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The Effectiveness of Blended Learning with Discovery Learning Model on Buffer Solution Materials to Improve Science Process Skills

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Abstract : The Effectiveness of Blended Learning with Discovery Learning Model on Buffer Solution Materials to Improve Science Process Skills. This study aims to describe the effectiveness of discovery learning model on buffer solution materials to improve students' science process skills. This research is a quasi-experimental study with the matching-only pretest and posttest control group design. Population on this study is all students of class XI IPA of SMAN 1 Sukadana East Lampung in even semester of the 2021/2022 academic year. The sampling technique used purposive sampling and obtain class XI IPA 3 and class XI IPA 2 as experimental class and control class, respectively. Hypothesis testing used the analysis of the average post-test value calculation using the difference test of two average by t-test. The results showed that the average post-test scores of students' science process skills in the experimental class were significantly different from post-test scores in the control class, and the average n-gain of students' science process skills in the experimental class is in the high category of 0,71. Thus, it can be concluded that blended learning with discovery learning model is effective to improve students' science process skills.

Keywords: discovery learning, blended learning, buffer solution, science process skills.

Abstrak : *Efektivitas Blended Learning dengan Model Discovery Learning pada Materi Larutan Penyangga untuk Meningkatkan Keterampilan Proses Sains.* *Penelitian ini bertujuan untuk mendeskripsikan efektivitas blended learning dengan model discovery learning pada materi larutan penyangga untuk meningkatkan keterampilan proses sains (KPS) siswa. Penelitian ini adalah kuasi eksperimen dengan desain the matching-only pretest and posttest control group design. Populasi penelitian ini seluruh siswa kelas XI IPA SMAN 1 Sukadana Lampung Timur semester genap Tahun Ajaran 2021/2022. Teknik pengambilan sampel menggunakan teknik purposive sampling dan diperoleh kelas XI IPA 3 sebagai kelas eksperimen dan XI IPA 2 sebagai kelas kontrol. Pengujian hipotesis menggunakan analisis perhitungan rata-rata nilai postes berupa uji perbedaan dua rata-rata dengan uji-t. Hasil penelitian menunjukkan bahwa rata-rata nilai postes KPS siswa di kelas eksperimen berbeda secara signifikan dengan nilai postes di kelas kontrol, dan rata-rata n-gain KPS siswa di kelas eksperimen berkategori tinggi sebesar 0,71. Dengan demikian, dapat disimpulkan bahwa blended learning dengan model discovery learning efektif untuk meningkatkan KPS siswa.*

Kata kunci: *discovery learning, blended learning, larutan penyangga, keterampilan proses sains.*

- **INTRODUCTION**

Chemistry learning requires students to learn the concepts and principles of chemistry which aims to improve the abilities possessed by students (Arif et al., 2018). Chemistry includes knowledge of chemistry in the form of facts, theories, principles, and laws based on scientific findings and scientific work (Kurniawati and Amarlita, 2013). The characteristics of chemistry are that most chemical concepts are abstract, chemical concepts are generally a simplification of the actual situation, and chemical concepts are sequential and tiered (Kean and Middlecamp, 1985). Therefore, in learning chemistry the teacher must be able to package and present the material to be taught in such a way that it can help students understand the material being taught properly.

In presenting chemistry material in high school, it cannot be separated from the demands of the applicable curriculum. Changes in curriculum require a change in orientation in learning chemistry. The 2013 curriculum applied in high school today does not only refer to the process of developing students' cognitive aspects, but also refers to the formation of students' attitudes (affective) and psychomotor aspects (Rahmah, 2021). To achieve this, in learning in schools, students must be actively involved and participate in the process of acquiring knowledge, while the teacher acts more as a facilitator to achieve these goals and stimulate curiosity and motivate students' abilities (Hamalik, 2005). In addition, chemistry learning also requires skills to find out, think scientifically and be able to solve problems in everyday life. Students' skills in finding out are called science process skills which include observing, classifying, measuring, predicting, communicating and concluding (Dimyati and Mudjiono, 2006).

These science process skills train students to be able to find facts, build concepts through activities in the laboratory or experiences in everyday life. Students who are trained in KPS are expected to be able to find a new concept, principle or theory as a development of an existing or previously acquired concept. Through science process skills, students can find concepts, not just memorize concepts, so that students are able to apply science process skills in real-world contexts.

Based on the results of interviews conducted with chemistry teachers at SMA Negeri 1 Sukadana, East Lampung, it was found that chemistry learning at the beginning of the Covid-19 pandemic was fully carried out online. In the online learning, the teacher uses Google classroom and WhatsApp class groups. The result in fully online learning makes it more difficult for students to understand the material being taught compared to offline learning. This is in accordance with the results of research conducted by Muhali et al., (2021) which showed that the online system of chemistry learning in the even semester of the 2019/2020 academic year during the Covid-19 pandemic was less effective, so face-to-face learning was still needed. The learning carried out tends to make students passive, less active, and not guided in the process of finding concepts. During chemistry learning, students never do practicum, so students' science process skills are not trained. This shows that the applied learning is less able to train science process skills so that students' science process skills are low. Therefore, we need a learning system that can combine online and offline learning so that students are active and can carry out practical activities. Learning with a blended learning system is considered appropriate as an alternative learning because it can combine offline and online learning processes.

One of the Basic Competencies in chemistry lessons that must be mastered by students in class XI even semesters that must be achieved in the 2013 curriculum is 3.12 Explaining working principles, calculating pH, and the role of buffer solutions in living organisms, and 4.12 Making buffer solutions with a certain pH (Permendikbud, 2016). To achieve these basic competencies, the 2013 curriculum mandates that learning must go through a series of scientific processes such as observing, formulating problems, making observations, making hypotheses, conducting experiments and drawing conclusions. The series of processes and steps are in accordance with the discovery learning model, because discovery learning is a series of learning activities that place students with a problem so that students can find ways to solve the problem systematically in accordance with the scientific process or scientific process (Bruner, 1977). Discovery learning learning model has several stages or procedures that must be carried out in teaching and learning activities in general, namely stimulation, problem statement, data collection, data processing, verification, and generalization (Hosnan, 2014).

Based on the results of the relevant studies showing that learning with discovery learning models is effective in improving students' learning outcomes and critical thinking skills (Nugrahaeni et al., 2017), video-assisted discovery learning models affect high school students' chemistry learning outcomes on the material solubility and solubility product (Atika et al. ., 2018), discovery learning-based worksheets on buffer solution material are effective for improving students' science process skills (Damayanti et al., 2018), as well as practical, effective and influential discovery learning models for improving flexible thinking skills on buffer solution materials (Fidiana et al., 2018).

The results also show that learning with the blended learning system is effective in improving student learning outcomes, these results are due to blended learning combining the positive aspects of face-to-face learning and e-learning (Anggraini, 2019), the application of blended learning to the buffer solution material obtained results student learning completeness has been completed classically, with a very good category, student activity also increases during the application of blended learning, teachers and students also give positive responses to blended learning (Afdhila et al., 2017), there is an effect of applying blended learning to students' science process skills on excretory system material in humans (Sari, 2021). From some of the results of these studies, it can be said that there is an effect of blended learning on students' science process skills and there is a good learning response through the application of blended learning.

Based on the description above, this research was carried out with the title "The Effectiveness of Blended Learning with the Discovery Learning Model on Buffer Solution Material to Improve Science Process Skills".

• METHOD

This study uses experimental research methods in the form of quasi-experimental (quasi-experimental). Form of the design used in this study was the matching-only pretest and posttest control group design (Fraenkel et al., 2012). The purpose of this study to describe the effectiveness of blended learning with discovery learning model on buffer solution materials to improve students' science process skills. This study was conducted at SMA Negeri 1 Sukadana on the even semester of 2021/2022 academic year.

The population in this study were all students of class XI IPA SMA Negeri 1 Sukadana East Lampung for the 2021/2022 academic year, totaling 90 students and spread over 3 classes. The samples in this study were two classes taken from class XI IPA at SMA Negeri 1 Sukadana, namely XI IPA 3 as the experimental class and XI IPA 2 as the control class. The sampling in this study was done by using purposive sampling technique.

Data Analysis and Hypothesis Testing

The data analysis technique used is to convert pretest and posttest scores into pretest and posts values using the formula:

$$\text{Student scores} = \frac{\text{total score of the answers obtained}}{\text{maximum total score}} \times 100$$

To determine the effectiveness of blended learning with the discovery learning model in improving KPS, an n-gain analysis of students from both sample classes was carried out using the formula according to Meltzer (2002):

$$n\text{-}gain\ (g) = \frac{posttest\ score - pretest\ score}{ideal\ score - pretest\ score}$$

After obtaining the n-gain from each student, then the average n-gain for each sample class is calculated using the formula:

$$\text{Class average } n\text{-}gain = \frac{\text{total } n\text{-}gain}{\text{total students}}$$

Then interpret the average n-gain for each sample class with the n-gain criteria presented in Table 1.

Table 1. *N-gain criteria*

***N-gain* (g)**	**Category**
(g) ≥ 0,7	High
0,3 ≤ (g) < 0,7	Average
(g) < 0,3	Low

Analysis of the pre-test data of students in the control class and the experimental class used the two-mean equation test to find out whether the average of science process skills pre-test scores of students in the experimental class were significantly the same as the average of science process skills pre-test scores of students in the control class. Before carrying out the two-average equation test, a normality test was first carried out to find out whether the data came from a normally distributed population and a homogeneity test to find out whether the study sample came from a population with homogeneous variance. The normality test in this study uses the chi-square test with the criteria for accepting H_0 (data normally distributed) if $x^2_{\text{count}} < x^2_{\text{table}}$. The homogeneity test uses the F test with the acceptance criterion H_0 (the data has homogeneous variance) if $F_{count} < F_{table}$ at a significant level of 5%.

Hypothesis testing in this study used a two-difference test on the average of science process skills posttest of students with the t-test which had previously been carried out with prerequisite tests in the form of normality tests and homogeneity tests. Hypothesis formulation for this test is:

$H_0 : \mu_{1x} = \mu_{2x}$: The average of students' science process skills pretest scores in experimental class are the same as control class

$H_1 : \mu_{1x} \neq \mu_{2x}$: The average of students' science process skills pretest scores in experimental class are not the same as control class

Students' activity data was obtained from observations which contained indicators for each aspect studied. Aspects of the activity observed in learning process are asking questions, giving opinions, and responding to other group presentations. Analysis of student activity is carried out by calculating the percentage of each activity for each meeting with formula:

$$\%\ \text{students who do activity i} = \frac{\sum \text{students who do activity i}}{\sum \text{students}} \times 100$$

Description:
i : student activity observed in learning (asking questions, giving opinions, and responding to other group's presentations)

Then interpret data with the interpretation percentage of student activity according to Table 2.

Table 2. Criteria for the level of achievement of student activities

Percentage	Criteria
80,1% - 100,0%	Very Good
60,1% - 80,0%	Good
40,1% - 60,0%	Average
20,1% - 40,0%	Poor
0,0% - 20,0%	Very Poor

(Sunyono, 2012)

- **RESULT AND DISCUSSION**

Based on research that has been done on two research sample classes, research data are obtained in the form of pretest scores, posttest scores, student activity scores as well as data analysis in the form of data analysis in the form of average pretest and posttest data, average n-gain and percentage of student activity.

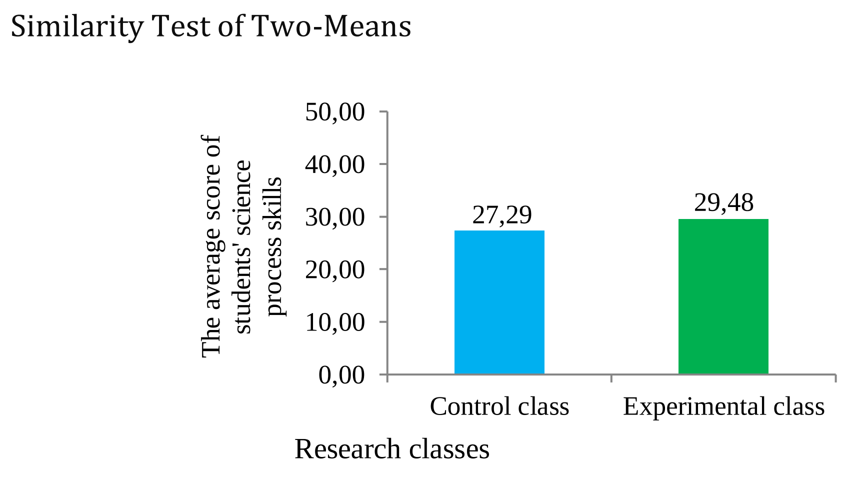

Figure 1. The average score of students' science process skills in experimental and control class

The similarity test of the two averages was used to determine whether the pretest scores of students' science process skills in experimental and control class were statistically significant, which had previously been subjected to prerequisite tests consisting of normality and homogeneity tests. The first prerequisite test to be carried out was the normality test on pretest scores of control and experimental class. Based on the calculation results, the score of $\chi^2_{counted}$ in control and experimental class is presented in Table 3.

Table 3. Normality data of students' science process skills pretest scores

Class	$\chi^2_{counted}$	χ^2_{table}	Test Criteria	Description
Control	3,91	7,82	H_0 accepted if $\chi^2_{counted} < \chi^2_{table}$	H_0 accepted
Experimental	4,74	7,82		H_0 accepted

In Table 3 it can be seen that the score of $\chi^2_{counted}$ in control and experimental class is smaller than the score of χ^2_{table}. Based on test criteria, it can be concluded that H_0 is accepted, meaning that the two research samples come from populations with normal distribution.

Table 4. Homogeneity data of students' science process skills pretest scores

Class	Variance	$F_{counted}$	F_{table}	Test Criteria	Description
Control	89,30	1,05	1,84	H_0 accepted if $F_{hitung} \leq F_{tabel}$	H_0 accepted
Experimental	85,23				H_0 accepted

The second prerequisite test is the homogeneity test of pretest scores of the control and experimental class. This test aims to determine whether the research sample has homogeneous variance or not. Based on the calculation results, the $F_{counted}$ score is obtained as shown in Table 4.

In Table 4 it can be seen that $F_{counted}$ is smaller than F_{table} with a significance level of 0,05. Based on the test criteria, it can be concluded that H_0 accepted, meaning that the control and experimental class have homogeneous variance.

After calculating the normality and homogeneity tests, then the statistical test used to test the similarity of the two-averages is the t-test. Data from the calculation of $t_{counted}$ on the two-average similarity test are presented in Table 5.

Table 5. Similarity data of the two-means pretest scores of students' science process skills

Class	$\bar{X}$	S^2	$t_{counted}$	t_{table}	Criteria Test	Description
Control	27,29	89,30	0,90	2,00	H_0 accepted if $t_{counted} < t_{table}$	H_0 accepted
Experimental	29,48	85,23				

In Table 5 it can be seen that t_{count} is smaller than t_{table} with a significant level of 0,05. Based on test criteria, it can be concluded that H_0 accepted, meaning that the average pretest value of students' science process skills in the experimental class is the same as control class on buffer solution material.

Difference Test of Two-Means

Hypothesis testing uses a two-means difference test to find out whether the average post-test score is significantly different or not. Before carrying out the two-means difference test, a normality test and homogeneity test are first carried out on the post-test scores to find out which parametric or non-parametric test will be performed. The normality test on students' science process skills posttests in experimental class was carried out using the chi-square test, with the criteria for H_0 accepted if $\chi^2_{count} \leq \chi^2_{table}$ with $\alpha = 5\%$.

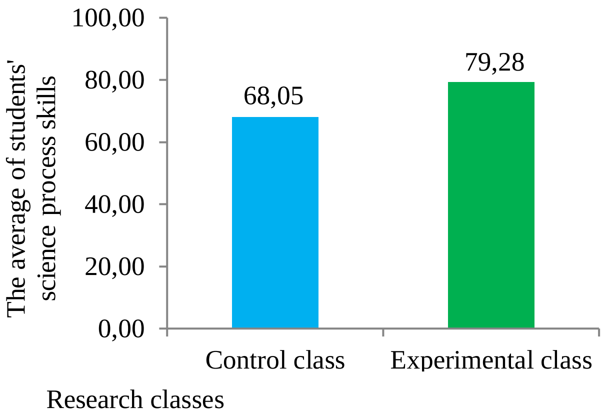

Figure 2. The average of students' science process skills posttest scores in experimental and control class

Based on the results of the normality test on post-test scores, the scores of χ^2_{count} and χ^2_{table} for students' science process skills in experimental class are presented in Table 6.

Table 6. Normality test results of students' science process skills posttest

Class	Scores		Test Criteria	Description
	$\chi^2_{counted}$	χ^2_{table}		
Kontrol	6,42	7,82	ounted < χ^2_{table} then cepted	**Terima H_0**
Eksperimen	**5,07**	**7,82**		**Terima H_0**

In Table 6 it can be seen that the value of $\chi^2_{counted}$ for students' science process skills in experimental and control class obtained is smaller than χ^2_{table}. Based on test criteria, the test decision is H_0 accepted, which means that the post-test data for both research classes, namely control and experimental class, come from populations that are normally distributed. The homogeneity test is used to find out whether the two classes have homogeneous variances, with the test criteria, H_0 accepted if $F_{counted} < F_{table}$ at 5% significance level.

Table 7. Homogeneity data of students' science process skills posttest scores

Class	Variance	$F_{counted}$	F_{table}	Test Criteria	Description
Control	71,01	1,11	1,84	H_0 accepted if $F_{counted} \leq F_{table}$	H_0 accepted
Experimental	64,14				

Based on the results of the calculation of homogeneity test on science process skills post-test scores, the F_{count} value for students' science process skills was 1,11. This score is smaller than F_{table} which is 1,84. Then the test decision is H_0 accepted, meaning that the two research classes have a homogeneous variance. The results of normality and homogeneity test showed that the two study classes came from populations that were normally distributed and had homogeneous variances, so a two-means difference test was performed using the parametric test (t-test). The t-test has acceptance test criteria H_0 if $t_{count} < t_{table}$ with degrees of freedom d(k) = n1 + n2 – 2 and level α = 5%.

Table 8. Two-means difference data of students' science process skills posttest

Class	$\bar{X}$	S^2	$T_{counted}$	t_{table}	Test Criteria	Description
Control	68,05	71,01	5,28	2,00	H_0 acepted if $t_{counted} < t_{table}$	H_0 rejected
Experimental	79,28	64,14				

Based on the results of two-means difference test, t_{count} score for students' science process skills was 5,28. This score is greater than t_{table} which is 2,00. Based on the test criteria, it can be seen that data on posttest scores of the two classes are H_0 rejected. This means that the average of students' science process skills posttest scores of in experimental class are significantly different from the control class. Thus, it can be said that blended learning with the discovery learning model is effective for increasing students' science process skills.

N-gain of Students' Science Process Skills

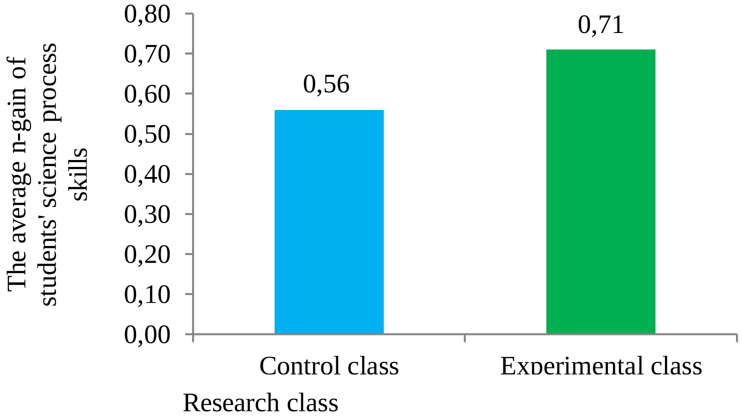

Figure 3. The average n-gain of students' science process skills in experimental and control class

After obtaining data on students' science process skills pre-test and post-test scores, the data is used to calculate the student's n-gain in the experimental class and the control class to see the improvement that occurs in students after the learning process. The average student KPS n-gain is presented in Figure 3.

In Figure 3 it can be seen that the average n-gain for the experimental class is 0.71 which is in the high category and the average n-gain for the control class is 0.56 in the medium category. Based on the results of data analysis, it shows that blended learning with the discovery learning model is effective for improving students' science process skills.

Student Activity Data

Observed student activity is student activity during the teaching and learning process which consists of several aspects. The research class that was observed was the experimental class. The average percentage of student activity in all meetings and in each aspect of the observed activity is presented in Figure 4 and Figure 5.

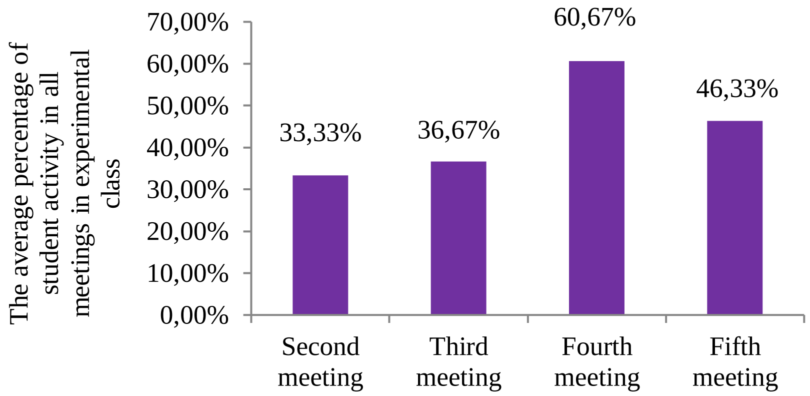

Figure 4. The percentage of student activity in all meetings in experimental clas

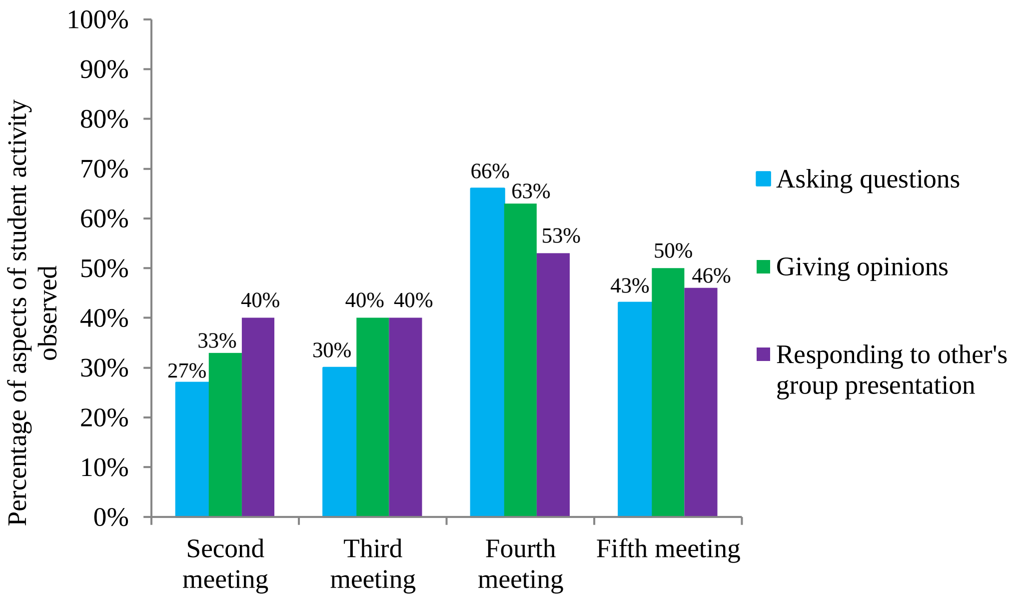

Figure 5. Percentage of aspects of student activity at each meeting in experimental class

In Figure 4 it can be seen that the percentage of student activity scores in experimental class at the second meeting was 33.33% in the less category, the third meeting was 36,67% in the less category, the fourth meeting was 60,67% in the good category, and the fifth meeting was 46,33% in the moderate category. Based on these data it shows that the highest percentage of student activity was at the third meeting.

- **CONCLUSION**

Based on the results of research data analysis and discussion showed that the average post-test scores of students’ science process skills in experimental class were significantly different from post-test scores in control class, and the average n-gain of students’ science process skills in the experimental class is in the high category of 0,71. Thus, it can be concluded that blended learning with discovery learning model is effective to improve students’ science process skills.

- **FERENCES**

Afdhila, R., Nazar, M., & Hanum, L. (2017). Penerapan Pembelajaran Blended Learning pada Materi Larutan Penyangga di SMA Negeri 1 Unggul Darul Imarah. *Jurnal Ilmiah Mahasiswa Pendidikan Kimia*, 2(3): 165-172.

Anggraini, E. (2019). *Pengaruh Pembelajaran Blended Learning Menggunakan Aplikasi Google Classroom terhadap Pemahaman Konsep Matematis pada Peserta Didik Kelas VIII SMPN 9 Bandar Lampung.* (Undergraduate thesis). Retrieved from http://repository.radenintan.ac.id/5450/1/Skripsi%20Full.pdf

Arif, Istyadji, M., & Syahmani. (2018). Implementasi Problem Based Learning Berbantuan Diskusi Daring terhadap Kemampuan Pemecahan Masalah dan Hasil Belajar Kimia pada Materi Larutan Penyangga. *Journal of Chemistry and Education*, 1(3), 237-244.

Atika, D., Nuswowati, M., & Nurhayati, S. (2018). Pengaruh Metode Discovery Learning Berbantuan Video terhadap Hasil Belajar Kimia Siswa SMA. *Jurnal Inovasi Pendidikan Kimia*,12(2),2149-2158.

Bruner, J. S. (1977). *The Process of Education.* USA: Harvard University Press.

Damayanti, R., Rosilawati, I., & Fadiawati, N. (2018). Efektivitas LKS Larutan Penyangga Berbasis Discovery Learning untuk Meningkatkan KPS Ditinjau dari Kemampuan Kognitif. *Jurnal Pendidikan dan Pembelajaran Kimia*,7(1),154-168.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to Design and Evaluate Research in Education*. New York: McGraw-Hill.

Fidiana, E., Rudibyani, R. B., & Tania, L. (2018). Penerapan *Discovery Learning* untuk Meningkatkan Keterampilan Berpikir Luwes Materi Larutan Penyangga. *Jurnal Pendidikan dan Pembelajaran Kimia*,7(1),104-115.

Hadiono, & Hidayati, N. A. (2016). Penerapan Model Pembelajaran *Discovery Learning* untuk Meningkatkan Motivasi dan Hasil Belajar Siswa Kelas VIII-D SMPN 2 Kamal Materi Cahaya. *Jurnal Pena Sains*, 3(2), 77-84.

Hamalik, O. (2005). *Proses Belajar Mengajar.* Jakarta: Bumi Aksara.

Hosnan, M. (2014). Pendekatan Saintifik dan Kontekstual dalam Pembelajaran Abad 21: Kunci Sukses Implementasi Kurikulum 2013. Bogor: Ghalia Indonesia.

Kean, E., & Middlecamp, C. (1985). *Panduan Belajar Kimia Dasar.* Jakarta: Gramedia.

Kurniawati, I. L., & Amarlita, D. M. (2013). Pengembangan Bahan Ajar Berbasis Masalah pada Mata Pelajaran Kimia SMA Kelas X dalam Materi Hidrokarbon. *Prosiding Seminar Nasional MIPA*,78-82.

Meltzer, D. E. (2002). The Relationship between Mathematics Preparation and Conceptual Learning Gains in Physics: A Possible "hidden variable" in Diagnostic Pretest Scores. *American Journal of Physics*,70(12),1259-1268.

Muhali, Muliadi, A., & Sabrun. (2021). Efektivitas Pembelajaran Kimia Sistem Daring pada Masa Pandemi Covid-19: Persepsi Mahasiswa. *Jurnal Ilmiah IKIP Mataram*,8(1),161-174.

Nugrahaeni, A., Redhana, I. W., & Kartawan, I. A. (2017). Penerapan Model Pembelajaran *Discovery Learning* untuk Meningkatkan Kemampuan Berpikir Kritis dan Hasil Belajar Kimia. *Jurnal Pendidikan Kimia Indonesia*,1(1),23-29.

Permendikbud. (2016). Standar Kompetensi Lulusan (SKL), Kompetensi Inti (KI), Kompetensi Dasar (KD). Jakarta: Kemdikbud.

Rahmah, N. (2021). *Desain dan Uji Coba Lembar Kerja Peserta Didik (LKPD) Berbasis Keterampilan Proses Sains (KPS) pada Materi Larutan Penyangga* (Undergraduate thesis). Retrieved from https://repository.uin-suska.ac.id/51802/2/SKRIPSI%20NUR%20RAHMAH.pdf

Sari, N. (2021). *Penerapan Pendekatan Blended Learning terhadap Keterampilan Proses Sains pada Materi Sistem Ekskresi pada Manusia di Kelas VIII MTs N 2 Kuantan Singingi* (Undergraduate thesis). Retrieved from http://repository.uin-suska.ac.id/56116/2/SKRIPSI%20NURMAYA%20SARI.pdf

Sudjana. (2005). *Metoda Statistika.* Bandung: Tarsito.

Sunyono. (2012). Analisis Keterlaksanaan dan Kemenarikan Model Pembelajaran SiMaYang dalam Membangun Model Mental Mahasiswa pada Topik Stoikiometri. *Prosiding Seminar Nasional Kimia dan Pendidikan Kimia*. Vol. 6.