' response to the problems they face and how the learners find a way out of the problem (Zahrah et al., 2018. Problem-based learning models can improve learners' critical thinking skills in solving problems. One of the materials in chemistry that is difficult to understand is salt hydrolysis.

The concept of salt hydrolysis material will be easier to understand with

laboratory media Laboratory media used in learning chemistry, namely, reel laboratories and virtual laboratories. In salt hydrolysis material, students generally acquire knowledge about salt hydrolysis only from reading books, and through memorization so that students do not understand the concept of the material through memorization so that students do not understand the concept of the material. Such learning will not be meaningful for students and in the end students will feel bored to participate in learning activities that will have an impact on learning outcomes will feel bored to take part in learning activities which will have an impact on student learning outcomes themselves student learning outcomes themselves. Therefore, in the salt hydrolysis material, it is needed media and the right learning model to provide meaningful learning for students for student In the reel laboratory, practicum activities are carried out in a laboratory equipped with tools and materials, and students observe directly, while virtual laboratory practicum activities do not use real tools and materials and students observe indirectly.

Practical activities carried out with real laboratory media use tools and materials provided in the laboratory room. Learners can carry out experimental activities and observe the results of experiments directly. With the practicum activities in a chemistry lesson, it will certainly increase the learning activities of students and increase their understanding of the concept of the material. Some relevant studies include the results of research (Siregar & Simatupang, 2020) suggesting that the learning outcomes of students taught with the Problem Based Learning learning model are higher than the learning outcomes of students taught with the Direct Instruction learning model on acid-base material in class XI even semester at SMA N 2 Percut Sei Tuan. The results of research (Penn & Ramnarain, 2019) show that the use of virtual laboratories can improve student learning outcomes. Furthermore, the results of research from (Fitriana et al., 2019) show that the results in the application of Problem Based Learning learning increased student learning activity in chemistry subjects in class X SMAN Plandaan Jombang (Harahap et al., 2021) stated that the class that was treated with a virtual laboratory had better learning outcomes than the real laboratory on the subject matter of acid-base. Based on the above background, the researcher wants to conduct research on "Differences in Student Activities and Learning Outcomes with the Application of Problem Based Learning Assisted by Real Lab and Virtual Lab Media on Salt Hydrolysis Material at SMAN 17 Medan

▪ METHOD

The research was conducted on two classes, the first class as the experimental class I and the second class as experimental class II. This research design uses the Pretest - Posttest Group Design model with T1 and T2 designs, each of which is an initial test and final test, while X and Y are treatments, namely the learning model and media use

Table 1. Research Design

Class	Pretest	Treatment	Posttest
Eksperiment I	$\mathbf{T_1}$	X	$\mathbf{T_2}$
Eksperiment II	$\mathbf{T_1}$	Y	$\mathbf{T_2}$

This research was conducted at SMA Negeri 17 Medan, carried out in the even semester of the 2023/2024 school year. Sample determination using Purposive Sampling

technique. This study used 2 experimental classes, namely experimental class I, which is a class that applies the PBL model with real laboratory media while experimental class II, which is a class that applies the PBL model with virtual laboratory media. Both classes were given a pretest to determine the initial ability of students in both experimental classes. After testing the normality and homogeneity of each data obtained. The research data were analyzed using descriptive statistical analysis methods and inferential statistics. Descriptive statistical analysis techniques are used to describe the achievement of each variable. While for inferential statistical analysis (comparational techniques) to test the hypothesis which then draws conclusions about chemistry learning outcomes obtained by using PBL learning models with real laboratories and PBL learning models with virtual laboratories. Statistical analysis is calculated by manusal formula with the help of miscrosoft excell

▪ RESULTS AND DISCUSSION

The data analysis technique used in this research is t-test. Prerequisite tests must be met before conducting the t-test, namely normality and homogeneity tests.

a. Normality Test

In this study, data normality testing used the Chi Square Test ($\chi 2$). From the results of the research conducted, it was found that the data from the test results, namely the pretest and posttest data and the data from the non-test results were normally distributed. After the calculation is obtained, the calculated Chi Square value ($\chi 2$) of the two experimental classes is smaller than the Chi Square table price at the 0.05 significance level, namely 11.7, so it can be said that the data is normally distributed data is normally distributed.

Table 2. Normality Test of Pretest and Posttest Data of Experiment Class I

Data	X- Count	X-Table	Description
Pretest	7,181	11,07	Normal
Posttest	6,68	11,07	Normal

Based on the table above, it can be seen that the Chi Kuadrat value calculated from the Pretest and Posttest data is smaller than the Chi Square table value. Therefore, it can be stated that the test data before the study and after the study are normally distributed at a significance level of 0.05. after the study are normally distributed at the 0.05 significance level.

Table 3. Normality Test of Pretest and Posttest Data of Experiment Class II

Data	X- Count	X-Table	Description
Pretest	6,48	11,07	Normal
Posttest	7,54	11,07	Normal

The table above shows that the data from the Pretest and Posttest results in experimental class II has a calculated Chi Square value smaller than the Chi Square table value at the 0.05 significance level. So, it can be stated that the data obtained from experimental class II both pretest and posttest have normal distribution.

Table 4. Normality Test of Non-Test Result Data

Data	X- Count	X-Table	Description
Eksperiment I	4,90	11,07	Normal
Eksperiment II	6,88	11,07	Normal

From the table presented above, it can be seen that the value of Chi Kuadrat value of experimental class I and experimental class II is smaller than the Chi Square table value at the 0.05 significance level. Thus, it can be stated that the non-test data in experimental class I and experimental class II are normally distributed.

b. Homogenity Test

The homogeneity test is carried out to determine whether the sample used comes from homogeneous data. The homogeneity test in the study was carried out using the Two Group Sample Homogeneity Test formula with the help of Microsoft Excel. Testing the homogeneity of data variance of two or more sample groups is done with the F test. The results obtained after the F test are presented in the table below.

Table 5. Homogeneity Test of Pretest and Posttest Data Results

Data	F- Count	F-Table	Description
Pretest	0,78	1,84	Homogenous
Posttest	1,07	1,84	Homogenous

From the table above, it shows that the F count obtained from the homogeneity test is smaller than the F table at the homogeneity test of the variance of the two groups is smaller than the F table at the significance level of 0.05, which is 1.84, it can be stated that the pretest and posttest data are homogeneous posttest homogeneous there is no difference in the data variance of experimental class I and experimental class II.

c. Hypothesis Testing

After knowing that the data is normally distributed, homogeneous in nature then the hypothesis test can be carried out, namely the hypothesis test for the test of the difference between the means of two independent sample groups with t-test. This t-test is conducted with a significance level of significance level $\alpha = 0.05$, the criteria for selecting hypothesis testing is to accept a different hypothesis (Ha) and reject the null hypothesis (Ho) if the total t count is greater than the t table value, with degrees of freedom (db) is greater than the t table value, with the degree of freedom (db) equal to n-1.

Table 6. Activity Data Hypothesis Test Results

Data Class	$\mathbf{t_{Count}}$	$\mathbf{t_{table}}$	**Description**
Experimental Class I $\bar{X}$ = 84,28 S^2 = 26,34 n =32	3,63	2,042	There is a difference in student learning activities between experimental class I and experimental class II

Experimental Class II $\bar{X}$ = 78,50 S^2 = 54,58 n = 32			

From the table above, it can be seen that the t distribution data (t-table) of t (0.05)(32) is 2.042 while the t-count obtained is 3.63. Because the t-count price is greater than the t-table price, the t-count is in the critical area, which means that Ha is accepted and Ho is rejected, it can be concluded that there is a significant difference between the learning activities of students who are taught by the teacher. That there is a significant difference between the learning activities of students who are taught with the Problem Based Learning model with the help of real lab media, and those who are taught with the Problem Based Learning model with the help of real lab media real lab media, and those taught with the Problem Based Learning model with the help of virtual lab media.

Table 7. Hypothesis Test Results of Learning Outcome Data

Data Kelas	t_{hitung}	t_{tabel}	Keterangan
Experimental Class I $\bar{X}$ = 87,19 S^2 = 46,67 n =32 **Experimental Class II** $\bar{X}$ = 81,09 S^2 = 54,41 n = 32	3,43	2,042	There are differences in student learning outcomes between experimental class I and experimental class II

From the results of data processing, the results shown in the table above show that the t-count value is greater than the t-table. Criteria for accepting Ha if t-count is greater than t-table. Therefore, it can be stated that there is a difference between the learning outcomes of students taught with the Problem Based Learning model with the help of real lab media, and those taught with the Problem Based Learning model with the help of virtual lab media.

This research was conducted at SMA Negeri 17 Medan, this research was conducted by applying the Problem Based Learning model with the help of Real lab media for experimental class I and Virtual lab media for experimental class II. This research centered on salt hydrolysis material. The population members in this study were

all students of class XI MIPA SMA Negeri 17 Medan which amounted to 6 classes. Class samples were obtained by purposive sampling, namely as many as two classes where class XI IPA 2 became the first experimental class taught with Problem Based Learning model with Real Lab media and class XI IPA 5 became the second experimental class taught with Problem Based Learning model with Virtual Lab media.

During the learning process, researchers examined student activity in both experimental classes. After the learning process was completed, namely for three meetings, the next step was carried out a post-test which aims to determine student learning outcomes determine student learning outcomes. After all the data is collected, both non tests and tests, then normality and homogeneity tests were carried out as prerequisites for conducting hypothesis testing where this hypothesis test is useful for answering the formulation of the problem in this study.

Based on non-test data, the average value of student learning activities was obtained in experimental class I it was 84.28 and in experimental class II it was 78.50 For more details, see the image below

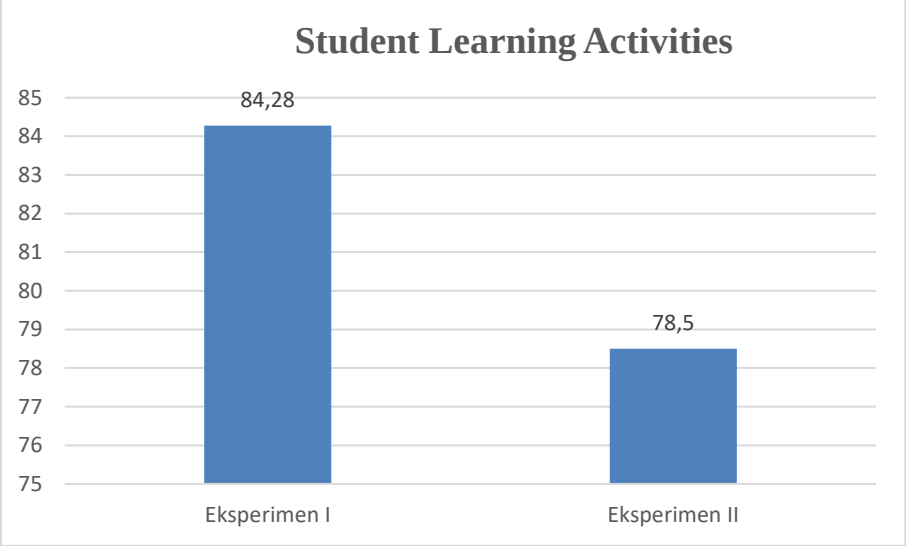

Figure 1. Graph of Student Learning Activities

The value of student learning activities in the experimental class I which is taught using the Problem Based Learning model with Real Lab media is higher than the activity value of students in the experimental class II which is taught using the Problem Based Learning model Virtual Lab media. In the learning process in experimental class I which uses real laboratory media, students play a more active role because students can directly carry out practical work with real tools and materials and observe directly. The experimental results in the experimental class I practicum were obtained from a series of concrete steps, then students drew conclusions by comparing the results obtained with universal indicators. When conducting experiments and drawing conclusions, students in experimental class I were active and critical in asking questions, apart from that, students were active in group activities. Meanwhile, in the experimental class II, which was taught using the same model as virtual laboratory media, students were less active, especially in asking questions about their findings. Because the virtual laboratory provides accurate results with the numbers shown by the pH meter.

Based on post-test score data, the average student learning outcomes were obtained, where the average learning outcomes in experimental class I were 87.19, while in experimental class II the average student learning outcomes were 81.09. For more details, you can see the following image.

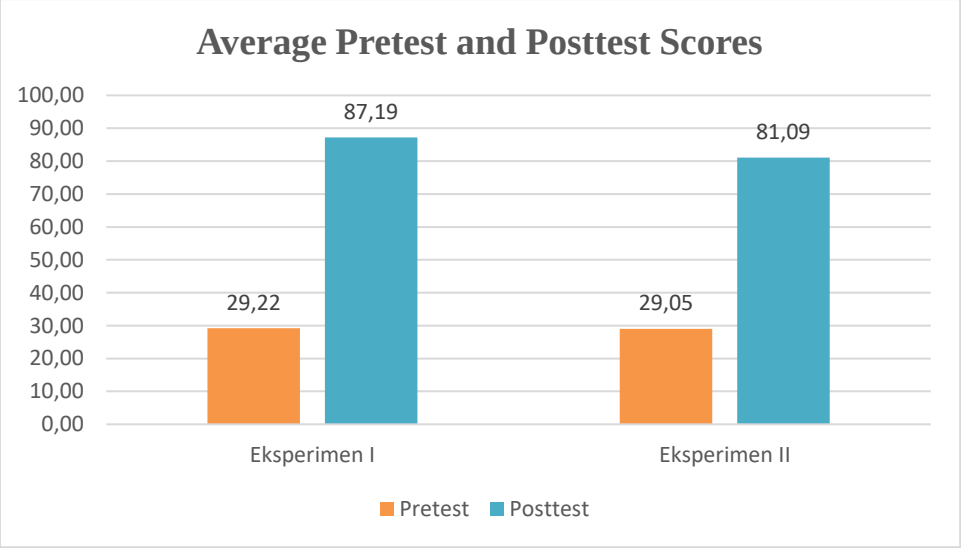

Figure 2. Graph of Student Learning Results

Based on the graph, you can see the average value of student test results before learning and after learning. Based on the learning outcome data obtained in the two experimental classes, there were significant differences between the two experimental classes. This is supported by the results of hypothesis testing with the t-test where the t-count was 3.43 while the t-table at a significance of 0.05 was 2.042. Because the t-count is greater than the t-table, Ha is accepted, which means there is a significant difference between the learning outcomes of students who are taught using the Problem Based Learning model using Real Lab media and students who are taught using the Problem Based Learning model using Virtual Lab media. This is in line with research (Endang Rizkiana et al., 2018) which states that there are differences in student learning outcomes who are taught the same model, namely guided inquiry using real and virtual laboratory media.

Student learning outcomes in experimental class I for students who were taught using the Problem Based Learning model with Real Lab media were higher than the learning outcomes of students who were taught with the same model with Virtual Lab media. This is in line with research (Sari et al., 2019) which states that the learning outcomes of students taught using real laboratory media are higher than virtual laboratories on the subject of reaction rates. In research (Siregar & Simatupang, 2020) it was concluded that the learning activities of students taught using the Problem Based Learning model were higher than the learning activities of students taught using the Direct Instruction learning model on Acid Base material. This is in line with research conducted by researchers where by providing learning based on the Problem Based Learning learning model, it will further encourage students to participate actively during learning.

Based on the presentation of the research results and discussion above, it can be seen that there are differences in learning activities and student learning outcomes that are taught using the same model, namely the Problem Based Learning model using real lab and virtual lab media. The learning activities and learning outcomes of students taught using the PBL learning model using real lab media are better than the activities and

learning outcomes of students taught using the PBL learning model using virtual lab. According to researchers, this is caused by the use of learning media where students play a more active role in real laboratories compared to virtual laboratories.

The cause of differences in learning activities and student learning outcomes in research is not only in terms of learning media. One of them is caused by learning time in class, where in the experimental class II which uses virtual lab media it is carried out during the day, so that many students feel bored and cannot focus on learning because they are tired and feel like going home immediately. This is what causes student activity. low. Chemistry lesson material, especially salt hydrolysis, which contains calculations requires high concentration to understand, so the right time is needed to study it. Low learning activities and student learning outcomes are also caused by their classmates, where their classmates sometimes invite them to talk about things outside of learning, this causes students not to listen and not fully concentrate on learning.

▪ CONCLUSION

After the researcher conducted research and analyzed the research data, the researcher concluded that there was a significant difference between the activities and learning outcomes of students who were taught using the Problem Based Learning learning model with Real Lab media and the learning activities of students who were taught with the Problem Based Learning model with virtual Lab media.

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