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Differences in Student Learning Outcomes Using the Predict Observe Explain Model and the Learning Cycle 5E Model on Acid Base Material

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Abstract: Differences in Student Learning Outcomes Using the Predict Observe Explain Model and the Learning Cycle 5E Model on Acid Base Material. This study aims to examine the ways in which the Learning Cycle 5E learning model improves student learning outcomes, the ways in which the Predict Observe Explain learning model improves student learning outcomes, and the ways in which the Learning Cycle 5E learning model differs from the Predict Observe Explain model in relation to acid-base material. Two randomly selected classes, XI-B and XI-C, served as samples. There are two experimental classes, namely I and II, and this study used a pretest-posttest control group design. A multiple-choice test with 20 questions was used in this study. Hypothesis test I produced t_{count} (26.77) greater than t_{table} (2.3451), then H_0 was rejected. Hypothesis test II: If t_{count} (38.67) is greater than t_{table} (2.3451), then H_0 was rejected. Hypothesis test III: If t_{count} (2.35) is greater than t_{table} (2.2921), then H_0 was rejected. Research has shown that there is an increase in student learning outcomes using the Learning Cycle 5E learning model on acid-base material, from the value before using the Learning Cycle 5E learning model of 45.29 to 85.71, there is an increase in student learning outcomes using the Predict Observe Explain learning model on acid-base material, from the value before using the Predict Observe Explain learning model of 42.86 to 81.71, and there is a difference in student learning outcomes using the Predict Observe Explain learning model and the Learning Cycle 5E learning model on acid-base material. The average value of learning outcomes in experimental class I is 85.71, while in experimental class II it is 81.71.

Keywords: Learning Cycle 5E, Predict Observe Explain, Learning Outcomes

Abstrak: Perbedaan Hasil Belajar Siswa Menggunakan Model Pembelajaran Predict Observe Explain dan Model Learning Cycle 5E pada Materi Asam Basa. *Penelitian ini bertujuan untuk menguji cara-cara di mana model pembelajaran Learning Cycle 5E meningkatkan hasil belajar siswa, cara-cara di mana model pembelajaran Predict Observe Explain meningkatkan hasil belajar siswa, dan cara-cara di mana model pembelajaran Learning Cycle 5E berbeda dari model Predict Observe Explain sehubungan dengan materi asam-basa. Dua kelas yang dipilih secara acak, XI-B dan XI-C, berfungsi sebagai sampel. Ada dua kelas eksperimen, yaitu I dan II, dan penelitian ini menggunakan desain kelompok kontrol pretes-posttest. Tes pilihan ganda dengan 20 pertanyaan digunakan dalam penelitian ini. Uji hipotesis penelitian I menghasilkan* t_{hitung} *(26,77) lebih besar dari* t_{tabel} *(2,3451), maka* H_0 *ditolak. Uji hipotesis II: Jika* t_{hitung} *(38,67) lebih besar dari* t_{tabel} *(2,3451), maka* H_0 *ditolak. Uji hipotesis III: Jika* t_{hitung} *(2,35) lebih besar dari* t_{tabel} *(2,2921), maka* H_0 *ditolak. Penelitian telah menunjukkan bahwa terdapat peningkatan hasil belajar siswa dengan menggunakan model pembelajaran Learning Cycle 5E pada materi asam basa, dari nilai sebelum menggunakan model pembelajaran Learning Cycle 5E sebesar 45,29 menjadi 85,71, terdapat peningkatan hasil belajar siswa dengan menggunakan model* *pembelajaran Predict Observe Explain pada materi asam basa, dari nilai sebelum menggunakan model pembelajaran Predict Observe Explain sebesar 42,86 menjadi 81,71, dan terdapat perbedaan hasil belajar siswa dengan menggunakan model pembelajaran Predict Observe Explain dan model pembelajaran Learning Cycle 5E pada materi asam basa. Nilai rata-rata hasil belajar pada kelas eksperimen I sebesar 85,71, sedangkan pada kelas eksperimen II sebesar 81,71.*

Kata kunci: *Learning Cycle 5E, Predict Observe Explain, Hasil Belajar*

▪ INTRODUCTION

Chemistry is the in-depth study of a material's properties, structure, composition, transformation, and energy (Baunsele et al., 2020). Acids and bases are part of the major subject covered, which is typically applied in grade 11 during the even semester. Acids and bases are fundamental topics, particularly in comprehending salt hydrolysis materials, thus students must have a thorough grasp of them (Sulastry et al., 2023). Poor or low-quality learning outcomes can be caused by abstract acid-base information and include complicated calculations.

According to the findings of first observations, specifically those carried out by researchers at SMA Negeri 17 Medan, information was gathered because in the process of learning acid-base material, chemistryteachers still use conventional models, with teaching techniques that are typically used include lecture methods, taking notes, providing examples of questions, and working on problems, so that students become less engaged throughout the learning process, this demonstrates that learning chemistry As a result, chemistry learning outcomes at SMA Negeri 17 Medan class XI remain low, as many students struggle to solve chemistry-based questions, particularly more complicated ones, and the instructor continues to dominate the learning experience. From the school archive data, it was found that the average results of the acid-base repeat exam for grade XI in the 2023/2024 academic year had not reached the minimum passing standard of 80, where most students had not achieved the minimum passing score.

In a study by Fajrin et al. (2020), it was found that insufficient understanding in chemistry can result from educators employing unsuitable teaching strategies or models. To enhance student performance, a learning model is required that effectively engages and inspires students to take an active role in their education (Handayani et al., 2021). In order to help students and instructors achieve their learning goals, Ardianti et al. (2022) defines a learning model as a series of activities that can present a structured explanation of the teaching process. According to Mirdad (2020), a learning model is a framework that can be utilized, particularly for developing extensive educational plans (curriculum), organizing content as a component of teaching resources, and directing the learning experience in classrooms and other settings.

The learning model plays a role in the student learning process and has a direct influence on the activities carried out by students, which then has an impact on topic mastery and learning outcomes. The learning model can be considered as a model selection; that is, teachers can choose the appropriate learning model to meet educational goals, such as the Learning Cycle 5E learning model or the Predict Observe Explain learning model. According to Liana (2020), the Learning Cycle 5E learning model consists of process stages that are arranged in such a way that students can be actively involved in understanding the skills that must be acquired. The Learning Cycle 5E has been shown to be useful in improving scientific stage abilities in chemistry education.

This is because students are forced to actively participate during the learning process, which leads to students' understanding and application of scientific methods (Aprilia et al., 2021). This learning model can help students avoid learning methods that are more memorization-based and can increase learning motivation because students are actively involved in the learning process (Kartini et al., 2021). The characteristic of this model is that each student is actively involved in small group discussions to remember and convey their initial understanding of a material. Furthermore, they and their groups build relationships between concepts in the material being studied. The teacher acts as a facilitator who rotates the discussion and provides direction and correction if there are errors in student understanding (Simaremare & Juwitaningsih, 2022).

Jaya and Indrayani's study (2021) asserts that utilizing the 5E Learning Cycle model can enhance the learning achievements of students, especially in topics concerning reaction rates. Thus, it is gathered from pupils who have met the cognitive integrity standards. This suggests that 5 students (20.83%) are highly qualified, whereas 19 students (79.17%) are well qualified. Susanti et al. (2022) also investigated the Learning Cycle 5E learning paradigm in attempt to improve students' learning outcomes. Considering the study's comes about, The test lesson that utilized the Learning Cycle 5E demonstrate completed 76.47% of the understudy learning prepare, while the control lesson that utilized the conventional show wrapped up fair 29.42%.

According to Yusni et al. (2023) POE learning approach is one that uses well-structured grammar. POE is one of the learning approaches pioneered by White and Guston. It is intended that pupils would grasp the topics they study in the prediction stage (Nugraha et al., 2019). The POE model is an alternate method for creating an engaging learning environment since it emphasizes direct student engagement. Using this methodology, students are educated in anticipating, communicating concepts, and completing information, ensuring that learning is centered on them.

Research by Leaongso et al. (2022) demonstrates how the Predict Observe Explain learning paradigm might help students learn about chemical bonding materials more effectively. This can be prove by the learning comes about of 8 understudies with astounding triumphs (33%), 10 students with good achievements (42%), 6 students with adequate scores, and no students with low scores. Adawiyah et al. (2019) Also did research using the Predict Observe Explain paradigm to improve student learning results. The Predict Observe Explain learning paradigm, which may inspire students to be motivated and excited about participation, especially the teaching process, is the reason for this development.

Constructivist learning is applied in both the Learning Cycle 5E and the Predict, Observe, Explain (POE) models. The Predict, Observe, Explain learning model and the Learning Cycle 5E learning paradigm employ different learning strategies. Unlike the Predict Observe Explain (POE) method of instruction, which stresses the involvement of students in creating predictions, observing, and explaining events, the Learning Cycle 5E learning model emphasizes the student experience via a process that includes elaborate, evaluate, explore, engage, and explain. Preliminary observations at SMA Negeri 17 Medan revealed that students were not benefiting from the current teaching technique. Applying these two models can provide insight into how they vary in terms of increasing student educational achievement, as well as aid in the identification of an engaging model capable of activating students' roles in teaching and learning. Consequently, learning results can be enhanced.

According to the description, the purpose of this study is to identify the improvement in student learning outcomes using the Learning Cycle 5E learning model, the improvement in student learning outcomes using the Predict Observe Explain learning model, and the differences in student learning outcomes using the Predict Observe Explain model and the Learning Cycle 5E learning model on acid-base material.

▪ METHOD

This research was conducted at SMA Negeri 17 Medan in the even semester of the 2024/2025 academic year. This type of research is a quasi-experimental research, with a pretest-posttest control group design (Rudibyani & Prabowo, 2020). In this research design, experimental class I was taught using the Learning Cycle 5E learning model and experimental class II was taught using the Predict Observe Explain model, each class was given a pretest and posttest with the same question format.

The population in this study were all students of class XI of SMA Negeri 17 Medan and the sample in this study was 2 classes selected randomly, namely sampling population members without considering strata in the population. This method is carried out if the population members are considered homogeneous (Rahim & Basir, 2019). The two classes selected were experimental classes, namely experimental class I and experimental class II.

Data were collected in this study through interviews, learning outcome tests, and documentation. Interviews were conducted to obtain initial information about the condition of students during learning. Assessment of learning outcomes in the form of objective tests in the form of multiple choice acid-base material given to students, and documentation as supporting data.

The test instrument is a tool to measure student learning outcomes (Juwita et al., 2024), before being tested, the instrument was first tested, in the form of validity, reliability, difficulty level, discrimination, and distractor tests. The research procedure includes the stages of compiling a research proposal, initial research, namely interviews with teachers, stages of research implementation, and preparation of the final report. The data analysis techniques used are normality, homogeneity, and hypothesis testing.

▪ RESULT AND DISCUSSION

RESULT

Learning Outcomes

Table 1 displays the average pre- and post-test results for experimental classes I and II.

Table 1. Average Pretest and Posttest Data for Students

No	Class	Treatment	
		Pretest	Posttest
1	Experiment I	45,29	85,71
2	Experiment II	42,86	81,71

Table 1 demonstrates that experimental class I's pretest and posttest scores were 45.29 and 85.71, respectively. This demonstrates that using the Learning Cycle 5E model resulted in an improvement in student learning attainment, whereas achievement scores on the pretest and posttest in experimental class II were 42.86 and 81.71, respectively. Although the Predict Observe Explain learning paradigm increased students' academic performance, the improvement was not as significant as in experimental class I. The test results showed that the two experimental groups' pretest and posttest scores differed. The Learning Cycle 5E learning model produced better student learning results than Experimental Class Group II, which employed the Predict Observe Explain learning paradigm.

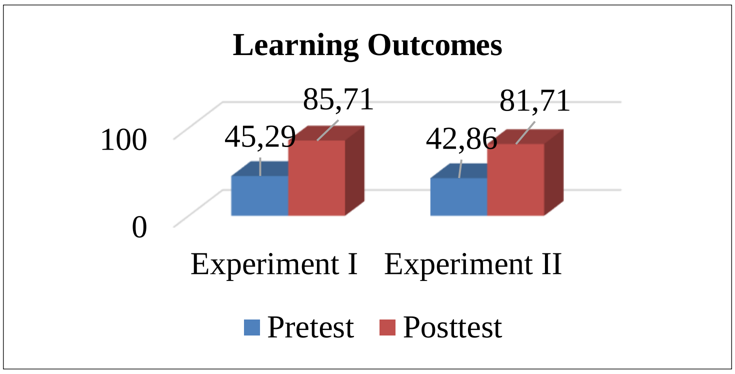

Figure 1. Diagram of Average Value of Student Learning Achievement

Normality Test

The normality test assesses if the learning outcomes of the two experimental class groups are normally distributed based on pretest and posttest results. A Chi Square test with a confidence level of $\alpha = 0.05$ and the criterion $(X^2)_{count} < (X^2)_{table}$ indicates that the data is normally distributed. Table 2 appears the comes about of the normality test calculated on the information from the two classes.

Table 2. Normality Analysis on Pretest and Posttest Learning Outcome Data

Class	Data	$(X^2)_{count}$	$(X^2)_{table}$	Description
Experiment I	Pretest	10,2	11,07	Normally distributed
	Posttest	10,9	11,07	Normally distributed
Experiment II	Pretest	10,4	11,07	Normally distributed
	Posttest	7,9	11,07	Normally distributed

Table 2 shows that the $(X^2)_{count}$ for the pretest in experimental class I is 10.2, whereas the posttest is 10.9. In experimental class II, the pretest $(X^2)_{count}$ is 10.4, whereas the posttest is 7.9. The results show that the data has a normal distribution pattern, since the computed $(X^2)_{count}$ is less than the $(X^2)_{table}$. With a significance level of $\alpha = 0.05$ and 5 degrees of freedom (db), the $(X^2)_{table}$ value is 11.07.

Homogeneity Test

The homogeneity test assures that data from two different samples are consistent. The homogeneity test indicates that if the F count result is smaller than the F table, then the value is homogeneous. The computed findings in Table 3 show the following homogeneity.

Table 3. Homogeneity Test of Pretest and Posttest Information Regarding Learning Outcomes

Class	Data	F_{count}	F_{table}	Description
Experiment I Experiment II	Pretest	1,32	1,80	Homogeneous data
Experiment I Experiment II	Posttest	1,62	1,80	Homogeneous data

As shown in Table 3, the F_{count} value for the pretest in both experimental classes I and II is 1.32, whereas the posttest is 1.62. So based on the analysis, the data is homogeneous. According to the analysis results, the information on the F_{count} value < F_{table}, where F_{table} at the significance level is $\alpha = 0.05$ with a degree of freedom (db) of 34, the result of which is 1.80.

Hypothesis Test I

The first hypothesis test looks at how student learning outcomes are increased by the acid-base content learning model based on Learning Cycle 5E. The results of the calculation may be expressed as follows:

Table 4. Hypothesis Testing I

Data	t_{count}	t_{table}	Description
Pretest-Posttest	26,77	2,3451	Reject H_0 and accept H_a

Table 4 shows a t_{count} score of 26.77 and a t_{table} (0.025) at db = 34 of 2.3451, indicating that the t_{count} is within the crucial range ($t<-2,3451$ dan $t> 2,3451$). As a result, the alternative hypothesis (Ha) is accepted whereas the null hypothesis (H0) is rejected. This illustrates how improving student learning outcomes is possible when the Learning Cycle 5E learning paradigm is used to acid-base topics.

Hypothesis Test II

In terms of the second hypothesis test, specifically, the enhancement of learning outcomes for students utilizing the Predict Observe Explain learning model with acid-base content. The results obtained from the calculation are presented in detail:

Table 5. Hypothesis Test II

Data	t_{count}	t_{table}	Description
Pretest-Posttest	38,67	2,3451	Reject H_0 and accept H_a

From the results of Table 5, the t_{count} value obtained = 38.67 and t_{table} (0.025) at db = 34 is 2.3451, so t_{count} is in the critical area ($t < -2,3451$ dan $t > 2,3451$). As a result, the null hypothesis (H0) is rejected and the alternative hypothesis (Ha) is supported, implying that employing the Predict Observe Explain learning model on acid-base content improves student learning results.

Hypothesis Test III

The last hypothesis test examines how the Predict Observe Explain model for acid-base materials and the Learning Cycle 5E learning model differ in terms of student learning results. The final conclusions from the computation may be described as follows:

Table 6. Hypothesis Test III

Data	t_{count}	t_{table}	Description
Experiment I Experiment II	2,35	2,2921	Reject H_0 and accept H_a

From Table 6, the t_{count} value obtained is 2.35 and the t_{table} value (0.025) at db = 68 is 2.2921, so t_{count} is in the critical area ($t < -2,2921$ dan $t > 2,2921$). Based on this, we may infer that the null hypothesis (H0) is rejected while the alternative hypothesis (Ha) is supported, indicating a difference in student learning results when utilizing the Predict Observe Explain model and the Learning Cycle 5E learning model on acid-base content.

▪ DISCUSSION

This study aims to determine the improvement of student learning outcomes using the Learning Cycle 5E learning model, the improvement of student learning outcomes using the Predict Observe Explain learning model, and the differences in student learning outcomes using the Learning Cycle 5E learning model and the Predict Observe Explain model on acid-base material. The initial process of the study, each class was given an initial test to determine the initial knowledge of the two sample groups in experimental class I and experiment II. The pretest value is known to be the average learning outcome of students in experimental class I 45.29 and experimental class II 42.86. The results of the pretest indicate that both classes have almost the same initial abilities because there is only a slight difference in the average of the two classes.

After being given treatment to experimental class I and experimental class II according to the syntax of each model, a final test was then held to determine the improvement in student learning outcomes from both classes. The average posttest score of experimental class I students was 85.71 and the average posttest score of experimental class II students was 81.71. Based on the pretest and posttest data from both classes, namely experimental class I and experimental class II, in experimental class I the t_{count} value was obtained = 26.77 and t_{table} (0.025) at db = 34 was 2.3451, so the t_{count} was in the critical area ($t < -2.3451$ and $t > 2.3451$), so it can be concluded that H_0 is rejected and H_a is accepted. This means that there is an increase in student learning outcomes using the Learning Cycle 5E learning model on acid-base material. This study is in accordance with the results of research conducted by Jaya & Indrayani (2021) which states that the application of learning with the Learning Cycle 5E learning model can improve student learning outcomes.

Meanwhile, in experimental class II, the t_{count} value was obtained = 38.67 and t_{table} (0.025) at db = 34 was 2.3451, so the t_{count} was in the critical area ($t < -2.3451$ and $t > 2.3451$), so it can be concluded that H_0 is rejected and H_a is accepted. This means that there is an increase in student learning outcomes using the Predict Observe Explain learning model on acid-base material. This study is in accordance with the results of research conducted by Leaongso et al. (2022) which states that the application of learning with the Predict Observe Explain learning model can improve student learning outcomes. However, some students in experimental class I and experimental class II have not reached the Minimum Completion Criteria (KKM). There are several factors that can affect student learning outcomes apart from the application of learning models, namely based on internal factors and external factors. Internal factors consist of health, interests, talents, and motivation while external factors consist of family and society (Nabillah & Abadi, 2019).

Based on the data on the average value of student learning outcomes from both classes, namely experimental class I and experimental class II, the t_{count} value of students in experimental class I and experimental class II was 2.35 with a t_{table} value (0.025) at db = 68 of 2.2921. The t_{count} value was obtained in the critical area ($t < -2.2921$ and $t > 2.2921$) so it can be concluded that H_0 is rejected and H_a is accepted. This means that there is a difference in student learning outcomes using the Predict Observe Explain learning model and the Learning Cycle 5E learning model on acid-base material.

Based on the results of the study, the Learning Cycle 5E learning model in experimental class I was higher in improving student learning outcomes than the Predict Observe Explain model in experimental class II. This can be seen from the differences in the syntax of the two models in the learning process. The Learning Cycle 5E model emphasizes independent exploration of concepts through group discussions and presentations, which allows students to build understanding gradually from the engagement, exploration, explanation, elaboration, to evaluation stages. This model provides opportunities for students to develop thinking and communication skills. Meanwhile, the Predict Observe Explain model in experimental class II focuses more on prediction, observation, and explanation activities after conducting experiments, so that students are more focused on connecting theory with practice, but less emphasis on broad concept exploration. As a result, although both models improve student learning outcomes, experimental class I shows a higher increase.

▪ CONCLUSION

The researcher may arrive to the following conclusions after doing research, analyzing data, and testing hypotheses: there is an increase in student learning outcomes using the Learning Cycle 5E learning model on acid-base material, from the value before using the Learning Cycle 5E learning model of 45.29 to 85.71, there is an increase in student learning outcomes using the Predict Observe Explain learning model on acid-base material, from the value before using the Predict Observe Explain learning model of 42.86 to 81.71, and there is a difference in student learning outcomes using the Predict Observe Explain learning model and the Learning Cycle 5E learning model on acid-base material. The average value of learning outcomes in experimental class I is 85.71, while in experimental class II it is 81.71.

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