



# Development of Electronic Student Worksheets (E-LKPD) Based on Problem Based Learning as an Effort to Improve Critical Thinking of Grade VIII Middle School Students on Respiratory System Material

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**Abstract:** This development research was motivated by the fact that the LKPD teaching materials used to support learning activities did not meet 21st century criteria and were not able to hone students' critical thinking skills. LKPD is not yet based on problem solving and utilizes electronic media. This research aims to determine the feasibility, practicality and effectiveness of electronic LKPD on respiratory system material. This research is Research and Development (R&D) research, using Lee & Owens design consisting of analysis, design, development, implementation and evaluation stages. Data collection techniques use questionnaires and tests. Data analysis techniques are quantitative and qualitative. The validation results by material experts and media experts stated that E-LKPD was very valid with validity of 88.33% and 95.58% respectively with the category suitable for use. Based on the teacher assessment results, the category was very good with a percentage of 89.33% in the category very good and feasible in practice. The results of the student response questionnaire showed a percentage of 94.26% in the very good category so that ELKPD is good for use in learning. The effectiveness of E-LKPD after being implemented shows that students' critical thinking abilities have increased with an N-Gain score of 0.56 which is included in the medium category. The conclusion is that E-LKPD based on Problem Based Learning can be used as a learning medium to improve students' critical thinking skills in science learning, especially material on the respiratory system.

**Keywords:** Critical thinking; E-LKPD; Problem based learning

## Introduction

Implementation of the 2013 curriculum in Permendikbud Number 20 of 2016 regarding 21st century skills which include communication, collaboration, critical thinking, creativity which is called 4C. The 21st century learning paradigm does not only transfer material, but also emphasizes students to think critically, collaborate, master information and communication technology, and be able to connect the knowledge received with real life (Frydenberg & Andone, 2011; Wijaya et al., 2016; Fathurrohman & Sulistyorini, 2018).

The United Nations Educational, Scientific and Cultural Organization (UNESCO) stipulate that one of

the abilities that students need to be equipped with in the 21st century is critical thinking skills (Sani, 2014). Critical thinking defines active, systematic, interconnected (complex) processes such as reading, writing, speaking and listening activities so as to increase conceptual understanding which continues with the active collection of information so as to obtain the right results and decisions and to equip students to face challenges in the future (Karakoc, 2016).

Husnidar et al. (2014) say critical thinking is reasoning that has the goal of gathering information that produces decisions that make sense and is directed towards belief in something. The process of believing in information through consideration and evaluation of information so that students can make decisions. This is

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necessary in science learning which produces knowledge in the form of understanding concepts so that the process is considered very important.

Sobron et al. (2019) interpret science as an abstract learning so that understanding it requires an effort of reasoning so that conclusions and even ideas and solutions are obtained. It is emphasized that science learning refers to the discovery aspect so that. Using the right learning model can help students and teachers find concepts such as experimental activities, placing students as if scientists can connect with the phenomena they encounter. This relates to the use of worksheets that help students discover concepts through their own activities.

The results of observations at SMPN 15 Tebo Regency found that students' critical thinking skills were still low. This can be seen when students are involved in a problem, it still tends to be difficult to analyze high-level questions and has not been able to provide further explanations and is wrong in concluding. When given student worksheets, students were less enthusiastic when working on LKPD.

This was confirmed by the results of interviews with science subject teachers and some students, it was found that science subjects always get problems every year in learning the respiratory system, including the sub-matter of breathing mechanisms. It was found that the daily test scores were low below the average 50% completeness and did not show indicators of critical thinking. When given assignments and questions, many students have not been able to provide further explanations and conclude correctly, and are still reading textbooks so that students feel bored and bored. Then during group discussions and being given student worksheets (LKPD) students were not able to answer questions correctly and there were no indicators of critical thinking. Educators feel the need to vary the model, in fact the model used is not in accordance with the needs of 21st century learning to become student-centered (Student Learned Center), so that a solution is needed as soon as possible to this problem so that it can be resolved immediately.

The student worksheets used do not meet the demands of 21st century learning and do not include the important components of 4C (Critical Thinking, Creativity, Collaboration, and Communication). The Science Student Worksheets that are used do not show learning steps in solving problems that help students to improve critical thinking skills. LKPD is a tool that can facilitate and construct students' knowledge so as to create a good atmosphere. LKPD needs to be supported with the right learning model so that learning is more focused, not boring, makes it easier to achieve learning

objectives so that the benefits of using LKPD are felt optimally (Prastowo, 2012).

The solution will be implemented by applying the Problem Based Learning (PBL) model (Sufairoh, 2016). The use of the PBL model can make students' critical thinking skills better (Chairani & Muchlis, 2019; Wulandari et al., 2020). PBL is a learning model that uses problems as a basis for developing new student knowledge with the main objectives of implementing the PBL model are critical thinking skills, problem solving abilities, and students' ability to actively build their own knowledge (Amini, 2019). PBL is a place to grow critical and analytical thinking for students (Gunantara et al., 2014; Yustianingsih et al., 2017; Ardianingtyas et al., 2020). The PBL model is considered effective and very suitable for use in training critical thinking (Aiman et al., 2019; Alita et al., 2019; Wati & Yuliani, 2020).

## Method

This development research chose to use the Lee and Owens model with the stages namely Analyze, Design, Development, Implementation, and Evaluation. Lee & Owens development model is the first model designed specifically for multimedia-based learning. This development model is said to be a procedural model because the sequence of steps in the process is systematically arranged and each development step has a sequence of development steps that are clearly arranged according to the development product that the researcher is developing (Lee & Owens, 2004). This research was conducted at SMPN 15 Tebo district, with the research subjects being all 24 class VIIIA students and science teachers.

To see the effectiveness, a trial was carried out using a test instrument with a one-group pretest-posttest design. The effectiveness test is used to prove whether the model is said to be able to achieve the stated goals or not (Prasetyo, 2020). After getting the pretest and posttest scores, an N-Gain test was carried out to see a general picture of the increase in score results between before and after being given treatment. The N-Gain criteria can be seen from Table 1. Before carrying out the N-Gain test, a normality and homogeneity test was carried out as a prerequisite test.

**Table 1.** Criteria for N-gain

N-Gain Score	Interpretation
-1.00 < g < 0.00	Less
g = 0.00	Stabil
0.00 < g < 0.30	Low
0.30 < g < 0.70	Medium
0.70 < g < 1.00	High

The feasibility data of the IPA E-LKPD were obtained from the results of expert validation in the field of developing teaching materials, while the practicality data of the IPA E-LKPD were obtained from the responses of teachers and students. E-LKPD IPA feasibility analysis is calculated using the feasibility percentage formula and then converted according to the criteria in Table 1 (Ernawati & Sukadiyono, 2017).

$$\text{Feasibility presentation} = \frac{\sum \text{Total score}}{\sum \text{Expected score}} \times 100\% \quad (1)$$

**Table 2.** Scoring of Material Expert Eligibility

Value Criteria	Value Range	Percentage (%)	Category
5	63-75	84.16-100	Very good
4	51-62.9	68.32-84.15	Good
3	39- 50.9	52.49-68.31	Enough good
2	27- 38.9	36.66-52.48	Not good
1	15-26.9	20.83-36.65	Very not good

**Table 3.** Eligibility Scoring of Media Experts

Value Criteria	Value Range	Percentage (%)	Category
5	71.4-85	84-100	Very good
4	57.8-70.9	68-83.5	Good
3	44.2-57.3	52-67.5	Enough good
2	30.6-43.7	36-51.5	Not good
1	17-30.1	20-35.5	Very not good

Teacher response data and student responses to the E-LKPD were analyzed using the formula and the results were converted according to the criteria in Table 2 (Arikunto, 2010; Arikunto, 2015).

$$P = \frac{\sum x}{\sum xi} \times 100 \% \quad (2)$$

Description:

P: Presentation eligibility

$\sum x$ : Jumlah skor yang diperoleh

$\sum xi$ : Maximum total score

**Table 4.** Teacher Assessment Questionnaire Presentation Criteria

Value Criteria	Value Range	Percentage (%)	Category
5	63-75	84-100	Very good
4	51-62.5	68-83.5	Good
3	39-50.5	52-67.5	Enough good
2	27-38.5	36-51.5	Not good
1	15-26.5	20-35.5	Very not good

**Table 5.** Criteria for Percentage of One-on-one Trial Questionnaires

Value Criteria	Value Range	Percentage (%)	Category
5	163.8-195	84-100	Very good
4	132.6-163.3	68-83.5	Good
3	101.4-132.1	52-67.5	Enough good
2	70.2-100.9	36-51.5	Not good
1	39-69.7	20-35.5	Very not good

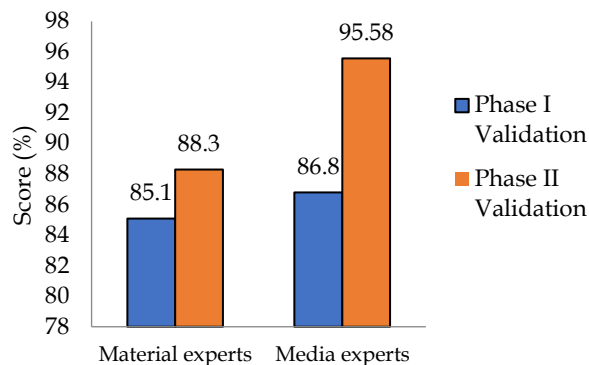
**Table 6.** Criteria for the Percentage of Response Questionnaires for Small Group Trials

Value Criteria	Value Range	Percentage (%)	Category
5	491.4-585	84-100	Very good
4	397.8-490.9	68-83.5	Good
3	304.2-397.3	52-67.5	Enough good
2	210.6-303.7	36-51.5	Not good
1	117-210.01	20-35.5	Very not good

## Result and Discussion

*The Feasibility of Problem-Based Learning Based E-LKPD on the Thinking Skills of Grade VIII Students of Junior High School*

The product produced in this research is an E-LKPD based on problem based learning which helps improve students' critical thinking skills. Based on the results of analysis of expert validity test data, it was found that the E-LKPD developed was very suitable for use with a percentage of material experts of 88.3% and media experts of 95.58%. The validation results can be seen in Figure 1.



**Figure 1.** Expert validation test results

From the validation results obtained, an increase in the validation score was obtained after the revision was carried out. The comments from experts suggest that the material be made and presented more varied so that it is not boring and more varied, then the sentences and words are adjusted to the child's level of development. Worksheets with the very appropriate category can be used in research after being revised according to suggestions from the validator (Haerunnisa et al., 2018).

From the validation results of material experts and media experts, E-LKPD was declared feasible and can be tested.

The e-LKPD produced is in accordance with students' needs regarding the problems they face. Active learning such as problem based learning has learning characteristics that not only gain knowledge but can also have an impact on students' critical thinking abilities. E-LKPD learning steps are arranged according to PBL syntax.

*The Practicality of Problem-Based Learning Based E-LKPD on the Thinking Skills of Grade VIII Students of Junior High School*

Data on the practicality of E-LKPD was obtained from a questionnaire that was assessed by 1 subject teacher and class VIII students by conducting one-on-one, small group trials. The results of data analysis on the practicality of E-LKPD based on problem based learning on critical thinking skills found that 89.33% of subject teachers were in the very practical category. The student response questionnaire contained 15 questions which were filled in by 24 students. Based on the results of one-on-one trials, the percentage was found to be 92%. It can be seen in Figure 2 that the value of each indicator is stated to be very good. The highest value was found in the benefit indicator. One-on-one trials can be seen in Figure 2 and are categorized as very good.

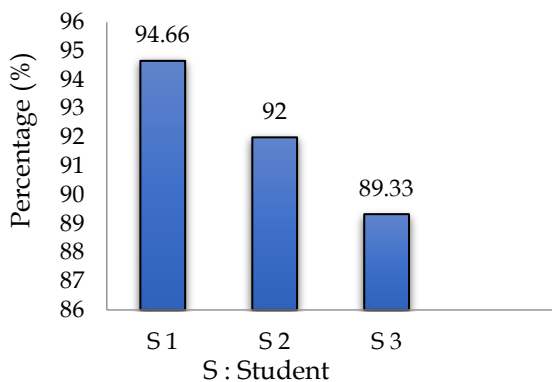


Figure 2. One-on-one trial

Based on Figure 2, the total percentage of student 1 is 94.66%, student 2 is 92%, student 3 is 89.33%, with a total percentage of 92% in the very good category. In this way, ELKPD can be used at the level of students' cognitive abilities and can be tested in small groups.

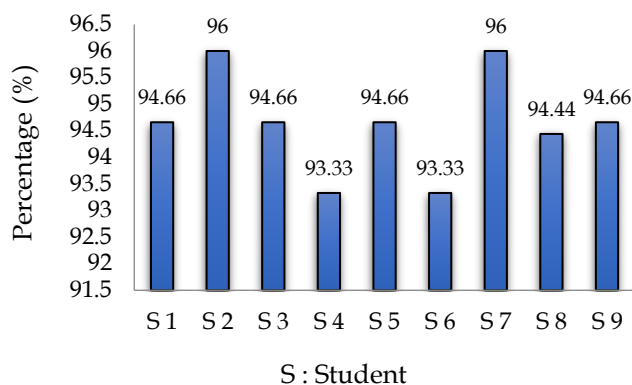


Figure 3. Small group trial

It can be seen from the score obtained for each indicator with a very good percentage with an average percentage of 94.66%. This states that E-LKPD based on problem based learning can be said to be practical and very interesting to use in learning on the topic of the respiratory system. This is in accordance with research by Astuti et al. (2018) which states that the combination of PBL-based LKPD is practical so that it addresses all aspects of learning and students' responses to problems.

*The Effectiveness of E-LKPD Based on Problem Based Learning on the Thinking Abilities of Class VIII SMP Students*

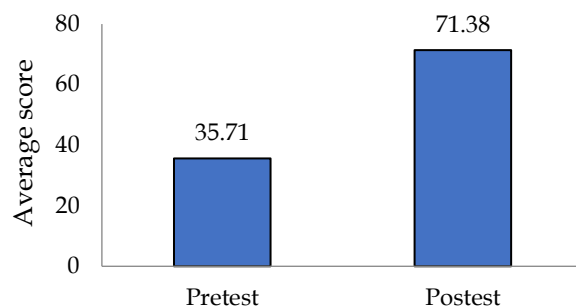


Figure 4. Average critical thinking scores of students

It was found that the average pretest score of students was 35.71. After being given treatment, so the posttest score was found to be 71.38. This means that the average posttest score was higher than the critical thinking pretest score of students.

Table 7. Overall Critical Thinking Ability

Frequency of pretest	Frequency of posttest	Percentage of Pretest	Percentage of Posttest	Category
1	4	4.1 %	20.83%	High
0	15	0%	62,5 %	Medium
0	5	0%	16,67%	Low

Based on Table 7, the results show that the average student at SMPN 15 Tebo Regency is at a percentage of

62.5% in the medium category. There was an increase in thinking ability before being given ELKPD and after learning to use ELKPD.

The results of the pretest and posttest data were tested for normality and homogeneity as requirements for the analysis of the paired sample paired T-test. The results of the normality and homogeneity test of the data are normally distributed, namely  $\text{sig} > 0.05$  and 0.730 for homogeneity, so it can be continued with the paired sample T-test. The test was carried out using the SPSS 20 statistical application so that it showed that the Sig. (2-tailed)  $0.000 < 0.05$ , meaning that there is a real difference between the pretest and posttest results before students use E-LKPD and after using E-LKPD. Then the data was tested again using the N-Gain factor formula.

The effectiveness test is to see whether the E-LKPD is effective on students' critical thinking abilities, carrying out prerequisite tests such as normality, homogeneity tests and the Paired T-test. The results of the normality test found a pretest sig of 0.736 and a posttest sig of 0.322, which means  $\text{sig} > 0.05$ , so the data is normally distributed and continued with the homogeneity test. The results of the homogeneity test found sig 0.730, which means  $\text{sig} > 0.05$ , so the data is homogeneous. Next, the Paired T-test showed a sig value of 0.000, which means  $\text{sig} < 0.05$ , so  $H_0$  was accepted and  $H_a$  was rejected so that there was a difference in the average critical thinking of pretest and posttest students after using E-LKPD based on problem based learning.

The N-gain test was carried out to determine whether or not there was an increase in students' critical thinking abilities both before the pretest and after the posttest using E-LKPD based on problem based learning. The N-gain recap can be seen from Table 8.

**Table 8.** N-Gain Test Results for Students' Critical Thinking Ability

Class	Average student score		N-Gain Score	Criteria
	Pretest	posttest		
VIIIA	35.71	71.38	0.56	Medium

Based on table 9, it is found that the N-gain value is 0.56 with medium criteria. After it was interpreted that there was an increase in students' thinking abilities after implementing learning using E-LKPD based on problem based learning on respiratory system material. The problem based learning model is able to have a good influence on oral, written communication and critical thinking (Aini et al., 2019). This is reinforced by the statement by Elfina & Sylvia (2020), Fitriyah & Ghofur (2021), and Munika et al. (2021) that if the results of the effectiveness test obtain a good percentage in the small

scale test and large scale test then it can be categorized as effective. This is because the E-LKPD is prepared systematically and involves critical thinking indicators. E-LKPD is effective as an effort to improve the critical thinking skills of class VIII SMP students who have a respiratory system. This is supported by Lestari (2020) stating that digital media is able to help students understand the context, be more motivated and can facilitate students to become more critical.

Active learning such as problem based learning has learning characteristics that not only acquire knowledge but can also have an impact on students' critical thinking abilities. This model invites you to respond to problems that exist around students' environment with the aim that students can easily apply them in real and not abstract learning. This model provides a way to open students' thinking abilities. This is strengthened by Astuti et al. (2018) which applies the development of LKPD in valid chemical equilibrium material. The results obtained show that the LKPD is valid, practical and effective in increasing students' thinking abilities and skills.

## Conclusion

Based on the feasibility, practicality and effectiveness analysis, it can be concluded that the E-LKPD based on problem based learning as an effort to improve the critical thinking skills of class VIII SMP students has been developed to meet the criteria of being very feasible, practical and effective in learning science on the respiratory system. The expected results can help teachers and schools in their need for teaching materials that are integrated with technology as an effort to improve students' critical thinking skills.

## Author Contributions

Vera Yulanda conceptualized the research idea, designed of methodology, management and coordination responsibility, analyzed data, conducted a research and investigation process; Afreni Hamidah and Evita Anggereini conducted literature review and provided critical feedback on the manuscript.

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## Conflicts of Interest

The authors declare no conflict of interest.

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