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The Effectiveness of Blended-Discovery Learning Model in Improving Mastery of Acid-Base Concepts

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Abstract : The Effectiveness of Blended-Discovery Learning With a Virtual Laboratory to Improve Mastery of Acid-Base Concepts. This study aims to describe the effectiveness of blended-discovery learning in increasing mastery of acid-base concepts. The method in this study is a quasi-experimental design with a non-equivalent control group design. The population in this study were all students of class XI MIPA at SMA Negeri 13 Bandar Lampung in the academic year 2021/2022. Sampling was done using random sampling technique so that the experimental class was obtained, namely class XI MIPA 3 which was given learning treatment using a blended-discovery learning model and class XI MIPA 1 as a control class using conventional blended-learning. Based on the results of the difference in the two averages (t-test) conducted, the average n-Gain mastery of the acid-base concept of students in the control class was 0.42 with the "medium" category and in the experimental class was 0.74 with "high" category. The results of the effect size test show that 86.5% of the increase in the mastery of the acid-base concept of students in the experimental class is influenced by blended-discovery learning with the help of a virtual laboratory. Based on the results of data analysis conducted, it can be concluded that the blended-discovery learning model is effective and has a "big" influence in increasing students' mastery of acid-base concepts.

Keywords: *acid-base, blended learning, discovery learning, effectiveness, concept mastery*

Abstrak : Efektivitas Model Pembelajaran Blended-Discovery Learning Dalam Meningkatkan Penguasaan Konsep Asam Basa. *Penelitian ini bertujuan untuk mendeskripsikan efektivitas pembelajaran blended-discovery learning dalam meningkatkan penguasaan konsep asam-basa. Metode dalam penelitian ini adalah quasi eksperimen dengan desain non equivalent control group design. Populasi dalam penelitian ini adalah seluruh siswa kelas XI MIPA di SMA Negeri 13 Bandar Lampung tahun pelajaran 2021/2022. Pengambilan sampel dilakukan dengan teknik random sampling sehingga didapatkan kelas eksperimen yaitu kelas XI MIPA 3 yang diberi perlakuan pembelajaran menggunakan model blended-discovery learning dan kelas XI MIPA 1 sebagai kelas kontrol yang menggunakan pembelajaran konvensional secara blended-learning. Berdasarkan hasil uji perbedaan dua rata-rata (uji-t) yang dilakukan, rata-rata n-Gain penguasaan konsep asam-basa peserta didik pada kelas kontrol sebesar 0,42 dengan kategori "sedang" dan pada kelas eksperimen sebesar 0,74 dengan kategori "tinggi". Hasil pengujian effect size menunjukkan bahwa 86,5% peningkatan penguasaan konsep asam-basa peserta didik pada kelas eksperimen dipengaruhi oleh pembelajaran blended-discovery learning dengan bantuan laboratorium virtual. Berdasarkan hasil analisis data yang dilakukan, dapat disimpulkan bahwa model blended-discovery learning efektif dan mempunyai pengaruh yang "besar" dalam meningkatkan penguasaan konsep asam-basa peserta didik..*

Kata Kunci: *Struktur Atom, Miskonsepsi, Three-tier Multiple Choice*

- **INTRODUCTION**

Education is a conscious and planned effort to create a learning atmosphere and learning process so that students are active. With education, students experience changes for the better in themselves so that they can be useful for the surrounding community (Hamalik, 2005). On the other hand, the spread of the corona virus has continued to soar since it first entered Indonesia, so the number of Covid-19 patients has also continued to increase by a large number. For this reason, the Indonesian government continues to strive to overcome the current Covid-19 pandemic by taking various steps such as implementing strict health protocols, such as PSBB, WFH and various other efforts. These various government policies are certainly very influential in various fields of life, especially in the field of education.

One of the impacts in the field of education is the implementation of bended learning or blended learning. Nasution (2019) and Dewi et al., (2019) State that blended learning is a combination of face-to-face learning in the classroom and online learning that is actively carried out to improve independent learning, whether carried out independently or independently. collaboration. Based on the results of observations made to one of the chemistry subject teachers at SMA Negeri 13 Bandar Lampung, it is known that during the learning process during the pandemic, students are not given the opportunity to discuss and seek their own knowledge by relating it to the knowledge that has been previously obtained. Due to the limited time to study in class, as a result, students have not been able to find their own knowledge but face-to-face time in class has been completed. This has an impact on the low learning outcomes of students, especially in chemistry learning whose concepts are abstract.

The application of blended learning chemistry learning in the learning process needs to be integrated with the learning model recommended in the 2013 Curriculum, one of which is discovery learning (Dewi et al., 2019). Discovery Learning is a series of learning activities that maximally involve all students' abilities to seek information and investigate systematically, critically, and logically so that they can find their own knowledge (Musdalifa et al., 2020). This is in accordance with the research results of Wijiastuti and Nurhayati (2021) which revealed that the blended learning-based discovery learning model can improve students' understanding of concepts in the excretory system material.

One of the chemical materials that requires a deep understanding of the concept is acid-base. In acid-base material, students are required to understand every difference in acid-base concepts and theories as well as the characteristics of strong acid and weak acid solutions and strong bases and weak bases. Understanding the correct concept by students will determine the quality of the next learning process, otherwise understanding the wrong concept will lead to errors in the application and development of further concepts. This causes the need for appropriate methods and models in the learning process, this can be trained through discovery learning stages such as making guesses, collecting data, analyzing, and drawing conclusions so that students can construct an understanding of new concepts with concepts that have been obtained previously (Nikmah, 2018).).

Chemistry learning in schools ideally teaches theory and laboratory practice that can help build students' concepts and theories (Pujiati, 2015). Practical activities in the laboratory will make it easier for students to understand what they are learning, but in reality the implementation of practicum in schools still has many obstacles such as conditions that make it impossible to carry out practicum in the laboratory as during the current pandemic (Sugiharti & Sugandi, 2020) . One solution to overcome the limitations or absence of laboratory equipment and to improve understanding of chemical concepts, can be done through a Virtual Laboratory (Sugiharti & Sugandi, 2020). In addition, in the virtual laboratory there is a feature to display a visualization of a submicroscopic representation of an acid-base solution that can make it easier for students to understand the concept of acid-base so that it has a positive influence on student learning outcomes (Musdalifa et al., 2020).

Based on the description of the background above, a research entitled "The Effectiveness of the Blended-Discovery Learning Model in Improving the Mastery of Acid-Base Concepts is carried out").

- **METHOD**

Population and Sample

The population in this study were students of class XI MIPA SMA Negeri 13 Bandar Lampung for the academic year 2021/2022, totaling 140 students and spread over four classes. Sampling using random sampling technique, so that obtained class XI IPA 3 with a number of 35 students as the experimental class and XI MIPA 1 with a total of 35 students as the control class.

Research Methods and Design

The method used is a quasi-experimental design with a pretest-posttest non-equivalent control group.

Research variable

The independent variable in this study is the learning model used, namely Blended-Discovery Learning with the help of a virtual laboratory and blended-learning with the help of a virtual laboratory. As the dependent variable is the understanding of students' concepts on the Acid-Base material.

Research Instruments

The research instrument used was a pretest-posttest question of mastering the concept of acid-base material which consisted of five essay questions, and an observation sheet on the teacher's ability to manage learning using the blended-discovery learning model. The validity and reliability of the instrument were analyzed with SPSS version 25.0. The instrument is said to be valid if rcount > rtable with a significant level of 5%. The reliability of the questions is determined by the Cronbach Alpha formula. The criteria for the degree of reliability are shown in Table 1.

Table 1. Criteria for the degree of reliability

Degree of Reliability	Criteria
$0,80 < r11 \leq 1,00$	Very high
$0,60 < r11 \leq 0,80$	Tall
$0,40 < r11 \leq 0,60$	Currently
$0,20, < r11 \leq 0,40$	Low
$0,00 < r11 \leq 0,20$	Unreliable

Data Analysis and Hypothesis Testing

The effectiveness of the blended-discovery learning model is determined from the student's achievement in increasing the mastery of the acid-base concept as measured by the n-Gain value (the difference between the posttest and pretest scores) with the following formula:

$$n - Gain = \frac{\%\text{Posttest score} - \%\text{Pretest score}}{100 - \%\text{Pretest Score}}$$

The results of the calculation of the average n-Gain are then interpreted using the criteria of (Hake, 1998). The criteria for the average n-Gain according to Hake are presented in Table 2:

Table 2. Criteria for n-Gain

Gain value (g)	Category
$(g) \geq 0,7$	Tall
$0,3 \leq (g) < 0,7$	Currently
$(g) < 0,3$	Low

The effect size of the blended-discovery learning model on the improvement of students' mastery of acid-base concepts was determined based on the test scores for the two average

differences (t test). Before the t-test was carried out, the normality test and homogeneity test were carried out on the n-Gain value using SPSS version 25.0 for windows with a significant level of 5%. The hypothesis for the normality test is to accept Ho if the sample comes from a normally distributed population, while the homogeneity test accepts Ho if the sample has a homogeneous variance. The test criteria are sig. Shapiro-Wilk > 0.05 and reject Ho otherwise (Sudjana, 2005). If the sample is normally distributed and homogeneous, then the parametric statistical test used is the t-test with the criteria of accepting Ho if the value is significant or sig.2-tailed> 0.05, which means there is a significant difference in n-Gain in both classes and rejects Ho if on the contrary. Based on the t-value obtained in the t-test, further calculations are carried out to determine the size of the effect with the formula according to Jahjouh (2014):

$$\mu^2 = \frac{t^2}{t^2 + df}$$

Using the criteria according to Dincer (2015) shown in Table 3 :

Table 3. Effect size criteria

Effect size (μ)	**Criteria**
$\mu \leq 0{,}15$	Effect is negligible (very small)
$0{,}15 < \mu \leq 0{,}40$	Small effect
$0{,}40 < \mu \leq 0{,}75$	Medium effect
$0{,}75 < \mu \leq 1{,}10$	Big effect
$\mu > 1{,}10$	Huge effect

- **RESULT AND DISCUSSION**

Based on the research that has been done in the experimental class and the control class at SMA Negeri 13 Bandar Lampung, the data obtained in the form of test results are data on pretest and posttest values of mastery of acid-base concepts. The data that has been obtained is then processed with the help of SPSS software version 23.0 and Microsoft Office Excel

Pretest And Posttest Scores

The effectiveness of the blended-discovery learning model with the help of a virtual laboratory can be seen from the average n-Gain value obtained between the control class and the experimental class. Before getting the average value of n-Gain, first the average pretest and posttest scores in the two classes were calculated. The average pretest and posttest results for the experimental class and control class are shown in Figure 1 :

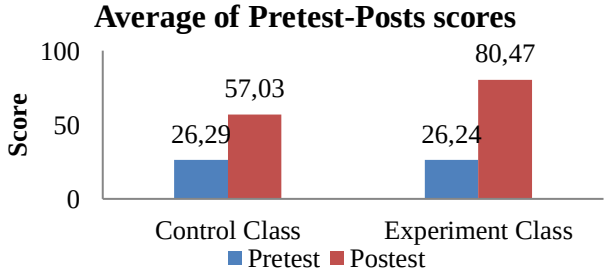

Figure 1. Average pretest and posttest scores for mastery of acid-base concepts

Percentage Of Student Answers On Each Question Item

In both classes there are also differences in the percentage of students' answers in each item which can be seen in Figure 2 :

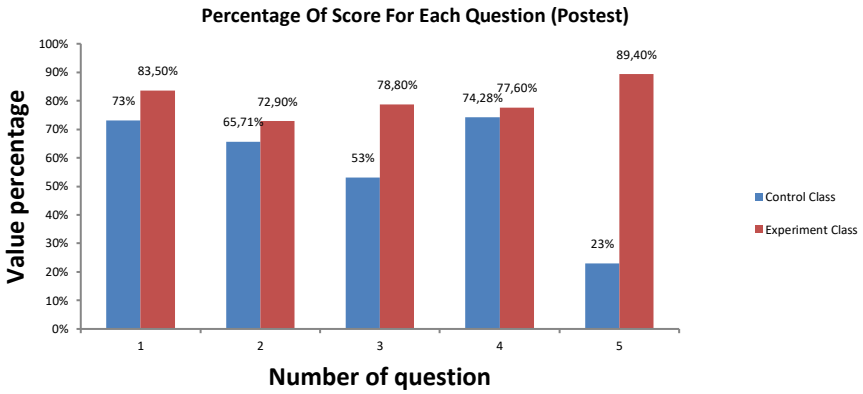

Figure 2. Percentage of students' answers to each question item

Based on the students' answers in Figure 5, the lowest percentage of students' answers is in question number 5. While in the experimental class, the highest percentage of students' answers is in question number 5. This is because question number 5 has category C4 (analyzing) which asks students to calculate the pH if the mass is known. To be able to answer question number 5, students must be able to relate it to the mole concept.

In the control class, most of the students only wrote down the formula to find pH and most of them did not answer at all, this was because students were only used to memorizing the formula without understanding the meaning of the formula. In the experimental class, most of the students could answer question number 5 completely and correctly. This is because the experimental class has been accustomed to using constructivism learning that connects old knowledge to get new knowledge, this is in accordance with the results of research by Wijiastuti and Nurhayati (2021) which states that constructivism learning can make students more active in learning. constructing a concept because it is done with steps that include observing, asking, trying, associating, and communicating. According to Umar et al. in Wijiastuti and Nurhayati (2021) if students are actively involved in learning it will create a pleasant learning atmosphere and will develop students' understanding of concepts in the classroom.

The highest percentage of students' answer scores in the control class was found in item number 4, in addition to item number 4 both in the experimental class and in the control class were not much different. This is because question number 4 has category C4 (analyzing) which asks students to determine which solution is a strong acid and a weak acid based on sub-microscopic images. Both the experimental class and the control class were mostly able to answer properly and correctly, this is because both classes use blended-learning learning that integrates a virtual laboratory, namely PhET Simulation as a practical medium. In the PhET Simulation there is a feature that displays a sub-microscopic image of an acid and base solution so that students can easily understand a solution of strong acid and weak acid when viewed from the sub-microscopic image. This is supported by the research results of Musdalifa, Ramdani, and Danial (2020) which say that blended-learning has a positive influence on student learning outcomes on buffer solution material.

Average N-Gain

Based on the research conducted, the average n-Gain ability to master the concept of acid-base in the experimental class and control class can be seen in Figure 3.

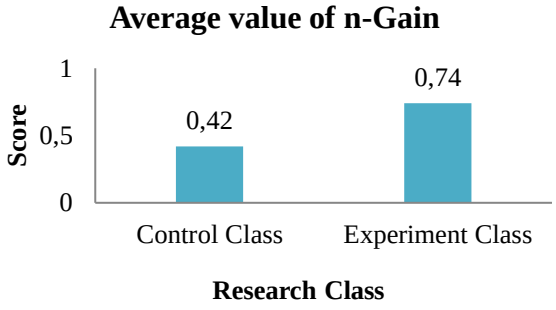

Figure 3. Average n-Gain value of mastery of acid-base konsep concept

In Figure 3, information is obtained that the average value of n-Gain for mastery of acid-base concepts in the experimental class is 0.74 and in the control class is 0.42. Based on the criteria of Hake (2002), the n-Gain value of the mastery of the acid-base concept of students in the experimental class is in the "high" criteria, in the control class is included in the "medium" criteria.

Test the difference between the two averages

Before testing the difference between the two averages, the normality test and homogeneity test were first carried out. The normality test was tested using the Kolmogrov-Smirnov test with a significance level of > 0.05. The test results using SPSS version 25.0 are presented in Table 4 and Table 5.

Table 4. The results of the normality test for the experimental class and the control class

Research Class	**<g>**		***n-Gain***	
			Sig. Test of Normality Kolmogrov-Smirnov	**Criteria**
Experiment (XI MIPA 3)	0,74	4	0,200	*sig. > 0,05*
Control (XI MIPA 1)	350,42	5	0.200	

Table 5. The results of the homogeneity test of the experimental class and the control class

Research Class	**<g>**		**Homogenitas**	
			Score *sig.*	**Criteria**
Experiment (XI MIPA 3)	0,74	4	0,628	*sig.* > 0,05
Control (XI MIPA 1)	0,42	5		

Based on the table above, it is known that the results of the normality test for the n-Gain value in the experimental class and control class have a sig value > 0.05, so the test decision is to accept H0 and reject H1, which means that the research data obtained came from a normally distributed population. The homogeneity test of the sample was carried out using the SPSS Statistics 25.0 program by looking at the One Way ANOVA value. The results of the homogeneity test of the n-Gain value in the experimental class and control class show that the value of sig. > 0.05 so that the decision to accept H0 and reject H1 is taken, which means that the research data obtained has a homogeneous variance.

Table 6. The test results of the difference between the two averages of the experimental class and the control class

Class	**average**	**t-test**	
	n-Gain	**sig. (*2-tailed*)**	**Criteria**
Experiment (XI MIPA 3)	0,74	0,000	sig. (*2-tailed*) < 0,05
Control (XI MIPA 1)	0.42		

The results of the two-average difference test on the n-Gain value of students' conceptual mastery in the two research classes showed a sig (2-tailed) value of 0.000 <0.05 so the test decision was to reject H0 and accept H1 which means 1x > μ2x: Average The average n-Gain of students' understanding of the concept of acid-base using Blended-Discovery Learning with the help of a virtual laboratory is higher than the average n-Gain of understanding the concepts of students using conventional blended-learning.

Effect Size Test

The results of the calculation of the effect size of blended-discovery learning in improving students' mastery of acid-base concepts can be seen in Table 7 as follows:

Table 7. The results of the test of the effect of blended-discovery learning in increasing mastery of acid-base concepts

Class	**f**	**t_{-test}**	**t^2**	**μ^2**	**Kriteria**
Experiment	4 6	20.603	424.48	0.865	Big Effect
Control	5 8	15.861	251,57	0.787	Big Effect

The results of the effect size calculation show that the effect size value of the experimental class is 0.865 with the criteria according to Dincer (2015) namely "large effect" then the control class has an effect size value of 0.536 with the criteria of "medium effect". So that learning with blended-discovery learning can be said to have a greater effect on increasing students' mastery of concepts than blended-learning learning with conventional methods.

This is because in the experimental class the teacher shows more learning with learning based on a scientific approach, namely the blended-discovery learning model. Students are more required to be active in learning and given the opportunity to seek their own knowledge and build concepts independently. This is in line with the results of research by Nikmah (2018), Putri (2017), Anisa (2017) which concludes that the discovery learning model can improve students' mastery of concepts..

The results of the data analysis of the teacher's ability to manage learning

The improvement of students' ability to master the concept of acid-base is influenced by the teacher's ability to manage learning well. The teacher's ability to manage this learning was observed during direct learning by 2 observers. The results of the observations of the two observers on the teacher's ability to manage learning during this study are presented in Table 8.

Table 8. Observation data on the ability of teachers to manage learning

No	Aspect Evaluation	%Teacher's ability the meeting						Aver a-ge	Criteria
	Discovery Learning Syntax	3.40	3.63	6.12	9.54	1.81	4.09	3.03	High
	Sistem Sosial	0	0	0	5	0	2.5	1.25	High
	Prilaku Guru	0	2.5	0	5	0	5	2.08	Very high

Based on the results of observations which were then analyzed, it was obtained that the average percentage of learning implementation had increased for six meetings. The results obtained from the teacher's ability to manage learning were assessed by two observers, namely partner teachers and research partners. The observed aspect is the implementation of the syntax (steps) of the discovery learning model which consists of 6 steps. The steps of discovery learning are; stimulation (stimulation), identification of problems (problem statement), data collection (data collection), data processing (data processing), verification (verification), and generalization (generalization). The second aspect is the social system which contains the activities of the teacher as a facilitator and the activities of students in participating in learning activities.

The results obtained that the average percentage of teachers' abilities in managing learning from meetings 1 to 6 increased. At meetings 1 and 2, the ability of teachers to manage learning is still low because students are not accustomed to using the blended-discovery learning model, so that students are not conducive to learning, as a result, teachers are not effective in managing learning. At meetings 3 and 4 there has been an increase where teachers are able to manage learning using the blended-discovery learning model. At meetings 5 and 6, the teacher was able to apply the blended-discovery learning model well, seen from the average percentage of teachers' ability to manage learning in the "very high" category. It can be concluded that the teacher's ability to manage learning from the aspects of introduction, syntax, closing, time management and overall mastery of the material has been running well and maximally. This means that the blended-discovery learning model is effective in increasing students' mastery of acid-base concepts. The results of this study are supported by research conducted by Anisa, Rudibyani, & Sofya (2017) which concludes that the discovery learning model is practical and effective in increasin students' learning motivation and mastery of concepts.

• CONCLUSION

Based on the results of data analysis and discussion, it can be concluded: (1) The blended-discovery learning model with the help of a virtual laboratory is effective in improving students' mastery of acid-base concepts. This can be shown through the teacher's ability to manage learning in the "high" category, as well as the significant difference between the n-Gain values in the control and experimental classes, where the experimental class has a higher average n-Gain value in the "large" category. and (2) the blended-discovery learning model has a "big" size of influence in increasing students' mastery of acid-base concepts.

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