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Improving Critical Thinking Skills With E-LKPD Oriented Think Pair Share For Chemical Equilibrium Material

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Abstract
Through the creation of Think Pair Share-oriented E-LKPD, This study aims to enhance the ability of pupils to think critically regarding chemical equilibrium content.. The methodology of research utilized in this study is the Research and Development (R&D) approach, which was modified from Sugiyono (2015). The limited trial used One Group Pretest-Posttest Design. This study was conducted at SMAN 12 Surabaya. The validity data come from the E-LKPD's validity results, the practicality data come from the results of student activity observation and student response questionnaires, and the effectiveness data come from the critical thinking skills and student learning outcomes pre- and post-test results. From the research findings, in terms of validity, a mode score of ≥ 3 was gained for each aspect. Practicality is shown by the results of the learner response questionnaire with a percentage of 94.76%. The n-gain score findings for students in the medium and high skill categories, as well as the Sig. (2-tailed) value of 0.000, which demonstrates a substantial difference between pretest and post-test critical thinking abilities and student learning outcomes, demonstrates effectiveness. Based on these findings, including the Think Pair Share stage in the E-LKPD can help students learn more actively, understand concepts better, and develop their critical thinking abilities.

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INTRODUCTION

The Merdeka Curriculum allows teachers to adapt their instruction to the requirements and characteristics of their pupils by providing a more flexible curriculum structure and placing this emphasis on fundamental knowledge (Kepmendikbudristek No. 56 Tahun 2022). To promote the development of graduate characters who are prepared for the workforce, the Merdeka Curriculum places a strong emphasis on the development of soft skills like problem-solving, communication, and critical thinking (Permendikbudristek No. 13 Tahun 2022).

Students should be able to apply mathematical operations to chemical calculations, study the nature, structure, and interaction of particles in the formation of various compounds, and comprehend and be able to explain aspects of energy, rate, and equilibrium of chemical reactions, according to the Merdeka curriculum's learning outcomes for chemistry (Kemendikbud, 2022). According to Wahyuni (2015), critical thinking is a type of thinking that try to connect cause and effect to find solutions to issues that arise both during the learning process and in everyday life. It also tries to understand problems in depth, has an open mind to the decisions and opinions of others, and seeks to understand and accurately evaluate the

information received before making decisions. Interpretation, inference, analysis, explanation, evaluation, and self-regulation are all parts of critical thinking (Facione, 2013).

Pre-study results in XII IPA 5 class of SMAN 12 Surabaya show that students had low critical thinking abilities. This was proven by the results obtained when students work on critical thinking skills questions given during pre-study. The results obtained on 5 critical thinking components include (1) Inference 52.38%, (2) Interpretation 58.09%, (3) Analysis 33.33%, (4) Explanation 62.85%, and (5) Evaluation 62.85%. This is further supported by the findings of the student survey, which show that 51.42% of students think that learning about chemical equilibrium is among the most challenging chemistry topics. Due to this, it is essential to create an Electronic Student Worksheets (E-LKPD) focused on a model of learning that may hone critical thinking abilities about chemical equilibrium content.

One way to enhance student's critical thinking abilities on chemical equilibrium content is through the use of learning resources like LKPD that are targeted toward their critical thinking abilities. LKPD (Students Worksheet) is one type of printed learning media that is often used by teachers in the learning process (Dermawati, 2019). Along with the development of increasingly sophisticated times, the use of digital technology is growing, especially in the field of education. By utilising digital technology, a learning medium can be created in the form of Electronic Student Worksheets (E-LKPD). E-LPKD can be used anywhere and anytime using a laptop or smartphone so that it can facilitate the learning process (Apriliyani & Mulyatna, 2021). The E-LKPD to be developed utilizes the Liveworksheets website. Liveworksheets is a web-based platform called Liveworksheet.com. Liveworksheets allow teachers to turn conventional worksheets into interactive online worksheets with automatic corrections and grades. The advantage of Liveworksheets is that it provides interesting E-LKPD editing features such as inserting video, audio, and images. Then, the special advantage is that the E-LKPD can be filled in directly on the website without having to install the application first (Sholehah, 2021). The E-LKPD developed in this study has features that help students comprehend the material and make it simpler for them to work on existing questions. These features include drop-down select boxes, drag and drop, answer filling boxes, and additional virtual labs that students can try directly by simply pressing the available links.

Students' critical thinking skills are expected to increase if students can construct or build knowledge together through deep understanding. A learning strategy called Think Pair Share (TPS) provides students time to reflect, respond, and assist one another (Lyman, 1985). TPS is a form of cooperative learning made to change how students engage with one another. TPS enables students to work both independently and in small groups with other students to assist one another. Unlike the classical method which allows only one learner to come forward and share the results with the whole class, each student has at least eight times more chances to be acknowledged and demonstrate their contribution to others when using the Think Pair Share method. (Slavin, 2005).

This refers to research conducted by Heni Mulyani (2019). The outcomes of this study's TPS learning model in class X on students' critical thinking abilities revealed an improvement. Judging from the first cycle with a percentage of 63.44% and the second cycle increased with a percentage of 82.38% and was categorized as very good. In research conducted by Arrosid (2019). In the results of this study, tt was discovered that using a cooperative learning approach like Think Pair Share might enhance the activities and critical thinking abilities of students in class X IPA 3 SMAN 1 Kota Bengkulu. This is demonstrated by the fact that students' critical thinking skills rose from 56.43% (moderately critical) in the first cycle to 72.50% (critical) in the second cycle. Additionally, the results of Lum'atul Khoirot's research (2021) revealed that using E-LKPD on environmental pollution material can enhance students' critical thinking abilities. This is shown by the results of the average N-gain on each indicator of 0.70, indicating

that there has been a significant improvement in students' critical thinking abilities overall. Nurkhaliza, Hamid, & Suharto (2018) the Cooperative Script learning model, which was developed in conjunction with TPS, can help students' critical thinking abilities advance from the category of quite critical to critical, their level of activity rises from quite active to active, and their cognitive learning outcomes move up from the low category to the medium category. Rizkika, Putra, & Ahmad (2022) claims that E-LKPD based on STEM can improve critical thinking skills with an N-Gain of about 0.43 in the older category and with an average response rate of about 87% in the more advantageous category. Furthermore, according to Firdaus (2013) research, the TPS model can improve students' motivation for learning and academic results. This is demonstrated by the computation of the average score on the student learning motivation questionnaire, which came out to 36, compared to a score of 35.15 in the control group, which is in the high category. Regarding student learning outcomes: in the experimental class, students' average scores were 77.86, with a classical completeness percentage of 89%, compared to 70.86 in the control class, with a classical completeness percentage of 58%.

According to the findings of this analysis, the authors are motivated to carry out a study titled "Improving Critical Thinking Skills on Chemical Equilibrium Material Using E-LKPD Oriented Think Pair Share." The later-developed E-LKPD will make use of a liveworksheet site with tools that can assist and enable students to directly complete the E-LKPD. Additionally, there is a think pair share stage that can assist students in becoming more engaged in their education and supporting one another during more intense discussions at the pair and share stages so that they can advance their critical thinking abilities and conceptual understanding.

METHOD

The Research and Development (R&D) technique, adapted from Sugiyono (2015), was used in making Think Pair Share-orientated E-LKPD. Because the goal of this research is to discover whether the product is feasible, it is only possible to conduct product trials. The adaptation of Sugiyono's (2015) R&D steps is shown in the following figure.

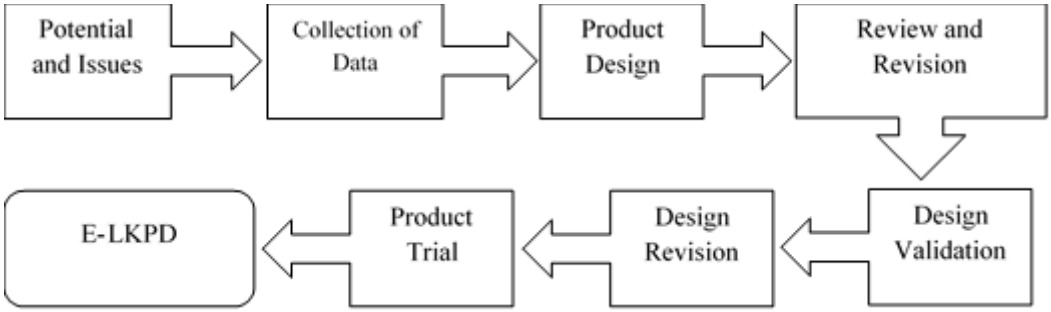

Figure 1. Sugiyono's (2015) modification of the R&D procedure.

Students in class XI IPA 5 SMAN 12 Surabaya participated in the product trial. One Group Pretest Posttest Design, which involves doing studies in just one group without using another group as a control, was employed in the product trial. The following figure depicts this design.

O_1	X	O_2

Figure 2. One Group Pretest-Posttest design

O_1 = The pretest result
O_2 = The posttest result
X = Application of Think Pair Share orientated E-LKPD

(Sugiyono, 2015)

Data from validation sheets, response forms, observations of students at work, tests of critical thinking abilities, and student learning outcomes were all analyzed. By completing the provided validation sheet, three validators evaluated the validation data and analyzed the results. Validators provide feedback using a Likert scale.

Table 1. Likert Scale Category

Scale Value	Criteria
4	Very Valid
3	Valid
2	Quite Valid
1	Less Valid
0	Invalid

Data from validation results can be analyzed by determining the mode on each aspect or indicator. If the aspect assessed by the validator has a mode score ≥ 3, then the aspect is declared valid (Lutfi, 2021).

Practicality data analysis is obtained from a response questionnaire and supported by observations of student activities. The response questionnaire will be filled in by students after the research is conducted to measure the practicality of the development of Think Pair Share (TPS) oriented E-LKPD based on a Guttman scale with the answer options "yes" and "no". The score obtained will determine the percentage of the practicality of TPS-oriented E-LKPD learning media with the following formula:

$$\text{Practicality percentage} = \frac{\text{Total score for each aspect}}{\text{Total respondent}} \times 100\%$$

The percentage results are used to determine practicality using the following categories:

Table 2. Practicality Category

Value	Category
0-20%	Impractical
21-40%	Less Practical
41-60%	Quite Practical
61-80%	Practical
81-100%	Very Practical

(Riduwan, 2012)

If the percentage results achieved are more than equal to 61%, E-LKPD is considered to be practical based on these criteria. The information from observing students' activities supports the data from the response questionnaire as well. Student activities observation data could be analyzed by determining the mode of each aspect or indicator. If the aspect assessed by the observer has a mode score = 1, then that aspect is declared practical.

Data from pretest and posttest on students' learning outcomes and critical thinking abilities can be used to evaluate effectiveness. The n-gain score will be used to examine and calculate data on critical thinking abilities and learning outcomes received as a result of pretest and posttest results using the following formula:

$$N - gain = \frac{Posttest - Pretest}{Maximum\ Score - Pretest}$$

The acquired findings will be categorized as follows using the N-gain score criteria.

Table 3. N-gain scoring criteria

Average n-gain score (g)	Criteria
$g \geq 0,7$	High
$0,3 \geq g \leq 0,7$	Medium
$g \leq 0,3$	Low

If the n-gain score ($<g>$) ≥ 0.3 or falls into the medium or high categories, it may be said that students' critical thinking abilities and learning outcomes have improved. The learning media that have been designed are also considered to be effective in these cases.

The paired sample T-test was also utilised to assess the pretest and post-test data. The collected data were checked for normality using the Kolmogorov-Smirnov test before being subjected to analysis using the paired sample T-test. The data is considered as normally dispersed when the significance value is greater than 0.05. When the data are normally dispersed, the paired sample T-test can be used to further analyze the data. Using SPSS, the paired sample T-test was performed. H_0 is disregarded and H_1 is approved when the Sig. (2-tailed) value < 0.05, whereas H_0 is approved and H_1 is disregarded if the Sig. (2-tailed) value is greater than 0,05.

RESULTS AND DISCUSSION

The findings demonstrated that students' use of Think Pair Share-oriented E-LKPD to analyze chemical equilibrium material improved their critical thinking abilities. The following will describe the research data obtained.

Validity

For Validity, It was derived from the validity of the E-LKPD results, which were evaluated by two chemistry education study program lecturers and one high school chemistry teacher. Content validity and construct validity make up the validity data. Chemical resources in E-LKPD that are appropriate for learning indicators, the Think Pair Share learning methodology, and the development of critical thinking abilities are all examples of content validity. Prastowo (2015) asserts that the inclusion of learning objectives in E-LKPD that include a variety of tasks aids students' comprehension of the information presented. While presentation, language, and images all contribute to build validity. Students' memories are highly impacted by the color of the text that accompanies the E-LKPD content, because a pleasing appearance will comfort students as they complete their work and be able to foster a nice learning environment (Sujarwo & Oktaviana, 2018). According to Prastowo (2013), high-quality E-LKPD are those E-LKPD whose language use makes it simple for readers to read and understand. The table below displays the validity results.

Table 4. Validity Result

Aspects of Validity	Mode		
	E-LKPD 1	E-LKPD 2	E-LKPD 3
Content Validity	4	4	4
Construct Validity	4	4	4

The Think Pair Share-oriented E-LKPD was developed to enhance students' critical thinking abilities on chemical equilibrium material. The validation results of content feasibility and construct feasibility received a mode value of 4. The mode value achieved is ≥ 3, allowing the E-LKPD to be considered legitimate with a very valid category (Aprilia & Lutfi, 2023).

Practicality

The practical result of E-LKPD were obtained from the results of the student response survey which were supported by observation data on student activities during the trial. The E-LKPD developed received a student response percentage of 94.76%., so it can be categorized that the practicality is very good because the percentage of students' responses ≥ 61% (Riduwan, 2012). There are 14 aspects in the response questionnaire that students were given, where in each aspect students can choose yes or no answers according to their opinions. All of these aspects are considered to represent the E-LKPD that has been developed in regard to content, appearance, language, and presentation. According to Azizah & Kuswanti (2022) showing that after utilizing E-LKPD Think Pair Share, the comprehension of concepts acquired by students rose by 20% supports the idea that high practicality scores might give an increase in the understanding of concepts obtained by students.

The student response questionnaire fell into the "very good" category, according to the results, and this is corroborated by the findings of the student activity observation, which fell into the "very fulfilling" category. This is because the observation of students' activities gets a mode value = 1. With the results of the response questionnaire with the percentage obtained ≥61% and the observation of students' activities with a mode value = 1, the E-LKPD developed can be declared practical with a very good category to use because the percentage of students' responses is 94.76% and has been backed up by observations of students' activities that have a mode of 1.

Effectiveness

The outputs of the pretest and posttest for critical thinking abilities and student learning outcomes are used to determine the effectiveness of E-LKPD. Before the restricted trial, which was held on May 8, 2023, students took a pretest that included questions about critical thinking skills and learning objectives. On May 9, 2023, students were given the post-test questions on critical thinking abilities and learning outcomes after a limited trial.

The pretest and posttest results demonstrate that students' critical thinking abilities have improved. The pretest was conducted before the limited trial of the developed E-LKPD. While the posttest was conducted after a limited trial of the developed E-LKPD. The outcomes of the critical thinking skills before and after a test for students are shown in the following table.

Table 5. Results of the Pre- and Post-Tests for Critical Thinking Skills

Components of Critical Thinking Skills	Pretest	Posttest	n-gain	Category
Interpretasi	40	73,3	0,56	Medium
Analisis	35,5	81,1	0,71	High
Inferensi	31,1	81,1	0,73	High
Eksplanasi	26,7	68,9	0,58	Medium
Evaluasi	18,9	78,9	0,74	High

The graph below displays the improvement in students' critical thinking abilities in each component between the pretest and posttest.

With high and medium n-gain score requirements, each critical thinking component has improved. Indicators that score poorly on the pretest because students don't comprehend the TPS-based learning process, which leads to inadequate knowledge of the subject matter and inadequate problem-solving skills. This is consistent with Norrazifti and Dian's (2019) claim that low pretest scores among students are acceptable because learning activities have not been completed.

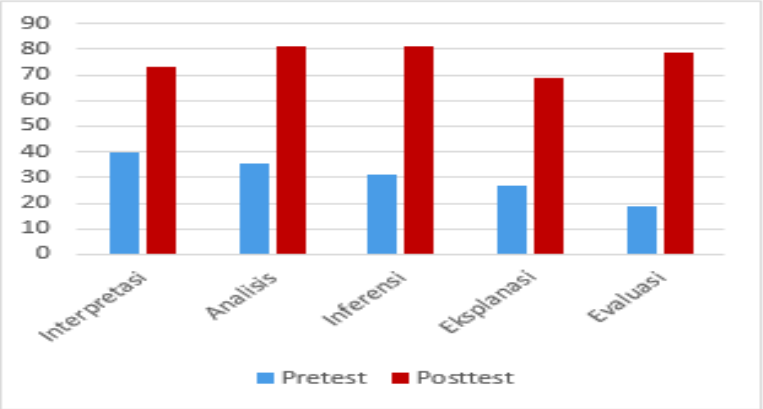

Figure 3. The increase of students' critical thinking skills in each component

A hypothesis test was performed on the data to find out the significant different in the critical thinking abilities of students before and after the small-scale development of Think Pair Share-oriented E-LKPD. With the aid of the SPSS tool, the received data was checked for normalcy, with the outcomes shown in the accompanying table.

Table 6. Normality of Test Results for Critical Thinking Skills

One-Sample Kolmogorov-Smirnov Test

		PretestKBK	PosttestKBK
N		30	30
Normal Parameters[a,b]	Mean	30,63	76,67
	Std. Deviation	10,984	15,320
Most Extreme Differences	Absolute	0,152	0,153
	Positive	0,133	0,095
	Negative	-0,152	-0,153
Test Statistic		0,152	0,153
Asymp. Sig. (2-tailed)		,075[c]	,072[c]

a. Test distribution is Normal.

According to the data from Table 6 above, the data with a Sig value > 0.05 is normally distributed with a pretest of 0.075 and a posttest of 0.072. Once it is known that the data acquired is normally dispersed, the paired sample t-test tested is performed using the values from the pretest and posttest. Using the same subject but receiving two different treatments, paired sample t-test analysis is used in hypothesis testing to look for differences (Paisal & Perdana, 2021). The following was the hypothesis that the paired sample t-test was testing:

- H_0 = No improvement in students' critical thinking skills in the material of chemical equilibrium after using Think Pair Share E-LKPD learning media.
- H_1 = There was an improvement in students' critical thinking skills in the material of chemical equilibrium after using Think Pair Share E-LKPD learning media.

The outcome of the paired sample t-test performed on the collected data are shown in the table 7. The Sig. (2-tailed) value is 0.000, meaning that a Sig. (2-tailed) value is less than 0.05, H_0 is disregarded and H_1 is approved. This indicates a significant existing disparity between the critical thinking abilities pretest and post-test scores. From the results that have been gained, this shows that the E-LKPD developed can be said to be effective. These results are also supported by research from Priantari (2014) which states that the TPS learning strategy is a

strategy based on constructivism, which has the principle that knowledge for individuals is the result of individual construction, correct knowledge if the constructed knowledge can be used to solve problems or relevant phenomena and knowledge cannot be transferred by someone from another person, but through their interpretation process.

Table 7. Paired Sample T-test Outcome of Critical Thinking Skills

Paired Samples Test

		t	Df	Sig. (2-tailed)
Pair 1	PreKBK – PostKBK	-21,349	29	0,000

A study conducted by Fajrin's (2015) research, students' critical thinking abilities can be enhanced by the TPS learning model since it encourages students to actively focus on problems, investigate theories, recognize problems, offer solutions to those problems, and be capable of make straightforward conclusions.. In addition, research conducted by Fitri (2019) states that critical thinking abilities can be enhanced by the TPS learning model. The findings revealed that in the pre-cycle the percentage of achievement of high category critical thinking skills indicators was 31.25%, then an increase in cycle I to 63.88% and an increase again in cycle II to 84.63%. Therefore that it is possible to claim that the TPS learning paradigm can assist students' critical thinking abilities.

Student Learning Outcomes

The findings of the pretest and posttest show that students' learning outcomes have improved. The pretest was performed before the limited test of developed E-LKPD. Meanwhile, the posttest was taken after a limited test of developed LKPD. The findings of the students' learning outcomes' pretest and posttest using the n-gain score criteria are shown in the table below.

Table 8. Student Learning Outcomes Using N-Gain Score Criteria

Number of students	Criteria
22	High
8	Medium

This demonstrates that good results are obtained when students' learning objectives are met. This is in line with the findings of Firdaus (2013) research, which shows that the TPS model can improve student learning outcomes and motivation to learn. The following graphs show how student learning outcomes' average pretest and posttest results have increased.

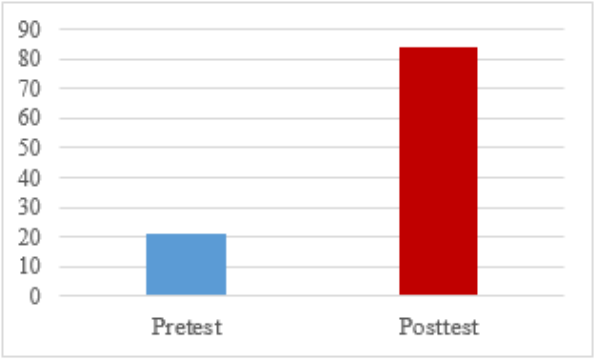

Figure 4. Rising Average Value of Student Learning Results

A hypothesis test was run on the collected data to see if there was a significant difference in the learning outcomes of the students before and following the small-scale implementation of the Think Pair Share-oriented E-LKPD. With the aid of the SPSS tool, the received data was checked for normalcy, with the outcomes shown in the accompanying table.

Table 9. Normality Test Results for Student Learning Outcomes

One-Sample Kolmogorov-Smirnov Test

		PretestHB	PosttestHB
N		30	30
Normal Parameters[a,b]	Mean	21,33	84,00
	Std. Deviation	16,761	13,025
Most Extreme Differences	Absolute	0,151	0,157
	Positive	0,151	0,154
	Negative	-0,123	-0,157
Test Statistic		0,151	0,157
Asymp. Sig. (2-tailed)		,081[c]	,057[c]

a. Test distribution is Normal.

According to the information taken from Table 9 above, which had a pretest Sig value of 0.081 and a posttest Sig value of 0.057. It can be concluded that the data with a Sig value > 0.05 is normally distributed (Puspita & Dewi, 2021). Once it is known that the data is normally dispersed, the paired sample t-test proceeds using the results of the pretest and posttest. The hypothesis was tested using the paired sample t-test:

- H_0 = No improvement in students' learning outcomes in the material of chemical equilibrium after using Think Pair Share E-LKPD learning media.
- H_1 = There was an improvement in students' learning outcomes in the material of chemical equilibrium after using Think Pair Share E-LKPD learning media.

The data obtained were tested paired sample t-test with SPSS and the results are presented in the following table.

Table 10. Learning Outcomes from Paired Sample T-Tests

Paired Samples Test

		t	df	Sig. (2-tailed)
Pair 1	PreHB - PostHB	-18,684	29	0,000

According to the information taken from Table 10 above, the value of the Sig. (2-tailed) is 0.000, indicating that a Sig. (2-tailed) value is less than 0.05, H_0 is disregarded and H_1 is approved, demonstrating a significant existing disparity between the students' learning outcomes on the pretest and posttest. Based on these findings, the Think Pair Share-oriented E-LKPD is thought to be capable of enhancing student learning outcomes and can be claimed to be effective because it achieved a medium and high percentage and significant differences in the pretest and posttest. The results of this study are corroborated by research done in 2014 by Boleng, who found that the experimental class learned more in the cognitive area than the comparison group section. This is because TPS learning is a classroom-based learning model that helps to express reasoning and reflect on the results of student thinking. According to Piaget (Nur and Wikandari, 2008) learning with the TPS learning model allows social

interaction that can help the cognitive development of students. Additionally, the Think Pair Share learning approach can enhance learning results, according to Fajrin's (2015) research. This can be seen by the increase in the average score from cycle I, which was 77 and had a percentage of learning outcomes that were completed of 74.2%, to cycle II, which was 83.38 and had a percentage of learning outcomes that were completed of 90.32%. Students' learning results can be improved by using the TPS learning model to encourage active participation in the classroom.

CONCLUSION

On the basis of the findings and analysis of the research previously stated, It means that the E-LKPD produced improves the critical thinking abilities of students and is appropriate for usage. This is evident from the findings of the pretest and posttests of the students' learning outcomes and critical thinking abilities that receive n-gain scores in the medium and high categories. The paired sample T-test outcomes on critical thinking abilities and student learning outcomes obtained a Sig. (2-tailed) value < 0.05, which indicates a significant existing disparity between the pretest and posttest of critical thinking abilities and student learning outcomes, indicating that the E-LKPD developed is successful in enhancing students' critical thinking abilities. The E-LKPD produced in this study only underwent a small trial, therefore it is hoped that in the future it will be utilized commercially on a big scale and spread widely.

RECOMMENDATIONS

To help students practice critical thinking, Think Pair Share-oriented E-LKPDs on additional chemical materials must be developed. It is believed that future researchers would be able to train and improve other critical thinking abilities or develop critical thinking skills that have been used by researchers since the research on critical thinking skills only limits it to 5 indicators.

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