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Implementation of E-LKPD on Acid–Base Socio-Scientific Issues to Improve Critical Thinking Skills and Learning Motivation

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Abstract: This research is motivated by the low critical thinking skills of students in chemistry learning. This is indicated by students who have not been trained in analyzing a problem and a lack of involvement, so that students are not motivated to learn. Students need effective teaching materials to be actively involved in analyzing problems and motivating learning, so that E-LKPD based on Socio-Scientific Issues is expected to be a learning innovation. This study aims to measure the effectiveness of E-LKPD based on Socio-Scientific Issues in acid-base learning on critical thinking and student learning motivation. E-LKPD is presented via the web Liveworksheets as an interactive medium. The type of research used is a quasi-experiment with a nonequivalent group pretest-posttest research design. The study was conducted in class XI IPA 8 and XI IPA 1 SMAN 4 Pekanbaru consisting of 90 students. Data analysis used the Normality test, t-test, and N-gain test. The results of the analysis for critical thinking obtained an N-gain of 0.6586 in the control class and 0.7509 in the experimental class. Meanwhile, for learning motivation, the N-gain obtained was 0.2537 in the control class and 0.4548 in the experimental class. Furthermore, the results of the t-test showed that there was a significant difference between critical thinking skills and learning motivation in the control class and the experimental class. Critical thinking skills and learning motivation have a positive relationship as evidenced by the sig. value < 0.05 with a Pearson correlation value of 0.419, thus E-LKPD based on Socio-Scientific Issues is effective in improving critical thinking skills and learning motivation in acid-base learning.

Keywords: Acid base learning; Critical thinking skills; E-LKPD; Learning motivation; Socio-Scientific Issues

Introduction

Education is the most important part of building quality human resources for a country. The need for quality education that is relevant to the demands of the times is increasingly urgent. 21st century education demands a paradigm shift in learning with the main focus on 21st century skills to prepare students with relevant skills and competencies (Hanipah, 2023). One of the 21st century skills that students must have is critical thinking skills. Critical thinking skills are included in the Pancasila student profile in order to create students with character through the Merdeka curriculum (Rihmahwati et al., 2024). Critical thinking skills are the ability to remember, research, obtain, apply, draw conclusions, synthesize, and evaluate information (Arfiani et al., 2024). Critical thinking plays an important role because it provides opportunities for students to learn through discovery. Through critical thinking skills, students can think reflectively about the decision-making made by students (Ramdani et al., 2020).

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The critical thinking skills of students in Indonesia are still relatively low. This is evidenced by the 2022 PISA data which show that Indonesia is ranked 67th out of 81 countries for the science category. Based on the data, it shows that students have not achieved the ability to solve complex problems. The PISA test results refer to students' ability to analyze and reason (Girsang et al., 2022). Critical thinking skills play an important role for students in understanding the main subjects. One of the main subjects is science which includes the discipline of chemistry (Novitasari, 2023).

Chemistry is a science that studies the structure, matter, composition, properties, changes, and energy that accompany these changes. Student studies chemistry to understand the conceptual basis in solving problems (Wahdan et al., 2017). Understanding concepts in chemistry learning is important because chemistry requires conceptual understanding in learning it (Fathonah et al., 2024). If students get an inappropriate concept, it will have an impact on learning activities (Yovanie, 2024). Students lack evidence or reasons for the answers to existing problems (Novitasari, 2023). The difficulties experienced by students in understanding concepts result in students not actively participating in learning, and are one of the factors that contribute to the lack of critical thinking skills (Arfiani et al., 2024). Low participation causes students to be unmotivated in learning activities. Someone who has high motivation tends to be enthusiastic about learning, thus encouraging the achievement of good learning quality (Rihmahwati et al., 2024). Student learning motivation is related to critical thinking skills. If students' learning motivation is low, then their critical thinking skills will also be low and vice versa (Liyanto et al., 2021).

Students are active in learning, such as actively asking questions or expressing opinions, so that students' critical thinking skills can improve and learning runs well (Arfiani et al., 2024). To improve students' critical thinking skills in learning, an efficient learning approach is needed so that learning objectives are achieved. One learning approach that can be used is the socio-scientific issues approach. This approach discusses socially relevant scientific issues, such as environmental and health problems, so that it can increase scientific understanding, hone analytical skills, and formulate logical solutions (Chomsun et al., 2025). Learning with the socio-scientific issues approach involves students in discussions related to science (Dusturi et al., 2024). Through socio-scientific issues learning, students are trained to develop complex thinking skills in solving problems. Chemistry learning is part of science so that learning can be packaged in socio-scientific issues content with the aim that students can master the skills they have (Firanti et al., 2024).

21st century learning prepares students to face technological advances. The impact of technology requires students and teachers to have skills in the teaching and learning process (Erna et al., 2024). Students can apply technology in learning using electronic teaching materials such as E-LKPD. The E-LKPD that is created must be interesting and increase students' knowledge. E-LKPD can create learning activities in accordance with the 21st century, namely training students' critical thinking skills and encouraging more active learning so that students' enthusiasm for learning increases (Pramana et al., 2022). E-LKPD trains students to collect information related to the material being studied and to discuss it together to find a deep understanding and conclusions regarding the concepts and characteristics of the material being studied (Wahyuni et al., 2024). The E-LKPD used can be integrated with social science issues according to the material being studied (Rohmaya et al., 2023). E-LKPD integrated with a socio-scientific issues approach is expected to improve students' critical thinking skills and learning motivation.

Based on this, efforts that can be made to improve critical thinking and student learning motivation in acid-base learning are through implementing E-LKPD based on Socio-Scientific Issues. The E-LKPD contains social issues around students that stimulate students to relate the issues that occur with scientific knowledge in the learning process (Chomsun et al., 2025). E-LKPD is equipped with learning materials, videos, and articles related to issues that aim to increase students' insight. Through the implementation of E-LKPD based on Socio-Scientific Issues, it is hoped that it can direct students to think critically and foster learning motivation, especially in chemistry learning.

Method

This study used a quasi-experimental method with a non-equivalent group pretest-posttest design. The study was conducted at SMAN 4 Pekanbaru. This design was used to determine the effect of treatment on research subjects who were not selected randomly. This design involved two classes, namely the experimental and control classes where before and after treatment, pretests or posttests were given to the two classes. The research population was class XI IPA students of SMAN 4 Pekanbaru in the 2024/2025 academic year. The research sample was class XI MIPA 8 as the experimental class and class XI MIPA 1 as the control class. The research instruments consisted of learning implementation instruments and data collection instruments.

The learning implementation instruments were in the form of chemistry learning objectives, teaching

modules and E-LKPD based on Socio-scientific Issues according to the meeting, and data collection instruments were in the form of pretest/posttest critical thinking questions and learning motivation questionnaires. The effectiveness of E-LKPD on critical thinking skills and learning motivation is measured through pretest-post test questions. The purpose of the pretest is to determine students' initial knowledge of acid-base learning, while the posttest aims to determine the achievement of students' final cognitive aspects in acid-base learning (Erna et al., 2024). In this study, a normality test was carried out using the Shapiro Wilk test, the equation can be seen as follows.

$$D = \sum_{i=1}^{n} (X_i - \bar{X})^2 \quad (1)$$

$$T_3 = \frac{1}{D}\left[\sum_{i=1}^{k} a_i \, (X_{n-i-1} - X_i)\right]^2 \quad (2)$$

The Shapiro Wilk normality test using SPSS 25 has the following provisions: If the significance value is > 0.05, then the research data is normally distributed; If the significance value is < 0.05, then the research data is not normally distributed. After the data obtained is normally distributed, the next step is to conduct a hypothesis test. Hypothesis testing is carried out for pretest-posttest data on critical thinking skills and student learning motivation using the independent sample t-test with SPSS 25. The equation for the independent sample t-test is.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(n_1 - 1){S_1}^2 + (n_2 - 1){S_2}^2}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \quad (3)$$

Independent sample t-test with SPSS 25 has the following provisions: If the significant value is > 0.05, then H_0 is accepted (H_a is rejected); If the significant value is < 0.05, then H_0 is rejected (H_a is accepted). If the test results show a difference in critical thinking skills between the control group and the experimental group, then the increase in critical thinking skills can be analyzed with the following N-gain score.

$$N\_gain = \frac{\text{Posttest score} - \text{Pretest score}}{100 - \text{Pretest score}} \quad (3)$$

The N-gain score obtained will be adjusted based on the criteria in Table 1 to see the increase in students' critical thinking skills.

Table 1. Criteria for N-gain

N-gain	Criteria
N-gain ≥ 0.70	High
0.30 < N-gain < 0.70	Medium
N-gain ≤ 0.30	Low

(Ananda & Fadhli, 2018)

In addition to measuring the level of critical thinking of students, an analysis of learning motivation data was conducted through a student questionnaire. In this learning motivation research questionnaire, the answers to each statement item were arranged using a Likert scale. The answers to each question item have levels from very positive to very negative. The learning motivation questionnaire instrument was arranged with four answer choices, this was to avoid answers that tended to be in the middle (neutral). The answer alternatives were: Strongly Agree (SS), Agree (S), Disagree (TS), Strongly Disagree (STS). The scores for each answer choice are presented in Table 2.

Table 2. Alternative item score of respondents' answers

Alternative answers	Positive item scores (+)	Negative item scores (-)
Strongly agree	4	1
Agree	3	2
Disagree	2	3
Strongly disagree	1	4

After measuring the level of critical thinking skills and learning motivation of students after the implementation of E-LKPD based on Socio-Scientific Issues, a hypothesis test was conducted to see the relationship between critical thinking and learning motivation. This test uses a simple correlation. The test is conducted to obtain the provisions of the coefficient value in seeing the relationship between two or more variables with a significance level of 0.05. The test uses IBM SPSS 25 with the following provisions: If the significant value is > 0.05, then H_0 is accepted (H_a is rejected); if the significant value is < 0.05, then H_0 is rejected (H_a is accepted). Correlation tests that can be used such as the Pearson Correlation test for normally distributed data, while the Spearman Correlation test for non-normally distributed data. correlation between two variables in Table 3.

Table 3. Interpretation of correlation coefficients

Correlation coefficients	Interpretation
0.00–0.199	Very low
0.20–0.399	Low
0.40–0.599	Currently
0.60–0.799	Strong
0.80–1.00	Very strong

Result and Discussion

Sampling was conducted using purposive sampling technique, namely sampling based on certain objectives/considerations (Sugiyono, 2019). The trial was conducted at SMAN 4 Pekanbaru in class XI IPA 8 as the experimental class and class XI IPA 1 as the control class consisting of 90 students. The purpose of the trial was to determine the effectiveness of the E-LKPD Acid Base based on Socio Scientific Issues that had been developed on students' critical thinking skills as seen through students' pretest-posttest data using an instrument of 15 essay questions according to critical thinking indicators according to Ennis. In addition, students' learning motivation can be seen through the provision of questionnaires during the pretest or posttest.

Critical Thinking Skills

Students' critical thinking ability was measured using critical thinking essay questions during the pretest and posttest of acid-base material in the experimental and control classes. The results of the pretest-posttest of students' critical thinking ability are presented in Figure 1 below.

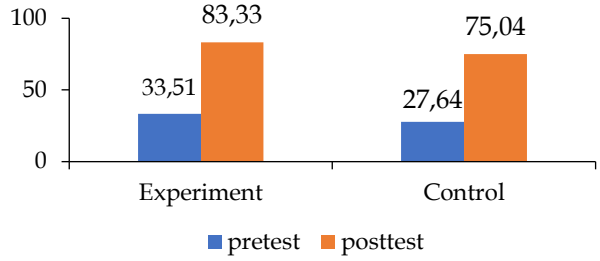

Figure 1. Pretest-posttest data for experimental class and control class

Based on Figure 1, there is a difference in the pretest-posttest values of the experimental class and the control class. Data analysis was carried out through several tests to see whether or not there was a difference in the average increase in critical thinking skills after the implementation of E-LKPD based on Socio Scientific Issues on acid-base learning.

Nomality Test

Normality test is a test conducted with the aim of determining whether the data distribution is normal or not. If the data obtained is normal, then the hypothesis analysis uses parametric statistical tests, while if the data obtained is abnormal, then non-parametric statistical tests are used. The normality test used is the Shapiro–Wilk parametric test. The significance level is 5% using IBM SPSS 25. The results of the critical thinking ability normality test are presented in Table 4 below.

Table 4. Results of the normality test of critical thinking skills

Variable	Treatment	Shapiro Wilk		
		Statistic	Df	sig.
Critical Thinking skills	Experiment Pretest	0.124	45	0.154
	Experiment Posttest	0.123	45	0.072
	Control Pretest	0.113	45	0.162
	Control Possttest	0.163	45	0.055

Based on Table 4, the significance value of critical thinking data in the experimental class and control class obtained a sig value > 0.05. The results obtained are normally distributed. After the data obtained is normal, then the hypothesis test is carried out on the critical thinking of students.

Hypothesis Test

Hypothesis test is a test used to determine whether there is a difference in the average of two unpaired samples. The hypothesis test used in this study is the Independent Sample T Test with SPSS 25. The criteria for hypothesis test are: If the sig. (2-tailed) value > 0.05, then H_0 is accepted and H_a is rejected; If the sig. (2-tailed) value < 0.05, then H_0 is rejected and H_a is accepted. The results of the hypothesis test of the pretest-posttest data on students' critical thinking skills are presented in Table 5.

Table 5. Results of critical thinking hypothesis test

	Independent Sample T Test			
		t	df	Sig. (2-tailed)
Critical Thinking Skills	Equal variances assumed	6.258	88	0.000
	Equal variances not assumed	6.258	86.115	0.000

Based on Table 5, the sig. (2-tailed) value obtained is < 0.05. This shows that there is a significant difference between the critical thinking skills of students in the experimental class and the control class. Based on these results, E-LKPD based on Socio Scientific Issues on acid-base material has an effect on students' critical thinking skills. Furthermore, the N-gain test was carried out to see how much the students' critical thinking skills increased.

N-gain Test

Critical thinking data analysis was conducted through the N-gain test with the aim of determining how much the students' critical thinking skills increased after using E-LKPD based on Socio Scientific Issues on acid-base learning. The magnitude of the increase in students' critical thinking is presented in Table 6 below.

Table 6. Improving students' critical thinking skills

Class	Critical Thinking Skills		N-gain	Category
	Pretest	Posttest		
Experiment	33.51	83.33	0.7509	High
Control	27.64	75.04	0.6586	Medium

Table 6 shows that the increase in students' critical thinking skills occurred in the experimental class and the control class. The n-gain score of students' critical thinking in the experimental class was 0.7509 (high), while the n-gain score in the control class was 0.6586 (moderate). Based on these results, the use of E-LKPD based on Socio Scientific Issues provides a better increase in critical thinking skills than classes that do not use E-LKPD based on Socio Scientific Issues. The results of the n-gain test on each indicator of critical thinking of students in the experimental class after using E-LKPD based on Socio Scientific Issues and the control class are presented in Table 7 below.

Table 7. Improvement of each critical thinking indicator in experimental class and control class

Indicator	N-gain Experiment	N-gain Control
Providing simple explanations	0.756	0.664
Building basic skills	0.828	0.764
Providing further explanations	0.743	0.677
Determining strategies and tactics	0.699	0.547
Summarize	0.857	0.730

Based on Table 7, it can be explained that the use of E-LKPD based on Socio Scientific Issues can improve every aspect of the critical thinking ability indicator for the experimental class. The following is an explanation of the improvement of each indicator.

Provide a Simple Explanation

This indicator obtained an n-gain score of 0.756 with a high category. This is because in the E-LKPD based on Socio Scientific Issues there is a scientific background stage, where this stage contains the presentation of the issues discussed and requires students to identify problems so that they can improve students' ability to provide simple explanations (Rosyidah & Subekti, 2023). Simple explanations were given regarding issues related to acids and bases.

Building Basic Skills

This indicator obtained an n-gain score of 0.828 with a high category. This happens because in E-LKPD based on Socio Scientific Issues there is a scientific background stage. In the learning process, students are asked to observe a social problem in learning and find solutions to a problem given to build students' basic skills (Effendi & Fauziah, 2022).

Provide Further Explanation

This indicator obtained an n-gain score of 0.743 with a high category. This happens because in E-LKPD based on Socio Scientific Issues there is an evaluation of information stage. In group learning activities, students convey ideas and get feedback from their group mates so that they can improve student understanding (Rosyidah & Subekti, 2023). Students will be accustomed to explaining further about the issues presented.

Determine Strategy and Tactics

This indicator obtained an n-gain score of 0.699 with a moderate category. This happens because in E-LKPD based on Socio Scientific Issues there are stages of impact of local, national, and global impact. Learning activities present problem issues that require students to provide solutions. Students and their group members discuss strategies and choose the right strategy in solving problems (Rosyidah & Subekti, 2023).

Summarize

This indicator obtained an n-gain score of 0.857 with a high category. This happens because in the E-LKPD based on Socio-Scientific Issues there is a decision-making stage. Students are able to observe and relate the problems presented and students can process the information obtained globally into more detailed and clear conclusions (Rosyidah & Subekti, 2023).

The benefits of presenting issues in E-LKPD are so that students can think critically by analyzing issues and providing ideas (Khasanah & Setiawan, 2022). Students who use the Socio-Scientific Issues approach tend to be more involved, motivated, and have a good understanding of the material being studied (Kirana & Arsih, 2024). Based on the results of the analysis of the five indicators of critical thinking skills, it can be concluded that the use of E-LKPD based on Socio-Scientific Issues can improve students' critical thinking skills, especially in the experimental class.

Learning Motivation

Students' learning motivation was measured using a questionnaire given to students before using E-LKPD based on Socio Scientific Issues (pretest) and after using E-LKPD based on Socio Scientific Issues (posttest) on acid-base material for the experimental class and control class. The following is a description of students' learning motivation.

Normality Test

The normality test is a test conducted with the aim of determining whether the data distribution is normally distributed or not. The normality test used for the pretest-posttest data of students' learning motivation was conducted using the Shapiro Wilk parametric test.

Testing with a significance level of 5% with IBM SPSS 25. The results of the normality test of students' learning motivation are presented in Table 8.

Table 8. Results of the normality test of learning motivation

Variable	Treatment	Shapiro Wilk		
		Statistic	df	sig.
Learning Motivation	Experiment Pretest	0.952	45	0.059
	Experiment Posttest	0.956	45	0.088
	Control Pretest	0.953	45	0.066
	Control Posttest	0.950	45	0.053

Based on Table 8, the significance value of the learning motivation data of students in the experimental class and control class obtained a sig. value > 0.05. The results obtained were normally distributed. After the data obtained were normal, the next step was to test the hypothesis of students' learning motivation using the Independent Sample t-test.

Hypothesis Test

Hypothesis test is used to determine whether there is a difference in the average of two unpaired samples. The hypothesis test used is the Independent Sample T Test with IBM SPSS 25. The criteria for hypothesis testing are: If the sig. (2-tailed) value > 0.05, then H_0 is accepted and H_a is rejected; If the sig. (2-tailed) value < 0.05, then H_0 is rejected and H_a is accepted. The results of the hypothesis test are presented in Table 9 below.

Table 9. Results of learning motivation hypothesis test

		Independent Sample T Test		
		T	df	Sig. (2-tailed)
Learning Motivation	Equal variances assumed	6.258	88	0.000
	Equal variances not assumed	6.258	86.115	0.000

Based on Table 9, the sig. (2-tailed) value obtained is < 0.05. This shows that there is a significant difference between the learning motivation of students in the experimental class and the control class. Furthermore, the N-gain test was carried out to see how much the learning motivation of students increased.

N-gain Test

The analysis of learning motivation data was conducted through the N-gain test with the aim of determining how much the learning motivation of students increased after using E-LKPD based on Socio Scientific Issues on acid-base material. The amount of increase in learning motivation of students is presented in Table 10.

Table 10. Increasing student learning motivation

Class	Learning Motivation		N-gain	Category
	Pretest	Posttest		
Experiment	68.537	83.037	0.4548	Medium
Control	63.5925	72.9074	0.2537	Low

Table 10 shows that the increase in students' learning motivation occurred in the experimental class and the control class. The n-gain value of students' learning motivation in the experimental class was 0.4548 (moderate), while the n-gain value in the control class was 0.2537 (low). Based on these results, it is concluded that the use of E-LKPD based on Socio Scientific Issues provides a better increase in learning motivation than classes that do not use E-LKPD based on Socio Scientific Issues. The results of the n-gain test on each indicator of students' learning motivation in the experimental class after using E-LKPD based on Socio Scientific Issues are presented in Table 11.

Table 11. Improvement of each learning motivation indicator in the experimental class

Indicator	N-gain	Category
Having a desire and wish to succeed	0.42	Medium
Having a drive and need to learn	0.40	Medium
Having hopes and aspirations for the future	0.50	Medium
Having appreciation for learning	0.45	Medium
Having interesting activities in learning	0.56	Medium
Having a conducive learning environment	0.45	Medium

Based on Table 11, it can be explained that the use of E-LKPD based on Socio Scientific Issues can improve every aspect of the learning motivation indicator. The following is an explanation of the improvement of each indicator as follows.

Having a Desire and Wish to Succeed

This indicator obtained an n-gain score of 0.42 with a moderate category. This is due to the scientific background stage which is manifested in student activities to solve problems in E-LKPD based on Socio Scientific Issues. This activity reflects one aspect, namely responsibility for tasks. Where students are responsible for developing the capacity to evaluate information on issues presented from various sources in order to increase knowledge (Rahayu et al., 2022).

Having a Drive and Need to Learn

This indicator obtained an n-gain score of 0.40 with a moderate category. The increase in this indicator occurred due to the use of E-LKPD based on Socio Scientific Issues used by teachers, so that students can understand the material well. This activity reflects one aspect, namely PBM activities in the classroom. E-LKPD based on Socio Scientific Issues includes a way to make

learning meaningful by students by investigating information to solve problems through critical thinking (Khasanah & Setiawan, 2022).

Having Hopes and Aspirations for the Future

This indicator obtained an n-gain score of 0.50 with a moderate category. The increase in this indicator occurred because the presentation of issues contained in the E-LKPD based on Socio Scientific Issues guided students to think and integrate components from various aspects, namely scientific, social, ethical and moral (Hanifha et al., 2023).

Having Appreciation for Learning

This indicator obtained an n-gain score of 0.50 with a moderate category. The increase in this indicator occurred due to feedback given by the teacher on the resolution of issues in the E-LKPD. This activity reflects one aspect, namely feedback on the results of student work. Students identify problems that arise in social science issues and convey scientific arguments supported by evidence, and enable the development of critical thinking skills. The various views provided by students allow teachers to provide appropriate feedback on the views given (Nubita & Istianah, 2024).

Having Interesting Activities in Learning

This indicator obtained an n-gain score of 0.56 with a moderate category. The increase in this indicator occurred due to the use of E-LKPD based on Socio Scientific Issues which presents practical work so that students are enthusiastic about learning. This activity reflects two aspects, namely the varied teaching materials used and new learning approaches. E-LKPD is used to facilitate students in independent learning, so that students are active in learning and solving problems. In learning activities, students will be more active if the teacher provides teaching materials based on Socio Scientific Issues (Ummah & Susantini, 2025).

Having a Conducive Learning Environment

This indicator obtained an n-gain score of 0.45 with a medium category. The increase in this indicator occurred because students enjoyed learning using E-LKPD based on Socio Scientific Issues in a clean and comfortable room.

Based on the results of the analysis of six learning motivation indicators, it can be concluded that learning using E-LKPD based on Socio-Scientific Issues can improve learning motivation.

The Relationship between Critical Thinking Skills and Learning Motivation

To determine the relationship between critical thinking variables and learning motivation, a correlation test was conducted. Correlation analysis used the Pearson correlation test. The results of the Pearson correlation test are presented in Table 12 below.

Table 12. Pearson correlation test results

		Critical Thinking Skills	Learning Motivation
Critical Thinking Skills	Pearson Correlation	1	0.419
	Sig. (2-tailed)		0.004
	N	45	45
Learning Motivation	Pearson Correlation	0.419	1
	Sig. (2-tailed)	0.004	
	N	45	45

Based on Table 12, it is explained that the value obtained is 0.004 < 0.05 and the Pearson correlation value shows 0.419. This proves that there is a positive relationship and moderate correlation between the critical thinking variables and learning motivation. These results are in line with other studies, namely that there is a positive correlation between learning motivation and critical thinking skills with a value of 0.367 (Marfuah, 2022). Students who have high motivation tend to have high critical thinking skills and students who have low motivation tend to have low critical thinking skills (Jelita et al., 2024).

Conclusion

Based on the results and discussion, it can be concluded that the N-gain value for critical thinking ability is 0.7509 for the experimental class with a high category and 0.6586 for the control class with a medium category, while the N-gain value for learning motivation is 0.4548 for the experimental class with a medium category and 0.2537 for the control class with a low category. The use of E-LKPD based on Socio-Scientific Issues in acid-base learning is effective in improving students' critical thinking skills and learning motivation. The issues presented in E-LKPD aim to enable students to think critically by analyzing ideas and attracting learning motivation. Students' critical thinking skills and learning motivation also have a positive relationship with a medium correlation category through the application of E-LKPD based on Socio-Scientific Issues in acid-base learning. It is hoped that further researchers can use different innovations, learning methods, and variables in E-LKPD based on Socio-Scientific Issues.

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The author declares no conflict of interest.

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