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# The influence of the learning cycle e-model and interest on learning outcomes in acid-base material

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**ABSTRAK**

Penelitian ini dilaksanakan atas dasar adanya dominasi penggunaan metode ceramah dan kurangnya penggunaan media dalam pembelajaran terkhusus materi ajar asam basa di sekolah menengah atas di kota Kisaran. Tujuan dari penelitian ini adalah untuk mengetahui apakah ada perbedaan dalam hasil belajar antara Model Pembelajaran *Cycle* 5E dan Model Pembelajaran *Cycle* 7E, dan perbedaan minat belajar serta untuk mengetahui bagaimana model dan minat belajar berinteraksi satu sama lain. Hasil penelitian diuji dengan ANNAVA dua jalur. Hasil menunjukkan bahwa model Kelas Pembelajaran *Cycle* 5E dan Kelas Pembelajaran *Cycle* 7E memiliki perbedaan hasil belajar yang signifikan. Ini ditunjukkan oleh harga $F_{hitung}$ 7,046 lebih besar $F_{tabel}$ 4,06, yang menunjukkan bahwa Ha diterima dan H0 ditolak. Untuk minat belajar tinggi dan minat belajar rendah, $F_{hitung}$ 4,58 lebih besar dari $F_{tabel}$ 4,06, menunjukkan bahwa ada perbedaan hasil belajar yang signifikan antara minat belajar tinggi dan minat belajar rendah. Selain itu, untuk interaksi antara model pembelajaran dengan minat belajar, $F_{hitung}$ 4,078 lebih besar dari 4,06, menunjukkan bahwa ada interaksi antara model pembelajaran dengan minat belajar dan hasil belajar.

***ABSTRACT***

*This research was carried out on the basis of the dominance of the pervasiveness of the lecture method and the lack of use of media in learning, especially in acid and base teaching materials in high schools in the city of Kisaran. The aim of this research is to ascertain whether there are differences in learning outcomes between the Cycle 5E Learning Model and the Cycle 7E Learning Model, along with differences in learning interests. In addition, the study also seeks to find out how the models and learning interests interact with each other. The research results were tested using two-way ANOVA. The results show that the Cycle 5E Learning Class and Cycle 7E Learning Class models have significant differences in learning outcomes. This is shown by the value Fcount 7.046 more than Ftable 4.06, which shows that Ha is accepted and H0 is rejected. Meanwhile, for the learning interest, Fcount 4.58 more than Ftable 4.06 was attained, indicating a significant difference in learning outcomes between high learning interest and low learning interest. In addition, for the interaction between the learning model and learning interest, Fcount 4.078 is greater than 4.06, indicating that there is an interaction between the learning model, learning interest, and learning outcomes.*

**INTRODUCTION**

The study of matter's characteristics, composition, and the changes in matter and energy that result from reactions is known as chemistry. In order to engage in the study of chemistry, students must have a correct understanding of chemical concepts (Astuti & Marzuki, 2018). Chemist's study natural phenomena through processes, such as observation and experimentation, with scientific attitudes, such as objectivity and honesty, when collecting and analyzing product data from scientific processes and attitudes applied by chemists in the form of facts, theories, laws, and science to be studied. Characteristics in science, especially chemistry, are considered as attitudes, processes and products that must be considered in order to obtain maximum chemistry learning and learning outcomes.

Chemistry is a subject that many high school students find challenging because solving chemical problems involves basic chemical concepts (Defri & Yerimadesi, 2023). Difficulty learning chemistry is most likely caused by students' limited understanding of basic concepts. This can have an impact on their ability to understand subsequent concepts (Van Driel et al., 2002). As stated by Hapsari & Yonata (2014), the goal of studying chemistry is to facilitate pupils to be capable of applying their understanding of the ideas, rules, laws, and theories of the subject to real-world problem-solving.

Acids and bases are important materials in chemistry as they are closely related to everyday life. The study carried out by Utami et al. (2022) revealed that the learning outcomes of class XI students on acid and base solutions suggested that more than 60% of 72 students have not achieved complete learning outcomes. A number of factors contribute to low student learning outcomes. For instance, Priliyanti et al. (2021) posited that in teaching activities and teacher interaction with students, learning is still teacher-centered. Meanwhile, Putra et al. (2018) stated that good learning is learning according to the rules of the scientific method, which focuses on students.

The absence of encouraging media and the student's lack of enthusiasm for learning have been identified to be the main causes of teachers' difficulties in the classroom, according to the findings of interviews conducted with teachers and a number of students at State Senior High School 4 Kisaran. Some students found the class XI materials about acids and bases difficult to understand due to the abstract nature of some of the ideas. The abstract nature of the concept makes it challenging for students to differentiate between acidic and basic compounds based on their physical properties. This difficulty is often attributed to a lack of fundamental understanding of the concept of acids and bases, which is further compounded by suboptimal learning in the classroom. Errors in teaching materials are also identified as a significant contributing factor. Students learning difficulties in chemistry are attributed to the subject's abstract, complex, and calculation-intensive nature.

According to the constructivist learning theory, students must be able to combine fresh knowledge with prior experiences to construct their own knowledge (Gazali & Yusmaita, 2018). Based on these results, this study offers an e-learning model for the learning cycle and uses PowerPoint as an educational medium. A number of current teaching strategies are being explored as options to enhance higher-order thinking abilities. The Learning Cycle Method, also known as Learning Cycle E by Aripin et al. (2018), is one of these strategies.

Learning cycle learning is a learning model for students. In this learning, during different stages, students can actively participate in achieving the competencies specified in the learning objectives. The characteristics of a constructivist learning model are particularly prominent in this cycle learning model. This is also an important component of structured inquiry, as outlined by Nurhuda et al. (2016). The availability of media in the classroom creates yet another barrier to learning. Media acts as a tool to transfer information from teachers to students, with the ultimate aim of achieving learning targets. It is important that the learning media is interesting, easy to understand, easy to access, highly effective, and efficient. Several media tools have been identified for use in chemistry learning, such as ChemSketch, ISIS Draw, Microsoft Office PowerPoint PowToon, and so on (Sumarni et al., 2020 and Pratama & Surahman, 2020).

The pupils' performance in the learning process determines their success and desire in learning using media This electronic tool enables teachers to facilitate the teaching process more effectively, thereby enhancing students' engagement and interest in learning. Based on research by Khaerunnisa et al. (2018), the use of Powerpoint media provides benefits to students, fostering a conducive and enjoyable learning environment. The incorporation of this medium into the learning process renders the material more tangible, captures students' attention, and stimulates their interest in comprehending the material in greater depth.

Interest is a psychological factor that influences learning outcomes. Besides, it has a correlation with students' chemistry learning outcomes (Rozikin et al., 2018). Consequently, higher learning outcomes are correlated with more engagement in chemistry classes. It is of paramount importance for teachers to foster their students' interest in and comprehension of the material they are learning. On the other hand, unpleasant feelings can hinder the learning process because they are unable to create a positive attitude and do not support interest in learning. Interests are basically not inborn but acquired later by Susanti et al. (2019). A strong interest in something becomes a big capital in achieving or achieving goals.

A study demonstrates the effectiveness of combining PowerPoint material with electronic learning cycle models to improve student learning outcomes (Mitrayani et al., 2018). The study further claimed that, when used in conjunction with PowerPoint materials, the 7E Learning Cycle model can increase learning results by 74% as compared to the control class. At the same time, Sayuna et al. (2018) claimed that the combination of the 5E Learning Cycle model and PowerPoint-based audiovisual materials presents a growing impact on the learning objectives of students in the classroom. Therefore, from the two Learning Cycle E Models, Cycles 5E and 7E both significantly enhance student learning results.

This study draws upon the contextual data presented to explore the impact of the learning cycle E model on students' learning outcomes, with a particular focus on acid-base materials. The researchers classified interest into two categories: "high interest" and "low interest," using the 5E and 7E learning cycle models as their two adopted learning models. The fact that the researchers did a factorial study by combining several learning interests and modes sets this study apart from others.

This study aimed to identify significant variations in average student learning results between the 5E and 7E learning cycle models in acid-base learning. The study also considers how acid-base materials are affected by high and low learning interest. In the last stage, this study determines the association between learning interest, learning style, and the average value of learning outcomes for students in acid-base subjects.

## METODE

This study included two class members per group and employed a semi-experimental research design. A pretest-posttest control group design was used as the study methodology. For this quasi-experimental investigation, a nonequivalent control group design was used. All eleventh-grade students in the State Senior High School 4 Kisaran class, which consists of 3 classes and comprises approximately 105 students, participated as the subjects of this study. Two categories were used as the focus of the sampling technique. The two classes chosen are XI-1 and XI-3, which were turned into experimental classes I and II. These classes attended the learning with PowerPoint materials and the Learning Cycle 5E and 7E Models.

The aforementioned draft elucidates the existence of two distinct learning groups, namely those that adhere to the 5E learning cycle model (A1) and those that adhere to the 7E learning cycle model (A2). The use of PowerPoint materials is a standard feature of every class. The student cohort is divided into two groups, distinguished by their respective learning interests. The first group, designated as the "high-interest learning group" (B1), is characterized by a proclivity for engaging in learning activities. The second group, designated as the "low-interest learning group" (B2), is distinguished by a lack of such proclivity.

The learning outcome serving as the dependent variable was determined by the post-test results. The learning cycle of the e-learning model was the independent variable, while the student's motivation in learning was the moderating variable. Tests and non-tests were used as research instruments. This testing instrument comprised 20 multiple-choice questions with 5 options, designed by experienced validators for students in the twelfth-grade students at the senior high school level based on testing (test item validity, degree of difficulty, power to differentiate, and reliability). Meanwhile, the non-test instrument was in the form of a questionnaire statement of interest in learning which has been validated by an expert validator. The questionnaire indicators of interest in learning included students' feelings of enjoyment, attention, interest, and involvement during the learning process. The assessment of the interest in learning questionnaire employed a Likert scale ranging from 1 to 4.

The data analysis process was performed using quantitative analysis. First, the Chi-Square technique and the Shapiro-Wilk test were performed using SPSS version 25.0 to ascertain whether the data was normal. There was a 5% significance threshold. If the sig value was more than α (0.05), the data was considered normal. Homogeneity was also examined using Fcount and Levene's test with SPSS version 25.0, provided that the significance value was α = 0.05. The sample was homogenous if sig > α (0.05) (Silitonga, 2014). Data analysis continued using two-way ANOVA for hypothesis testing. The flow chart of this study is shown in Figure 1.

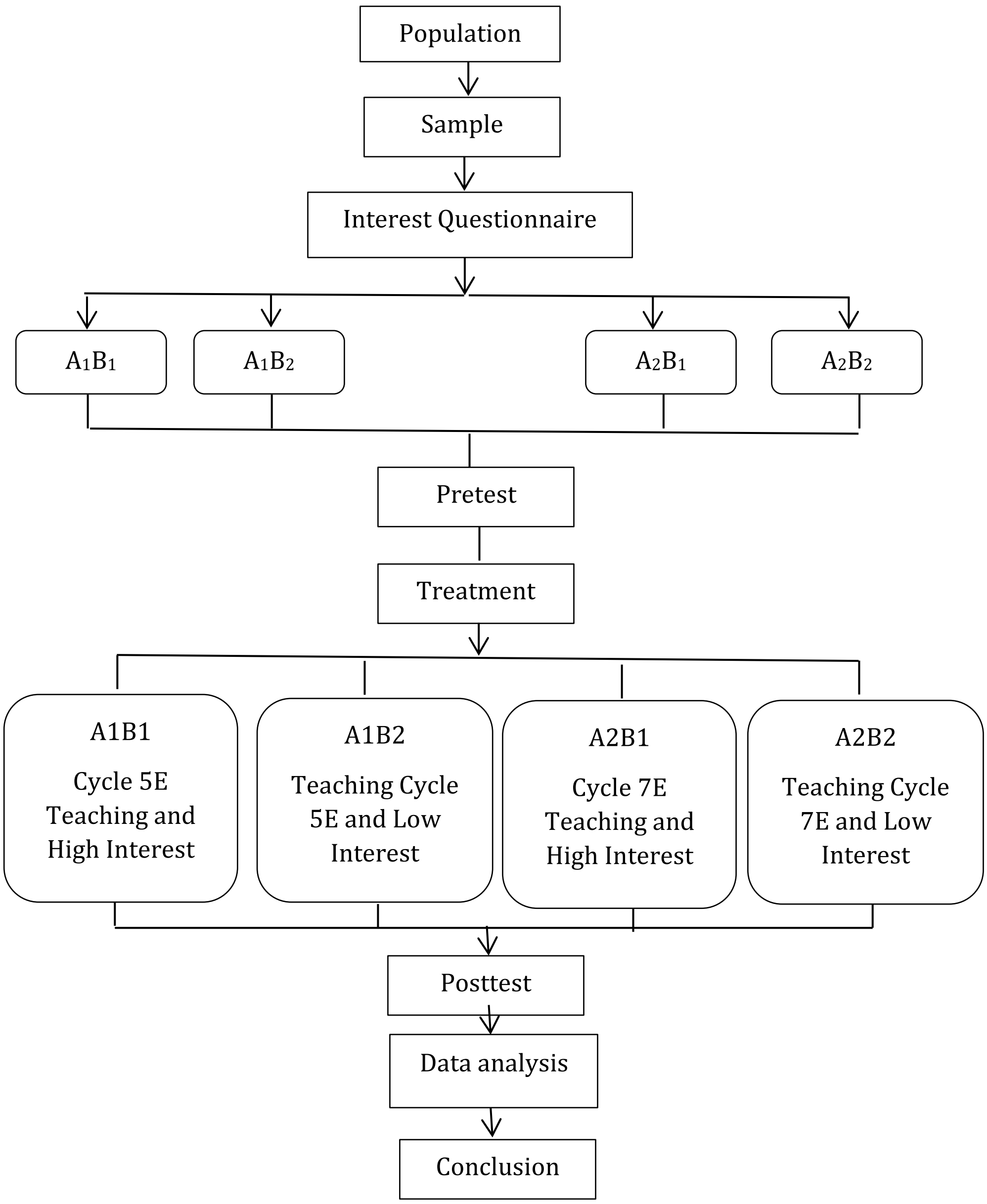


**Figure 1. Scheme of research stages**

## RESULTS

The normality and homogeneity of the data must be tested using the post-test results since a parametric test must be performed prior to doing a hypothesis test (Silitonga, 2014)

### Normality Test

The Chi-Square Test (x^2) was used in this research, with the significance threshold (α) was set at 0.05. The data was deemed to be normally distributed when the calculated Chi-Square value ($x^2$) < Chi Square value ($x^2$) table (Nuryadi et al., 2017). The criteria for normality test results are presented in Table 1. Meanwhile, the normality test results are presented in Table 2.

Based on the data in Table 2, in the Learning Cycle 5E learning model, sig.0.132 was obtained, while in the Learning Cycle 7E model attained a sig. of 0.115, where the second value was sig. > (α)=0.05, which indicated that the data on learning outcomes was distributed properly. Then, in the learning interest category for high interest, sig. 0.062 was obtained, while those with low interest obtained sig.0.530 where the second value is sig. > (α)=0.05, which means the learning outcome data is normally distributed.

**Table 1. Normality test results data**

| No | Class | Treatment | Difference between post-test and pre-test scores | | |
|---|---|---|---|---|---|
| | | | ($X^2{}_{count}$) | ($X^2{}_{table}$) | Information |
| 1 | XI-1 | $A_1B_1$ (Cycle 5E, High Interest) | 5,069 | 11,07 | Normal |
| 2 | XI-1 | $A_1B_2$ (Cycle 5E, Low Interest) | 8,491 | 11,07 | Normal |
| 3 | XI-3 | $A_2B_1$ (Cycle 7E, High Interest) | 6,083 | 11,07 | Normal |
| 4 | XI-3 | $A_2B_2$(Cycle 7E, Low Interest) | 5,843 | 11,07 | Normal |

**Table 2. Normality test results**

**Learning model**

| Learning outcomes | Learning Model | Shapiro-Wilk | | |
|---|---|---|---|---|
| | | Statistic | Df | Sig. |
| | Cycle 5E | .936 | 24 | .132 |
| | Cycle 7E | .933 | 24 | .115 |

**Interest to learn**

| Learning outcomes | Interest to learn | Shapiro-Wilk | | |
|---|---|---|---|---|
| | | Statistic | Df | Sig. |
| | High interest | .921 | 29 | .062 |
| | Low interest | .958 | 19 | .530 |

### Homogeneity test

In order to ascertain whether the samples originated from homogeneous data, a homogeneity test was conducted. Using SPSS 25.0 for Windows, homogeneity was assessed using Levene's test, with a significance level of α = 0.05. Table 3 contains the data for the results of the uniformity test. The data on learning outcomes with different media and different learning interests are homogeneous, as indicated by the value of 0.584 > $\alpha$ (0.05).

**Table 3. Homogeneity test results**

| Levene's test of equality of error variances[a,b] | | | |
|---|---|---|---|
| Dependent variable: Learning outcomes | | | |
| F | df1 | df2 | Sig. |
| .655 | 3 | 44 | .584 |

### Hypothesis testing

From the post-test results, the average learning outcome scores can be seen in Table 4.

**Table 4. Data on the typical learning outcomes for students in each treatment combination**

| Learning Model Factors (A) | Learning Interest Factor (B) | |
|---|---|---|
| | **$B_1$** | **$B_2$** |
| $A_1$ | 83,66 | 87,30 |
| $A_2$ | 84,44 | 75,45 |

Information:
$A_1B_1$ : 5E Cycle Learning Model and High Interest in Learning
$A_1B_2$ : 5E Cycle Learning Model and Low Interest in Learning
$A_2B_1$ : 7E Cycle Learning Model and High Interest in Learning
$A_2B_2$ : 7E Cycle Learning Model and Low Interest in Learning

The proposed hypothesis was accepted following its testing using a two-way analysis of variance (ANOVA) technique and the application of the testing criteria of Fcount > Ftable at a significant threshold of $\alpha = 0.05$. The following outcomes, which are shown in Table 5, were derived based on the data processing results.

**Table 5. Analysis of various student learning outcomes**

| Source of variation | Db | JK | RK=JK/dk | $F_{count}$ | F(0,05, db) F(1,44) |
|---|---|---|---|---|---|
| Factor A | 1 | 400,238 | 400,238 | 7,044 | 4,06 |
| Factor B | 1 | 260,466 | 260,466 | 4,584 | 4,06 |
| AB Interaction | 1 | 231,296 | 231,296 | 4,078 | 4,06 |
| In | 44 | 2.500 | 56,818 | - | - |
| Total | 47 | 3.392 | - | - | - |

Table 5 presents an analysis result of several learning outcomes. It is evident that Fcount(A) is 7.044 and Ftable is 4.06. Since Fcount > Ftable. Therefore, Ha is accepted, indicating that there were notable variations in the average learning outcome scores between students who were taught acid and base content using the 5E and 7E learning cycle models. Moreover, Fcount(B) equals 4.584, and Ftable is equal to 4.06. Ha, thereby Fcount > Ftable. This indicates that there is a significant distinction in the average learning outcome scores of students with high and low learning interest in acid and base content. Moreover, Fcount(AB) equals 4.078, and Ftable is equal to 4.06. Ha, thereby, an interaction between the model and learning interest on the average value of students' learning outcomes in acid-base content is accepted since Fcount > Ftable.

Additionally, a two-way ANOVA was used for hypothesis testing with a significance level (α) of 0.05. Table 6 displays the results of the hypothesis test.

**Table 6. Hypothesis test results**

| ***Tests of Between-Subjects Effects*** | | | | | |
|---|---|---|---|---|---|
| | *Dependent Variable:* Learning outcomes | | | | |
| *Source* | *Type III Sum of Squares* | *df* | *Mean Square* | *F* | *Sig.* |
| Learning Model | 147.426 | 1 | 147.426 | 7.863 | .048 |
| Interest | 246.196 | 1 | 246.196 | 4.781 | .034 |
| Model * Interest | 579.775 | 1 | 579.775 | 4.258 | .002 |

The SPSS 25.0 Windows software program was utilized to conduct a two-factor analysis of variance for hypothesis testing, with a significance level (α) of 0.05. The result obtained is sig. 0.048 < $\alpha$ (0.05), which indicates that Ha is accepted and Ho is refused in response to the first question, which asks whether there is a significant difference in the average learning outcomes of students learning using the Cycle 5E and Cycle 7E models. Regarding the second hypothesis, which concerns if students with high and low learning interests differ significantly in their average learning outcome scores, the answer is sig. 0.034 < $\alpha$ (0.05), signifying that Ha is accepted and Ho is rejected. In the third hypothesis, which concerns the possibility of an interaction between the model and learning interest, the significance level (sig) is 0.002<$\alpha$ (0.05), indicating the rejection of Ho and the acceptance of Ha.

To ascertain the students' learning outcomes, the researchers administered a post-test following the three sessions of the learning process. The results of the post-test, students in experimental class 1 performed academically on average 81.87, while students in experimental class 2 performed academically on average 83.95. Figure 2 provides a graphical depiction of the rise in learning outcomes.

According to the results of the hypothesis test, students who attended learning utilizing the PowerPoint media-supported 5E learning cycle model had an average learning outcome of 84.44 for low interest and 83.66 for high interest. In contrast, the average learning outcome in classrooms using the 7E Learning Cycle Model with PowerPoint materials with high interest was 87.30, whereas the average in sessions with low interest was 75.45, as shown in Figure 3.

In addition, a second test, the Scheffe Test, was performed to determine the fundamental impacts of each factor due to the presence of an interaction. The Scheffe test revealed that the differences between A1B1 and A2B2, A2B1 and A2B2, and A1B2 and A2B2 were significant. This indicates that the learning interests of individual participants and the contrast in the offered learning model are very dissimilar.

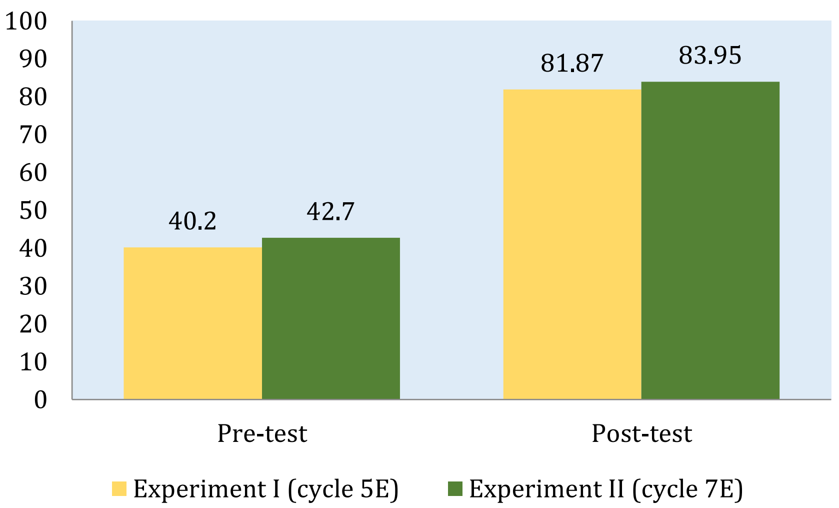


**Figure 2. Student learning results**

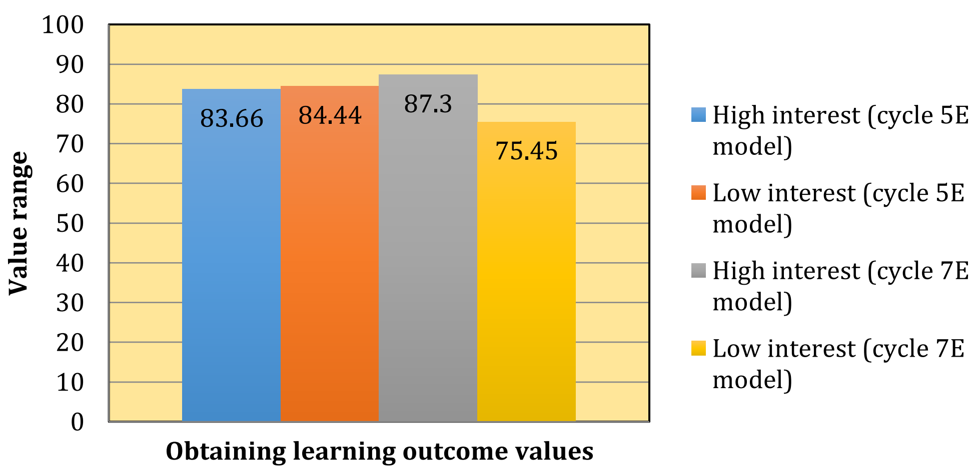


**Figure 3. Average student learning outcomes with varying models and interests**

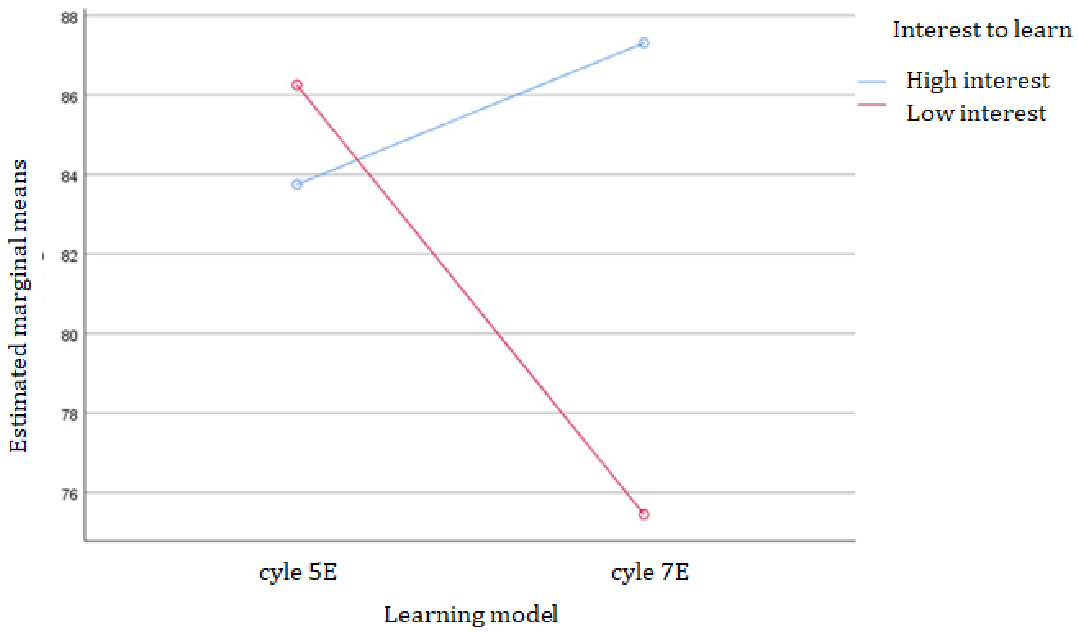


**Figure 4. Interaction graph of learning model and learning interest**

**DISCUSSION**

The research commenced by providing a questionnaire to ensure the uniformity of samples in the class. This was followed by a learning interest questionnaire to group the samples used based on their high interest and low interest in learning. Once the samples had been divided into two groups for each of the two experimental classes, the experiment proceeded with the administration of a pre-test, which was designed to ascertain the students' initial abilities. The prediction data indicated that both sample groups were homogeneous and normally distributed, with an average prediction score of 40.20 for Experiment I and 42.70 for Experiment II. This study was conducted in three sessions in each experimental class. There were variations in the academic results of experimental classes one and two based on the learning achievement data of the two sample groups. The learning cycle 7E model is taught in a higher-level class than the learning cycle 5E model. This is consistent with studies by Aripin et al. (2018), which discovered that, as shown by variations in higher-order thinking skills (HOTS), the 7E learning cycle strategy produced greater and better learning results than the 5E learning cycle approach.

This was further supported by the findings of the Zuhra et al. (2017) study, which claims that the Learning Cycle 7E model is an improvement over the Learning Cycle 5E model and is believed to be more effective at raising average learning outcomes in the classroom. Students' responses to instructor queries demonstrate that changes in the Learning Cycle E model's syntax can genuinely increase their enthusiasm for learning.

The learning model is considered to be an alternative to improving student learning outcomes. One of the learning models considered suitable for science learning is the Learning Cycle E model. Adilah & Budiharti (2015) stated that the application of the 7E Learning Cycle model is more prevalent in integrated science lessons such as Biology, Physics, and Chemistry. This is because the model does not only focus on the final result, but students gain scientific knowledge through a series of activities using the students' own scientific methods.

In related research, Pratiwi et al. (2022) stated that learning cycle 5E assisted by ChemDraw media has been able to increase learning outcomes by 86%, superior to those without using a model on a hydrocarbon cap. In line with that, Lasaiba. (2023) posited that learning cycle 5E is also effective in enhancing in-class learning outcomes for students.

The results of the hypothesis test show that Fcount (A) is 7.044 and Ftable is 4.06. Since Fcount > Ftable, Ha is accepted, suggesting a significant contrast in the average learning outcomes of students who studied using the 5E learning cycle model and the 7E learning cycle model in the acid-base material. Furthermore, Fcount (B) is 4.58 while Ftable is 4.06. As the Fcount > Ftable, Ha is accepted. For Fcount (AB), the value obtained is 4.078, and for Ftable is 4.06, suggesting that Fcount > Ftable, then the Ha is accepted. This funding indicates the presence of an interaction between the model and learning interest, such as the average of students' acid-base learning outcomes.

Another test, the Scheffe Test, was performed to determine the basic impacts of each factor because there was an interaction. The Scheffe test revealed that the differences between A1B1 and A2B2, A2B1 and A2B2, and A1B2 and A2B2 were significant. This indicates that the learning interest of an individual and the contrast in the offered learning model are very dissimilar. Students' enthusiasm in learning is stimulated by the offered learning paradigm. This aligns with Fitriyani et al.'s (2019) study, which found that students' situational interest—which motivates them to learn actively and enthusiastically—is best demonstrated throughout the involvement and elaboration stages of the Learning Cycle E model, as presented in Figure 4.

Only the first and last phases of the learning process differ between Learning Cycles 5E and 7E. Therefore, there is no discernible difference in the learning process overall. Nonetheless, it is evident that students with high interest levels are better suited for the 7E learning cycle model, whereas students with low-interest levels are more suited for the 5E learning cycle model. This aligns with the study carried out by Puluhulawa et al. (2020), which posits that students who possess a strong formal thinking ability would benefit more from learning cycle learning. Conversely, pupils who struggle with formal thinking are better suited for the direct learning approach.

The 7E learning cycle has a profound impact on the learning process (Balta & Sarac, 2016), and thus, teachers must adapt their creativity in implementing this strategy to align with their personal teaching styles in order to foster student interest in learning. The same is true for Tyas and Sugiman's study. (2015) stated that the 7E learning cycle can further enhance students' interest in learning compared to the expository learning model.

This study also proposes that the 5E learning cycle is suitable for improving students' interest in learning, as evidenced by each improvement in the learning outcomes of the two experimental classes. Susanti et al. (2019) stated that the increase in students' interest in learning is also due to students' high interest in the topic they are learning. On the other hand, the use of media is also an important factor in improving students' interest in learning, as Anugraheni (2016) pointed out that the 5E learning cycle supported by multimedia can improve students' interest in learning science.

This indicates that the best way to improve classroom learning is to combine variables A (learning style) and B (learning interest). Good learning outcomes are ensured by the "Learning Cycle 7E" learning paradigm in conjunction with a high level of learning interest. The gain in learning outcomes is less evident, though, when combined with a lack of enthusiasm for studying. Students who are eager and have a stronger interest in learning are more motivated to finish the seven learning phases (syntax) of Cycle 7E. At the same time, because Learning Cycle 5E has less grammar than Cycle 7E and is more constructive in nature, it is better suited for teaching groups with low learning interests. However, in general, judging from the post-test results for each class, both models used are able to get better student learning outcomes.

In this research, the researcher contributed to the full implementation of the process as well as designing the research results. According to the researcher's observation, experimental class 2 is more suitable for teaching using the 7E learning cycle model because the leading class is composed of students with higher interests, while experimental class I is more suitable for teaching using the 5E learning cycle model.

## CONCLUSION

The results indicate that students' learning outcomes in acid-base materials are influenced by various learning strategies. Compared to the Learning Cycle 5E model, the Learning Cycle 7E model demonstrated better student learning outcomes. Comparably, learning results for individuals with high and low learning interests differ significantly. Students' learning results varied as a result of the interaction between learning interests and learning styles in this study. In this study, classrooms with high levels of learning interest are better suited to the 7E learning cycle model, whereas courses with low levels of learning interest are more suited for the 5E learning cycle model. However, it should be noted that this study only used factorial design and quantitative research, which may have introduced certain limitations. Therefore, it is hoped that other researchers will be able to combine it with qualitative research so that the research results are better. Other researchers can also change the design factors in terms of other aspects to be measured.

**Author contributions**

The authors made significant contributions to the study's conception and design. The authors were in charge of data analysis, interpretation, and discussion of results. The final manuscript was read and approved by the authors.

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**Conflict of interest**

The authors declare that there is no potential conflict of interest.

**Data availability statement**

All data are available from the authors.

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