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E-LKPD Assisted with Liveworksheets to Improve Students' Critical Thinking Skills on Material Shifting Direction of Equilibrium

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Abstrak

Tujuan penelitian ini untuk mengembangkan *e*-LKPD berbantuan *Liveworksheet* dalam meningkatkan keterampilan berpikir kritis peserta didik pada materi faktor pergeseran arah kesetimbangan yang ditinjau dari validitas, keefektifan dan kepraktisan. Penelitian ini menggunakan pendekatan penelitian dan pengembangan (R&D). Validitas *e*-LKPD memperoleh kriteria sangat valid dilihat dari aspek kelayakan isi, kebahasaan, penyajian dan kegrafikan dengan presentase rata-rata 81%; 82%; 81%; dan 81%. Kepraktisan *e*-LKPD dinilai dari angket respon peserta didik yang dilihat dari aspek kelayakan isi, kebahasaan, penyajian, kegrafikan dan pengoperasian didapat presentase rata-rata sebesar 98%; 98%; 96%; 97% dan 95% memperoleh kriteria sangat praktis. Selain itu didukung oleh observasi peserta didik yang memperoleh presentase sebesar 100%. Keefektifan *e*-LKPD mendapat kriteria sangat efektif, Nilai *N-gain* tes kognitif didapatkan rata-rata sebesar 0,78 dengan kriteria sangat tinggi dan n-gain keterampilan berpikir kritis didapatkan rata-rata 0,51 dengan kriteria sedang. Didukung dengan uji Paired Sample T-test yang mendapatkan skor Sig. (2-tailed) sebesar 0,000. Hal ini menunjukkan terdapat pengaruh pada hasil tes keterampilan berpikir kritis dan kognitif setelah pembelajaran dengan menggunakan *e*-LKPD berbantuan *Liveworksheet*.
Kata Kunci: keterampilan berpikir kritis, faktor pergeseran arah kesetimbangan, e-LKPD.

Abstract

The goal of this project was to create an e-LKPD using Liveworksheets to help students enhance their critical thinking abilities on the subject of moving elements toward equilibrium in terms of validity, efficacy, and practicality. Research and development (R&D) is the methodology used in this investigation. With an average percentage of 81%, 82%, 81%, and 81%, the validity of the e-LKPD was found to have met very valid standards in terms of the viability of content, language, presentation, and graphics. The student response questionnaire was used to evaluate the practicality. E-LKPD the aspects of content, language, presentation, graphics, and operation were considered, and the average percentages were 98%, 98%, 96%, 97%, and 95%, which met very practical criteria. Additionally, it is backed by observations of children who achieve a 100% grade point average. The N-gain value of cognitive tests received an average of 0.78 with very high criteria, the e-LKPD efficacy received highly effective criteria, and the n-gain critical thinking abilities received an average of 0.51 with moderate criteria, backed up by the Paired Sample T-test, which had a Sig (2-tailed) score of 0.000. This demonstrates that learning with the help of e-LKPD and Liveworksheets has an impact on the outcomes of cognitive and critical thinking tests.
Keywords: *critical thinking skills, factors in the direction of equilibrium, e –LKPD*

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INTRODUCTION

Chemistry is a discipline of science that investigates the notions of matter's composition, properties, structure, and transformations, as well as the energy that accompanies it (Mulyono, 2007). Chemistry is abstract due to the existence of a study of these materials' structure and organization. Many students believe that chemistry is an abstract, complex, and quantitative subject that can only be mastered by pupils with above-average cognitive talents, according to Sunyono (2009). According to Uliya's (2022) research, 79.41% of students found chemistry to be a challenging subject. Furthermore, the symbolic level dominates the learning of chemistry materials, resulting in rote learning of concepts. To put it another way, a lot of educational resources do not incorporate the three amounts of chemical representation—macroscopic, sub-microscopic, and figurative their teaching. It is often found that learning only emphasizes the symbolic level, without being associated with natural phenomena and the daily experiences of students at a macroscopic level, as well as explanations at a sub-microscopic level. Sub-microscopic and symbolic levels are two levels that are abstract and are not experienced directly by students. This is what causes chemistry to be considered a science that is not easily understood so it tends to be memorized by students (Dhindsa, 2009). One of the more challenging chemistry study materials for class XI SMA is the chemical equilibrium item. Permendikbud No. 37 of 2018 covers the fundamental competency 3.9 analyzing the factors that influence the change in the position of equilibrium and its implementation in industry, or even the fundamental competency 4.9 designing, conducting, and concluding as well as presenting results of the experiment of factors that influence the change in equilibrium position. Students must be able to understand concepts that are then applied in everyday life, according to basic skills 3.9 and 4.9. In order to build learning concepts and comprehension, students must also be active and independent during the learning process (Putri, 2022).

The government must be able to improve basic reading, encourage critical and creative thinking abilities, highlight the value of teamwork and communication, and increase basic reading in order for the younger generation to comprehend science in the twenty-first century. This suggests that critical thinking skills should be instilled in pupils at an early age. The ability to think critically in order to make decisions that can be trusted and accountable is known as critical thinking ability (Redhana, 2011). Critical thinking is a high-level cognitive process that places an emphasis on logical and sensible beliefs and is able to provide a series of standards and procedures to activate the skills of interpreting, analyzing, identifying questions, evaluating ideas/evidence, and making conclusions (Yustina, 2015). In critical thinking skills there are several aspects, interpreting, analyzing, inferring, evaluating, explaining, evaluating, and self-control (Filsaime, 2008). Susilowati in the Aspects of students' critical thinking abilities were still in the lowest quartile, according to the 2017 National Conference on Science Education Proceedings. So that they can develop their critical thinking abilities, students need learning materials in the form of sheets for students.

Sheets for students (LKPD) are sheets that contain material, summaries, and tasks that must be done by students (Anggraini, 2016). LKPD is also a means that can facilitate the formation of interactions between teachers and students, so as to increase the activities of students in improving learning achievement. As a result of its evolution, there are currently online-based LKPDs, also known as Electronic LKPDs (e-LKPD), which will facilitate learning for both teachers and students. Liveworksheet is one of the tools that can be used to build online worksheets. Liveworksheet can display content in the form of movies, images, and intriguing symbols that can boost student engagement and appeal. Depending on the creator's ingenuity, students can complete assignments with a variety of question types, including multiple-choice, drop-down options, open-ended questions, matching with lines, and question checkboxes in the form of drag and drop. Additionally, Live flowsheets can be accessible by portable devices or PCs that can be used both inside and outside of the learning process, allowing students to learn on their own. After the students complete their given tasks, the

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answer key can be input directly on the LiveWorksheet to automatically provide the results. With these advantages, *Liveworksheet* can be used to create *e* -LKPD.

Based on the aforementioned claims, the creation of learning materials in the form of e-LKPD with the aid of Liveowrksheet will be undertaken to enhance students' critical thinking abilities on the material factor that impact the change of direction of the equilibrium.

RESEARCH METHOD

The research and development (R&D) technique proposed by Sugiono serves as the design framework for this investigation (2016). With the intention of creating innovative products through to the development phase, the R&D method is a technique for manufacturing specific items and evaluating their efficacy (Sugiyono, 2016). The 10 steps of the R&D process are as follows: (1) possible issues, (2) data gathering, (3) graphic designing, (4) giving the ability, (5) layout revisions, (6) product involvement, (7) product revised version, (8) experiment usage, (9) product revised version, and (10) mass - producing.

E -LKPD assisted by the *Liveworksheet* that was developed was tested on a limited basis in March 2020 at the Surabaya Development Taruna Intensive High School. The participants of the limited trial were 20 students of class XI MIPA who had obtained the material for shifting the direction of the equilibrium factor. The purpose of this study is to determine whether e-LKPD with Liveworksheet is feasible. These three aspects include validity, practicability, and efficacy.

A validation sheet was the research tool used to assess the reliability of the Liveworksheet-assisted e-LKPD that was created. Three validators, including two academics from the State University of Surabaya's Department of Chemistry and one chemistry instructor from the Surabaya Development Youth Intensive Senior High School, filled out the validation sheet. The collected data will be subjected to quantitative analysis using the percentage methodology. Table 1 shows how to calculate the percentage of this validation sheet data using the Linkert scale.

Table 1
Scale of Linkert

Scale value	Evaluation
1	Totally invalid
2	Not valid
3	Quite valid
4	Valid
5	Very valid

(Riduwan, 2016)

The data obtained from the validator is calculated by the formula:

$$Presentase\ (\%) = \frac{jumlah\ nilai\ yang\ diperoleh}{jumlah\ nilai\ maksimal} x\ 100\%$$

In the context of the criteria in table 2, the findings of the validation sheet analysis are interpreted.

Table 2
Scale of Interpretation Category Value Validation

Percentage(%)	Category
0-20%	Totally invalid
21-40%	Not valid
41-60%	Quite valid
61-80%	Valid
81-100%	Very valid

(Riduwan, 2016)

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If the proportion of achievement is 61 percent, the e-LKPD helped by Liveworksheets is certified valid to be used as a learning medium based on the requirements in table 2.

The instrument used to determine the practicality of the *e* -LKPD assisted by *Liveworksheet* was developed as a student response questionnaire and student observation sheets. Using the Guttman scale, data from student response surveys and student observation sheets were measured, and the percentage was then computed using the formula:

$$Precentage\ (\%) = \frac{the\ amount\ of\ the\ score\ achieved}{maximum\ amount\ of\ the\ score}\ x\ 100\%$$

After that, the proportion is interpreted in light of the categories in table 2. If the proportion of achievement is 61 percent, the e-LKPD helped by Liveworksheets is deemed feasible to be used as a learning medium according to the requirements in table 2.

The research instrument used to determine the effectiveness of the *e* -LKPD assisted by the *Liveworksheet* that was developed was a multiple-choice *pretest* and *posttest sheet for the cognitive domain and essays* for the critical thinking skills domain. The data obtained were then analyzed for the *N-gain value*, normality test as a prerequisite test using the *Shapiro-Wilk* test, and hypothesis testing by methods of the *Paired Sample T-test* on SPSS. *N-gain value* can be calculated using the formula:

$$N - gain = \frac{skor\ pretest - skor\ posttest}{skor\ maksimal - skor\ pretest}$$

N-gain assessment criteria according to Hake (1998) as shown in table 3.

Table 3
Category *for N-gain*

***N-gain* value**	**Category**
g > 0.7	Tall
0.3 ≤ g ≤ 0.7	Medium
g < 0.3	Low

Using the standards in table 3, the *e*-LKPD assisted by *Liveworksheets* is declared to be effectively used as a learning medium if the *N-gain value* is 0.4 (Hake, 1998).

Shapiro-Wilk test was used as a requirement to ascertain the data's normality because there were fewer than 50 data points in the data set (Razali, 2011). The information is supposedly normally distributed if the results of *Sig.* > 0.05 (Ghozalli, 2016). Additionally, the Paired Sample T-test is used to assess hypotheses (Rahmawati F. F., 2021).

RESULT AND DISCUSSION

There was an investigation at the Taruna Pembangunan Intensive High School Surabaya for 4 meetings including 1 meeting for the *pretest*, 2 meetings for the Liveworksheet-assisted *e - LKPD trial*, and 1 meeting for the *post-test*. The information acquired demonstrates the viability of the e-LKPD-assisted Liveworksheet in terms of its reliability, usefulness, and efficiency.

Validity of e-LKPD

Validation aims to determine the feasibility of the developed *Liveworksheet-assisted e-LKPD media*. The validity of *e-LKPD* assisted by the Liveworksheet consists of two criteria, namely content validity and construct validity (Suryabrata, 2005). The degree to which an instrument's questions or items accurately reflect the entirety of the subject matter or topic being assessed is known as content validity (Matondang, 2009). Meanwhile, construct validity is a measuring tool that shows linguistic and presentation aspects (Duli, 2019).

Table 4 displays the findings of the validity evaluation performed by the three validators using the validation sheet instrument.

Table 4
Validation Results

Rated aspect	Average percentage	Category
Content eligibility	81%	Very valid
Language	82%	Very valid
Presentating	81%	Very valid
Graphics	81%	Very valid

The information in table 4 reveals that the e -LKPD assisted by the *Liveworksheet* that was developed has a very high validity with an average percentage of 81.25%. This shows that the *e* -LKPD assisted by the *Liveworksheet* that was developed is possible to use as a teaching tool on the material for shifting the direction of the equilibrium factor. A product is said to be feasible/valid if it is in accordance with the existing theory and all aspects are mutually sustainable consistently (Rochmad, 2012).

The first aspect that is assessed is the feasibility of the content, obtaining a percentage of 81%. It can be concluded that from the aspect of content feasibility, the *e*-LKPD assisted by the *Liveworksheet* developed is in accordance with the 2013 curriculum, competency standards and basic competencies guided by Permendikbud No. 37 of 2018 and the learning activities contained in the *e* -LKPD have contained 3 of the 4 critical thinking skills indicators that need to be improved, including interpretation, analysis, and inference.

The second aspect that is assessed is linguistics, obtaining a percentage of 82%. From a linguistic perspective, it can be said that the Liveworksheet-assisted development of the e-LKPD has been deemed to be extremely valid. Readability, information clarity, adherence to Indonesian language rules, and effective language use are among the linguistic factors evaluated. These factors will make it simpler for students to comprehend the overall content of the e-LKPD and ensure that there are no misunderstandings (Omrond, 2009).

The third aspect that is assessed is presentation, obtaining a percentage of 81%. It can be inferred that the Liveworksheet-assisted development of the e-LKPD has been deemed to be extremely valid from the perspective of presentation. According to the topic covered in the e-LKPD, the presentation's order is consistent from beginning to end. Student activities that refer to a scientific approach to practice critical thinking abilities, and presentation of e -LKPD packaged in software are all examples of easy-to-understand work instructions, phenomena presented in the form of videos that can pique students' interest, and student activities that refer to a scientific approach to practice critical thinking abilities, and presentation of e -LKPD packaged in software. *Liveworksheets* can be accessed by students through *gadgets* so that learning becomes more fun. The requirements for the LKPD's structure, which comprise titles, study instructions, fundamental competencies or subject matter, supporting data, assignments or work processes, and evaluations, are in line with expert opinions in this respect (Prastowo, 2014).

Graphics received an 81 percent score in the fourth category of evaluation. The graphic aspect leads to the conclusion that the Liveworksheet-assisted development of the e-LKPD has been deemed to be extremely valid. The use of fonts, typefaces, font sizes, chemical illustrations presented, and the design of the *e* -LKPD display can be read clearly. The order of layout has been orderly and the selection of colors does not interfere with the concentration of students in the process of learning. The points that have been described meet the indicators in the graphic aspect of the National Education Standards Agency claims (BSNP, 2006).

Practicality of e-LKPD

The findings of the questionnaire analysis of student replies and student observations show how practical the e-LKPD is. The first data was obtained from the student response questionnaire sheet which contained questions using the yes or no checklist method. There are five aspects of the document with student

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responses to the survey, including the feasibility of content, language, presentation, graphics, and operations. The following is the percentage of data results in each aspect:

Table 5
Percentage of Student Response Questionnaire Data

Aspect	Average percentage	Criteria
Content eligibility	98%	Very practical
language	98%	Very practical
Presentation	96%	Very practical
Graphics	97%	Very practical
Operation	95%	Very practical

Table 5's results allow us to conclude, that it can be stated that the e-LKPD assisted by the *Liveworksheet* that was developed meets the very practical criteria for all aspects with a percentage of 61% (Riduwan, 2016). In the aspect of the feasibility of content and language, the percentage is 98%, which means that students understand the learning objectives, the concepts of the material presented, and the components of critical thinking abilities contained in the e-LKPD. In addition, the language used is very easy to understand, and the information contained in the e-LKPD is very clear, making the e-LKPD easier for students to complete and work on. In the presentation aspect, the percentage is 96% and in the graphic aspect is 97%. The high student response in these two aspects means that the e-LKPD presented has an attractive display design that will motivate students in learning and can stimulate brain work to be more effective which will affect learning outcomes (Schunk, 2012). In the operational aspect, the percentage obtained is 95%, which is the aspect that gets the lowest percentage among other aspects. This means that there are some students who are still confused about operating the e-LKPD assisted by *Liveworksheet*. In this operational aspect, there are 3 points, namely ease of operation, operating instructions, and time allocation for e-LKPD work. Of the three points, the allocation of processing time received a low percentage. The time allocation of 2x45 minutes was deemed insufficient for some students working on the e-LKPD.

The second data was obtained from student observation sheets which contained several student activities during the learning process using e-LKPD assisted by *Liveworksheets*. The activities evaluated are consistent with what students are doing in the RPP. The method used is the yes or no checklist method. On the first and second days, four observers watched the students' activities. In table 6, it can be seen that the proportion of student activities that were observed by 4 observers for 2 days.

Table 6
Percent of Student Activity Results from Observations

Observer	Data presentation	
	First day	The second day
Observer 1	100%	100%
Observer 2	100%	100%
Observer 3	100%	100%
Observer 4	100%	100%

Table 6's results allow us to conclude that the e-LKPD that was created with the help of the Liveworksheet satisfies the highly practical requirements based on observations of student activity during learning since it achieves a percentage of 61 percent (Riduwan, 2016). This indicates that the students' activities are consistent with the students' activities listed in the RPP.

Effectiveness of e-LKPD

The outcomes of the students' pretest and posttest in the cognitive and critical thinking skills areas demonstrate the efficacy of the e-LKPD. Cognitive domain tests are conducted online using *the google form platform*, while tests for critical thinking skills are conducted *online* using *the Liveworksheet platform*. The link for the test is shared through the *WhatsApp* group and done individually at their respective homes. *The*

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pretest was conducted before the students received learning using the e-LKPD assisted by the *Liveworksheet*, while the *posttest* was conducted after the students received the learning using the e-LKPD assisted by the *Liveworksheet*. *e* -LKPD is said to be effective if in the cognitive test and critical thinking abilities it reaches a value for N-gain of $g \geq 0.4$.

Ten multiple-choice questions on the variables influencing the direction of the equilibrium are part of the cognitive domain test. The outcomes of the cognitive test obtained an average of 29.5 for the *pretest* and 84 for the *posttest*. Meanwhile, the critical thinking skill domain test is divided into 3 subs, each of which represents a factor that affects the change in the equilibrium's direction. The test of the realm of critical thinking abilities uses a scientific method by containing 3 indicators of critical thinking skills, including interpretation, analysis, and inference. The average score on the test of critical thinking abilities was 45.9 on the pretest and 79.3 on the post-test. The value of N-gain is then calculated using the data obtained using a specified formula. Table 7 displays the N-gain values for cognitive tests and critical thinking skills assessments.

Table 7
N-gain calculation outcomes

Test Format	Average N-gain	Criteria
Cognitive Test	0.78	Tall
Critical Thinking Skills Test	0.51	Currently

Table 6 reported that the mean N-gain value on the cognitive test is 0.78 with high criteria and that it is 0.61 with medium criteria for the test of critical thinking abilities (Rahmawati, 2016). The average result shows that the *e* -LKPD assisted by the *Liveworksheet* developed is very effective because the N-gain value obtained by both tests is g 0.4 (Hake, 1998). Because there is an improvement in student test scores after learning using the e -LKPD supported by Liveworksheets, the e -LKPD assisted by Liveworksheets is suitable to be utilized as a learning medium to improve critical thinking skills.

In order to ascertain the impact of administering e-LKPD on cognitive abilities and critical thinking skills, a preliminary test was conducted in the form of a normalcy test followed by a hypothesis test. Shapiro-Wilk test was used on SPSS to perform the normality test to make sure the data were distributed normally. Because there were only about 50 data points included in the investigation, the Shapiro-Wilk method was employed in this test. (Razali, 2011). The Shapiro-Wilk test outcomes on SPSS are in table 8 and table 9.

Table 8
Normality Test for Cognitive Domain data

Tests of Normality						
	Kolmogorov-Smirnov [a]			Shapiro-Wilk		
	Statistics	df	Sig.	Statistics	df	Sig.
pretest	0.165	20	0.160	0.918	20	0.089
posttest	0.187	20	0.065	0.917	20	0.085

Table 9
Normality Test for Critical Thinking Skills

Tests of Normality						
	Kolmogorov-Smirnov [a]			Shapiro-Wilk		
	Statistics	df	Sig.	Statistics	df	Sig.
pretest	0.126	20	,200 *	0.954	20	0.434
posttest	0.149	20	,200 *	0.938	20	0.216

Tables 5 and 6 provide evidence that the results of cognitive tests and tests of critical thinking abilities were normally distributed, as shown by the findings of Sig. > 0.05 for pretest and posttest (Ghozalli, 2016).

If the data obtained have been normally distributed, the Paired Sample T-test is then used to assess the hypothesis to determine the impact of test outcomes following instruction using e -LKPD assisted by *Liveworksheets*. The analysis is grounded in Sig's value (2-Tailed). H_0 is allowed if the value of Sig. (2-Tailed) > 0.05, otherwise H_0 is rejected if the value of Sig. (2-Tailed) is less than 0.05 (Ghozalli, 2016). Classification of hypotheses as follows:

H_0 : After studying with e-LKPD helped by Liveworksheet, there is no development in cognitive abilities or critical thinking.

H_1 : By using e-LKPD helped by Liveworksheet to learn, there is an improvement in cognitive abilities and critical thinking.

Tables 10 and 11 are the results of the *Paired Sample T-test* for cognitive domain tests and critical thinking skills tests.

Table 10
Results of *Paired Sample T-test* Cognitive Domain

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	PRE TEST - POST TEST	-54,50000	8,87041	1,98348	-58,65148	-50,34852	-27,477	19	0,000

Tabel 11
Results of *Paired Sample T-test* Critical Thinking Skill Domain

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	PRE TEST - POST TEST	-33,50000	6,06543	1,35627	-36,33871	-30,66129	-24,700	19	0,000

Based on these findings, the value of Sig. (2-Tailed) was calculated to be 0.000. As a result, H_0 is ruled out because the value of Sig. (2-Tailed) is less than 0.05. This suggests that studying the e-LKPD using Liveworksheet has an influence on the cognitive domain test and the critical thinking skills test.

CONCLUSION

In terms of validity, practicality, and effectiveness criteria, it can be determined that the e-LKPD, helped by the Liveworksheet that was built, is deemed possible to increase students' critical thinking abilities on the material variables that affect the direction of the shift in equilibrium.

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