Eduproxima: Jurnal Ilmiah Pendidikan IPA
http://jurnal.stkippgritulungagung.ac.id/index.php/eduproxima

ANALYZE OF STUDENT LEARNING OUTCOMES USING *PROBLEM BASED LEARNING* AND *DISCOVERY LEARNING* REVIEWED FROM HOTS

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Article history:
Submitted: Jan. 15th, 2024; Revised: Feb. 05th, 2024; Accepted: Feb. 27th, 2024; Published: July 28th, 2024

ABSTRACT

This study aims to determine whether there is a difference between the learning outcomes of students taught with Problem Based Learning and Discovery Learning models in terms of higher order thinking skills (HOTS) on chemical equilibrium material. The study population was all students of class XI IPA SMA Negeri 11 Medan. The sample in this study consisted of 2 experimental classes. The instrument used in the study was a test instrument. Before hypothesis testing, normality test and homogeneity test were conducted first. In the normality and homogeneity test in each class sample, the results showed that the data were normally distributed and homogeneous. Furthermore, the N-Gain test was carried out, the results of data processing showed that the increase in learning outcomes in experimental class I was in the medium category, and in experimental class II was in the high category. Based on the results of data processing with the Independent Sample T-Test test for hypothesis testing, the Sig value is obtained. = 0.017 at the 5% significance level (α = 0.05). Because the value of Sig. < α (0.05), then in this study the alternative hypothesis (Ha) is accepted.

Keywords: learning outcomes; PBL; DL; HOTS

INTRODUCTION

A course called Higher Order Thinking Skill (HOTS) aims to prepare students for the 21st century. HOTS estimates the capacity to: a) move ideas; b) handling and applying data; c) connecting various sorts of data; d) tackle issues utilizing data; what's more, e) basically look at thoughts and data. HOTS literacy is expected to support the implementation of an effective and optimal learning process (Panggabean, Silitonga, et al., 2022). In its implementation, HOTS must be reflected in the teacher's learning tools. Teachers develop learning objectives from basic competencies using operational verbs that can be observed to cover attitudes, knowledge and skills (Zebua & Harmalis, 2021).

The outcome of the educational experience can't be isolated from the capacity of educators to foster learning models that are situated towards expanding the force of understudy association successfully in the educational experience. According to Abidin (2017), a learning model is a plan or pattern used to plan classroom learning. The capacity to catch illustrations by understudies can be impacted by picking the right learning model, with the goal that the learning targets set will be accomplished (Tabrani & Amin, 2023). There are a few learning models that can be utilized to further develop understudy learning results (understudy focused), two of which are the Issue Based Learning (PBL) and Disclosure Learning (DL) models. In general, it has

been demonstrated by previous research that PBL and DL learning models can enhance student learning outcomes. (Anjelina et al., 2021).

The Problem Based Learning (PBL) model is a learning model that includes orienting students to the problem, organizing students to learn, guiding individual and group investigations, developing and presenting work, and analyzing and evaluating the problem-solving process. (Hasmiati et al., 2022). The PBL model gets ready understudies to think fundamentally and scientifically, as well as to find and utilize learning assets. The PBL model has been investigated by a few past specialists and is demonstrated to further develop understudy learning results, because it can improve students' creative thinking skills. Previous research has also revealed that the creative thinking ability of students who use PBL models is better than those who use conventional models (Panggabean, Munthe, et al., 2022).

The Discovery Learning (DL) model is a learning model that includes Stimulation, Problem Statement, Data Collection, Data Processing, Verification, and Generalization. DL learning is a cognitive learning method that requires teachers to be more creative in creating situations that can make students learn to actively find their own knowledge (Bahir et al., 2020). The growing experience of the DL model is a progression of learning exercises that include the limit of every one of understudies' capacities to look and examine efficiently, fundamentally, coherently, systematically so they can form their own disclosures (Nugrahaeni et al., 2017). The application of the Discovery Learning model can further develop understudy learning exercises, further develop understudies' decisive reasoning abilities, further develop the coordinated topical growing experience, so it will affect further developing understudy learning results. (Marisya & Sukma, 2020).

Learning outcomes are the benchmarks that each student will achieve in each subject (Ahmad et al., 2018). In light of the perceptions of analysts at SMA Negeri 11 Medan, it is realized that understudy learning results on the Synthetic Balance material are still low, shown from the percentage of student graduation which is only 40% (KKM score 70). The ability of students to answer HOTS-based questions is also still rarely considered by teachers because teachers are too busy making and preparing other devices. The learning process in class is directed to the ability of children to listen, and record the material conveyed by the educator (teacher centered), with the goal that understudies are less dynamic in the growing experience which affects low understudy learning results. In light of these issues, educator must make efforts to enhance the quality of learning through inventive and engaging activities that involve students in the process of learning.

Research results (Panggabean et al., 2023) shows that there is a direct and huge connection between understudy learning results and inspiration with Issue Based Learning and Revelation Learning models. The *Problem Based Learning* model obtained a calculation r_{hitung} (0.773) > r_{tabel} (0.349) and the *Discovery Learning* model obtained a calculation r_{hitung} (0.770) > r_{tabel} (0.349). Based on research (Mauludi, 2022) It was concluded that student learning outcomes improved after applying the (PBL) and (HOTS) models. The collaboration of PBL and HOTS encourages students to think creatively and innovatively. Furthermore, the aftereffects

of past exploration connected with the utilization of the Issue Based Learning (PBL) model are the results of research (W. D. Siregar & Simatupang, 2020) in the Acid-Base material shows that student learning activities learned using the PBL model reached a value of 86.20%. Then the results of Silaban's research in (Panggabean & Harahap, 2020) Regarding the use of the *Problem Based Learning* (PBL) model, PBL states that PBL can increase chemistry learning outcomes from the average pretest of 27.2 up to 63.95; 72.5 in 2 experimental classes I and experimant II.

Research conducted by (Kurniawan, 2020) with the title " Use of HOTS-Oriented *Discovery Learning* Learning Model (*Higher Order Thinking Skill*) as a Work to Further develop Understudy Learning Results" expressed that subsequent to leading information investigation, it was presumed that learning with the HOTS-based learning-focused Disclosure Learning model can further develop understudy learning results. The increment happened from pre-cycle to cycle II, in precycle the level of old style culmination was 44%, expanding in cycle I to 81% and in cycle II to 94%. Based on research (Fatma et al., 2020) It was presumed that the utilization of the Discovery Learning (DL) model to the Corrosive Base Arrangement material was viable in further developing understudy learning results. One student received the highest score, a 95, while five students received the lowest, a 70. The average score of student learning outcomes is 78.55 and the value that often appears (mode) is 75 obtained by 12 students. Furthermore, the results of previous research related to the application of the *Discovery Learning* (DL) model, namely the results of Suyati & Sutiani's research in (S. L. Siregar & Panggabean, 2020) shows that the learning outcomes of the first cycle students show an average score of 83.38 with the lowest score of 71 and the highest score of 89. Then the results of the study (Agustina et al., 2019) regarding the application from *Discovery Learning* (DL) model to the Buffer Solution material, it shows that learning with the DL model achieves learning completeness of 91.18% (31 out of 34 students).

METHODS

This research was conducted at SMA Negeri 11 Medan situated on Jl. Pertiwi No.93 Medan, Bantan, Kec. Medan Tembung in the odd semester of the 2023/2024 scholastic year. This study's population consists of all XI Science Semester I SMA Negeri 11 Medan, which consists of 7 classes. Sampling was carried out in two stages, namely class samples were taken 2 classes randomly by lottery, then student samples were taken purposively from each class that was relatively homogeneous in status. The samples in this study were class XI Science 3 (experimental class I) and XI Science 4 (experimental class II), each amounted to 27 students. Each class sample is given a different treatment.

The type of research used is quantitative research, for research design using one pretest-posttest group design. In this study, information will be gotten as understudy learning results. Information on understudy learning results are acquired by providing tests in the form of pretest and posttest in the form of multiple choices based on HOTS on Chemical Equilibrium material.

RESULTS AND DISCUSSION

Result

A. Descriptive Data Research Results

Based on the calculation results, statistical information on understudy learning results in exploratory class I and trial class II are summed up in Table 1 beneath.

Table 1 Statistical Data on Student Learning Outcomes

Data	Statistics	Class	
		Experiment I	Experiment II
Pretest	Average	24.25	24.81
	Standard Deviation	8.89	8.76
Posttest	Average	72.03	78.33
	Standard Deviation	9.83	8.60

The average pretest and posttest scores for experimental class I and experiment II can be seen in Figure 1.

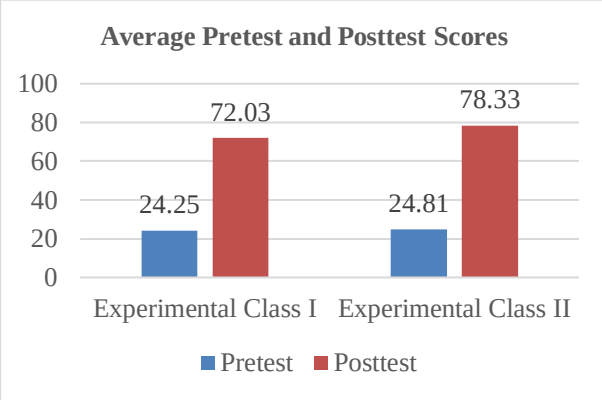

Figure 1 Pretest and Posttest Scores of Student Learning Outcomes

In view of the aftereffects of the computations got, it tends to be seen that exploratory class I which was educated with the Issue Based Learning model got the typical benefit of learning results (posttest) = 72.03 while trial class II which was educated with the Revelation Learning model acquired the normal benefit of learning results (posttest) = 78.33. According to these findings, students in experimental class II perform better academically than students in experimental class I.

In this study, there are five indicators of competency achievement, including Indicator 1: Analyzing dynamic equilibrium, Indicator 2: Analyzing homogeneous and heterogeneous equilibrium, Indicator 3: Processing data related to the value of the equilibrium constant (Kc and Kp) of a reaction, Indicator 4: Processing data related to the equilibrium constant based on the degree of dissociation of a reaction Indicator, and Indicator 5: Analyze the shift in the direction of equilibrium and the factors that influence it.

The distribution of each indicator's student learning outcomes in experimental classes I and II is summarized in Figure 2.

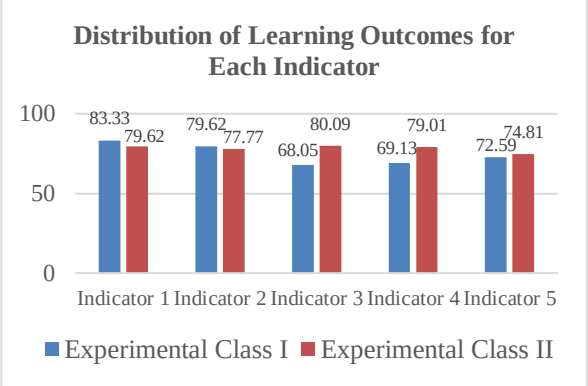

Figure 2. Distribution of Student Learning Outcomes on Each Indicator

Based on the picture above, it can be seen that in both experimental classes, the distribution of learning outcomes for students in Indicator 1, Indicator 2, and Indicator 5 is almost the same, but in Indicator 3 and Indicator 4 there is a significant difference. In trial class II the conveyance of learning results of Marker 3 is 80.09 and Pointer 4 is 79.01. Subsequently, from these outcomes, it tends to be presumed that the dispersion of understudy learning results in exploratory

class II in Indicator 3 and Indicator 4 is higher than experimental class I.

Furthermore, the distribution of KKM accomplishment in the two exploratory classes is displayed in Table 2 beneath.

Table 2 Distribution of KKM Achievement in Experimental Class I and Experiment II

Criteria	Experiment I	Experiment II
Above KKM	13 student	20 student
Comply with KKM	5 student	4 student
Under KKM	9 student	3 student
Amount Student	**27**	**27**

In light of the information introduced in the table above, it very well may be seen that in exploratory class I there were 18 understudies who passed KKM while 9 understudies didn't pass KKM. In exploratory class II there were 24 understudies who passed KKM while 3 understudies didn't pass KKM. In this way, from these outcomes, it tends to be reasoned that the circulation of KKM accomplishment in trial class II is higher than exploratory class I.

B. Analysis of Research Results Data

To test a research hypothesis, the condition that must be met is that the information should be regularly dispersed and homogeneous. Before testing the hypothesis of student learning outcome data obtained in each class, analysis requirements were tested, namely the Ordinariness Test, Homogeneity Test, and N-Gain Test.

1) Normality Test

The ordinariness test is utilized to figure out that the information acquired is typically dispersed or not. The ordinariness test was performed involving SPSS 25 for Windows with the Shapiro Wilk Test at an importance level of α = 0.05. The information is supposed to be regularly conveyed if the cost of Sig. > α (0.05). The consequences of the ordinariness test should be visible in Table 3.

Table 3 Data Normality Test Results

Class	Data	Sig.	*α*	Information
Experi-ment I	*Pretest*	0.075	0.05	Normal Distribu-tion
	Posttest	0.257	0.05	Normal Distribu-tion
Experi ment II	*Pretest*	0.083	0.05	Distribusi Normal
	Posttest	0.480	0.05	Normal Distribu-tion

In view of the consequences of information handling with SPSS 25 for Windows, for pretest and posttest information in exploratory class I and trial class II, it was gotten that the learning result information was ordinarily disseminated with a worth of Sig. > 0.05.

2) Homogeneity Test

The homogeneity test is used to determine whether or not the sample's data are homogeneous. Information homogeneity testing was performed involving SPSS 25 for Windows with Levene Test at importance level α=0.05. Information is supposed to be homogeneous if the worth Sig. > α (0.05). The homogeneity test results should be visible in Table 4.

Table 4 Data Homogeneity Test Results

Data	Sig	*α*	Information
Pretest	0.873	0.05	Homogeneous Data
Posttest	0.600	0.05	Homogeneous Data

Based on the results of data processing, for prestest and posttest data of

students in experimental class I and experimental class II, obtained that the learning outcome data was homogeneous with values Sig. > 0.05.

3) N-Gain Test

In this research, the N-Gain test was utilized to decide the improvement in understudy learning results subsequent to being given treatment. The improvement in understudy learning results was estimated utilizing pretest and posttest scores which were then broke down utilizing the N-gain equation. The consequences of the N-Gain test (conveyance of upsides of substance balance learning results) in exploratory class I should be visible in Table 5 and in trial class II should be visible in Table 6.
N-Gain score criteria (Meltzer, 2002)

Table 5 Distribution of Learning Outcomes of Experimental Class I (N-Gain Test)

Acquisition N-Gain	Frequency	Criteria
g > 0.7	7	High
0.3 < g ≤ 0.7	19	Medium
g ≤ 0.3	1	Low
Amount	**27**	
Improved Learning Outcomes	**0.6283**	**Medium**

Table 6 Distribution of Learning Outcomes of Experimental Class I (N-Gain Test)

Acquisition N-Gain	Frequency	Criteria
g > 0.7	15	High
0.3 < g ≤ 0.7	11	Medium
g ≤ 0.3	1	Low
Amount	**27**	
Improved Learning Outcomes	**0.7087**	**Tall**

Based on the calculation results obtained, it can be concluded that the increase in student learning outcomes in experimental class II is higher than experimental class I.

4) Hypothesis Testing

In this examination, the speculation test involves SPSS 25 for Windows with a Free Example T-Test with an importance worth of α=0.05, where if the worth of Sig. < α (0.05) then Ho is dismissed and Ha is acknowledged, while if the worth of Sig. > α (0.05) then Ho is acknowledged and Ha is dismissed. Information on the computation of the speculation test should be visible in Table 7.

Table 7 Hypothesis Test Results

Class	Average	Sig. (2-taild)	α	Information
Experiment I	72.03	0.017	0.05	Ha accepted
Experiment II	78.33	0.017	0.05	

Based on the results of data processing, for the hypothesis test obtained the value of Sig. = 0.017 where the value Sig. < α (0.05), then it can be concluded that Ha is accepted. This means that there is a difference between student learning outcomes learned with the *Problem Based Learning* and *Discovery Learning* models in terms of *Higher Order Thinking Skills* (HOTS) in chemical equilibrium material.

Discussion

Research is carried out on a regular basis. Before learning begins, researchers always check student attendance first to facilitate data collection of students who take part in learning. The study began with the provision of initial tests (*pretest*) on both experimental class samples. Pretest is completed to decide the ability to underlying of understudies, where the inquiries tried to understudies are 20

various decision questions, which have met the necessities with regards to legitimacy, dependability, level of trouble, and separation. In light of fundamental experimental outcome information, the normal pretest score got in exploratory class I before treatment was 24.25 while in trial class II was 24.81. From these outcomes, it was found that the pretest brings about exploratory class I and examination II were practically something similar, where both classes had very low initial abilities. After the pretest was carried out, it continued with the learning process of chemical equilibrium material, where each class was given different treatment. In exploratory class I is shown utilizing the Problem Based Learning model and trial class II is shown utilizing the Discovery Learning model.

In this research, the chemical equilibrium learning process was carried out as many as three meetings to discuss starting from dynamic equilibrium; homogeneous and heterogeneous equilibrium; equilibrium constant values (Kc and Kp) of the reaction; and by degree of dissociation; as well as shifts in the direction of equilibrium and the factors that influence it. Furthermore, the study ended by providing an evaluation of learning outcomes (*posttest*) with the same questions as the *pretest*.

Based on the learning outcome data (posttest) obtained in this study, the posttest results acquired in trial class I subsequent to being educated with the Problem Based Learning model were 72.03 while the posttest brings about exploratory class II in the wake of being instructed with the Discovery Learning model were 78.33. So end can be drawn that the learning results of understudies learned with the Discovery Learning model are higher than those learned with the Problem Based Learning model. This is in accordance with research (Ariyani et al., 2020), where the experimental outcomes show that the normal posttest score of the Discovery Learning model is higher than the Issue Based Learning model, which is 78.40 and 75.35 individually.

From the worth of understudy learning results acquired in the review, subsequent to being tried with information examination necessities tests, to be specific ordinariness tests and homogeneity tests, it was tracked down that the benefit of learning results of exploratory class I and trial class II students was normally distributed and homogeneous, where the price Sig. > α (0.05). Before the hypothesis test was carried out, first tested with the N-Gain test to see if there was an increase in student learning outcomes, and from the results of data processing it was seen that in both experimental classes there was an increase in learning outcomes, where in experimental class I (Problem Based Learning) the increase in learning outcomes was in the "medium" category (N-gain = 0.6283) while in experimental class II (Discovery Learning) the increase in learning outcomes was in the "high" category (N-gain = 0.7087). This is in line with research (Mauludi, 2022) which concludes that student learning outcomes have improved after applying the model *Problem Based Learning* and *Higher Order Thinking Skill*. Next, research (Kurniawan, 2020) also stated that after conducting data analysis, it was inferred that learning with the HOTS-based learning-focused Discovery Learning model can further develop understudy learning results.

In Hypothesis Test using *SPSS 25 for Windows* Test with *Independent Sample T-Test* at significance 0.05, obtained that the

value of the value of Sig. = 0.017. Since the value of Sig. = 0.017 (the value of Sig. is less than 0.05) then Ha is accepted. Thus, there is a difference between the learning outcomes of students who are taught with the *Problem Based Learning* and *Discovery Learning* models in terms of *Higher Order Thinking Skills* (HOTS) in chemical equilibrium material.

Judging from the distribution of Based on the conveyance of understudy learning results on every marker in both exploratory classes, it tends to be seen that the appropriation of understudy learning results in Indicator 1, Indicator 2, and Indicator 5 is almost the same, where the difference is very small. From these results, it can be concluded that the three indicators can apply the *Problem Based Learning* or *Discovery Learning* model. However, unlike Indicator 3 and Indicator 4, it can be seen that the difference seems quite significant, where the distribution of student learning outcomes in experimental class II is higher than experimental class I. Indicator 3 and Indicator 4 are loaded with numbers and calculations that are closely related to students numerical abilities. So the better the student's numerical ability, the better he will be at understanding ideas and ideas communicated as numbers and the more straightforward he can think and take care of issues with numbers (Nurdin, 2017).

In light of the consequences of information handling, in trial class I the dispersion of learning results of Indicator 3 was 68.05 while in exploratory class II the circulation of learning results was 80.09. Likewise, with Indicator 4, the distribution of learning outcomes in experimental class I is 69.13 while in experimental class II the distribution is 79.01. From these results, it can be concluded that for both indicators, it is better to apply the Discovery Learning model. Moreover (Diba et al., 2018) also states that the *Discovery Learning* model has an effect on improving students' mathematical representation abilities. Further based on research (Sutrisno et al., 2020) suggest math teachers use the Discovery Learning model to improve student achievement and interest.

Although this examination prevailed with regards to further developing understudy learning results, individual fulfillment can't be supposed to be 100 percent complete, cause in both experimental classes there are still some students whose posttest scores have not reached the KKM score of 70. This is likely to occur due to several factors, such as the level of difficulty of the material tested, namely chemical equilibrium material loaded with calculations, parts of supporting assets connected with offices and framework accessible at school, angles connected with understudies' scholarly level, inadequacy of applying models with pointers to be accomplished, etc.

CONCLUSION

In light of the consequences of exploration that has been led, it was reasoned that there is a distinction between the learning results of understudies who are educated with the *Problem Based Learning* and *Discovery Learning* models in terms of *Higher Order Thinking Skills* (HOTS) in chemical equilibrium material. The average learning outcomes of experimental class I students who were taught using the *Problem Based Learning* model were 72.03. While the average learning outcomes of experimental class II students who were taught using the *Discovery Learning* model were 78.33. The expansion in understudy learning results learned with the *Problem Based Learning* model was 62.83 while the

expansion in understudy learning results learned with the *Discovery Learning* model was 70.87.

REFERENCES

Abidin, A. M. (2017). Kreativitas Guru Menggunakan Model Pembelajaran Dalam Meningkatkan Hasil Belajar Siswa. *Didaktika Jurnal Kependidikan*, *11*(2), 225–238. https://doi.org/10.30863/didaktika.v11i2.168

Agustina, D. T., Cahyono, E., & Widiarti, N. (2019). Keefektifan Model Discovery Learning Terhadap Hasil Belajar Siswa Pada Materi Larutan Penyangga. *Journal Of Chemistry*, *8*(1), 1–10. http://journal.unnes. ac.id/sju/index.php/ijcs

Ahmad, M., Tambak, S., & Siwal, S. (2018). Penerapan Metode Diskusi Dalam Meningkatkan Hasil Belajar Murid Pada Pelajaran Fiqh. *Jurnal Al-Hikmah*, *15*(1), 60–79. https://doi.org/10.25299/jaip.2018.vol15(1).1585

Anjelina, R., Elvinawati, E., & Nurhamidah, N. (2021). Studi Perbandingan Hasil Belajar Kimia Siswa Menggunakan Model Pembelajaran Problem Based Learning (PBL) Dan Discovery Learning Pada Materi Larutan Penyangga. *Alotrop, Jurnal Pendidikan Dan Ilmu Kimia*, *5*(1), 27–34. https://doi.org/10.33369/ atp.v5i1.16483

Ariyani, S., Suardana, I. N., & Devi, N. L. P. L. (2020). Komparasi Model Problem Based learning dan Discovery Learning Terhadap Keterampilan Berpikir Kritis Siswa SMP. *Jurnal Pendidikan Dan Pembelajaran Sains Indonesia*, *3*(1), 61–70.

Bahir, F. A., Inanna, I., Hasan, M., Tahir, T., & Rahmatulah, R. (2020). Model Pembelajaran Discovery Learning Untuk Meningkatkan Motivasi Belajar Peserta Didik. *Indonesian Journal of Social and Educational Studies*, *1*(1), 10–21. https://doi.org/10.47080/progress.v1i1.130

Diba, S. F., Bharata, H., & Widyastuti, W. (2018). Pengaruh Model Discovery Learning Terhadap Kemampuan Berpikir Kreatif Matematis Siswa. *Jurnal Pendidikan Matematika Unila*, *3*(6), 236–247. https://doi.org/ 10.38114/riemann.v3i1.108

Fatma, F., Marhadi, M. A., & Rudi, L. (2020). Penerapan Model Discovery Learning Dalam Meningkatkan Hasil Belajar Kimia Siswa Kelas XI IPA Materi Larutan Asam-Basa. *Jurnal Pendidikan Kimia FKIP Universitas Halu Oleo*, *5*(2), 59–67. https:// doi.org/10.36709/jpkim.v5i2.13311

Hasmiati, H., Faisal, M., & Muhsin, A. (2022). Penerapan Model Pembelajaran Problem Based Learning Dalam Meningkatkan Hasil Belajar Siswa Kelas II SD Inpres 5/81 Latonro. *Pinisi Journal PGSD*, *2*(1), 196–203.

Kurniawan, I. (2020). Penggunaan Model Pembelajaran Discovery Learning Berorientasi HOTS (Higher Order Thinking Skill) Sebagai Upaya Meningkatkan Hasil Belajar Siswa. *Jurnal THEOREMS (The Original Research of Mathematics)*, *5*(1), 25–31. https://doi.org/10.31949/ th.v5i1.2090

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. https://doi.org/10.1119/1.1514215

Marisya, A., & Sukma, E. (2020). Konsep Model Discovery Learning pada Pembelajaran Tematik Terpadu di Sekolah Dasar Menurut Pandangan

Para Ahli. *Jurnal Pendidikan Tambusai*, *4*(3), 2189–2198.

Mauludi, A. (2022). *Penerapan Model PBL (Problem Based Learning) Dan HOTS (Higher Order Thinking Skill) Dalam Memahami Potensi Sumber Daya Alam*. 8(1), 110–117.

Mika, Laras (2020). Identifikasi Kemampuan Numerik Siswa Pada Materi Kesetimbangan Kimia di SMA Negeri 12 Banda Aceh.

Nugrahaeni, A., Redhana, I. W., & Kartawan, I. M. A. (2017). Penerapan Model Pembelajaran Discovery Learning Untuk Meningkatkan Kemampuan Berpikir Kritis Dan Hasil Belajar Kimia. *Jurnal Pendidikan Kimia Indonesia*, *1*(1), 23–29. https://doi.org/10.23887/ jpk. v1i1.12808

Nurdin, A. N. (2017). Analisis Hubungan Kemampuan Numerik Dengan Hasil Belajar Fisika Peserta Didik Kelas XII IPA SMA Muhammadiyah Di Makassar. *Jurnal Pendidikan Fisika*, *5*(2), 193–204.

Panggabean, F. T. M., & Harahap, M. F. (2020). Analisis Problem Based Learning dan Discovery Learning menggunakan Macromedia Flash pada materi Termokimia. *Jurnal Inovasi Pembelajaran Kimia*, *2*(2), 58–63. https://doi.org/10.24114/ jipk. v2i2.19391

Panggabean, F. T. M., Munthe, G. W. S., Silitonga, P. M., Juniar, A., & Selly, R. (2022). Development of HOTS Integrated Problem Based Learning (PBL) Chemistry Learning Module on Buffer Solution Material at SMA Negeri 1 Purba. *International Journal of Computer Applications Technology and Research*, *11*(08), 301–304. https://doi.org/10.7753/ijcatr1108.1001

Panggabean, F. T. M., Silitonga, P. M., Purba, J., Jasimidi, J., & Purba, R. A. (2023). *Analysis Student Motivation and Learning Outcomes by Apllying Problem Based Learning and Discovery Learning Models*. *5*(1), 11–16.

Panggabean, F. T. M., Silitonga, P. M., & Sinaga, M. (2022). Development of CBT Integrated E-Module to Improve Student Literacy HOTS. *International Journal of Computer Applications Technology and Research*, *11*(05), 160–164. https://doi.org/10.7753/ijcatr1105.1002

Siregar, S. L., & Panggabean, F. T. M. (2020). *Analisis PBL Dengan DL Menggunakan Macromedia Flash Terhadap Motivasi Dan Hasil Belajar Siswa Pada Materi Laju Reaksi Di SMA Negeri 10 Medan*. *2*(1), 21–25.

Siregar, W. D., & Simatupang, L. (2020). Pengaruh Model Pembelajaran PBL Terhadap Aktivitas Belajar Dan Hasil Belajar Siswa Pada Materi Asam Basa. *Jurnal Inovasi Pembelajaran Kimia*, *2*(2), 91–96. https:// doi.org/ 10.24114/jipk.v2i2.19571

Sutrisno, S., Happy, N., & Susanti, W. (2020). Eksperimentasi Model Discovery Learning Terhadap Prestasi Dan Minat Belajar Matematika Siswa. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *9*(3), 580–590. https://doi.org/10.24127/ ajpm. v9i3.2804

Tabrani, T., & Amin, M. (2023). *Model Pembelajaran Cooperative Learning*. *5*(2), 200–213

Zebua, D. R. Y., & Harmalis, H. (2021). Analisis High Order Thinking Skill (HOTs) pada Tujuan dan Asesmen Mata Pelajaran Kimia. *Journal on Education*, *03*(02), 208–216. https:// doi.org/10.31004/joe.v3i2.475