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Development of LKPD Based *on Discovery Learning* on Human Respiratory System Material to Train Skills Student Critical Thinking

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Abstract: LKPD (Student Worksheet) based *on discovery* learning is intended to provide learning knowledge directly in the process of meaningful learning activities so as to direct students to find learning concepts. This study aims to determine the level of feasibility, practicality and effectiveness of LKPD based on *Discovery Learning* to train students' critical thinking skills on respiratory system material. Researchers used the R&D (*Research* and Development) method using a 4-D development model (*Define, Design, Development and Desemminate*) developed by S. Thiagarajan, Dorothy S. Semmel, and Melvyn I. Semmel in 1974. The test subjects in the study consisted of 36 students from class XI IPA SMA PAB 4 Sampali. The results showed that the feasibility value of developing LKPD from material experts was 86.1% with the very feasible category and LKPD experts by 75% with the feasible category. Then the percentage of practical scores for LKPD development from biology teachers and students of science XI was 82.14% and 83.47% respectively with the practical category. The effectiveness of LKPD development based on individual completeness from the pre-test *and* post-test *students obtained an average N-Gain* score of 62.14, so the use of the method has been effective because the N-Gain normality value obtained between 0.30 < g < 0.70 with the "effective" criterion. Then for the N-Gain score value of 0.62, this value is in the medium category because the N-Gain score is between 0.3-07 with the category "medium N-Gain". From the overall results including valid, practical and effective categories, it can be concluded that LKPD based on *Discovery Learning* on the equipment system material is suitable for use and distribution to PAB 4 Sampali High School.

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Introduction

Education is generally an interaction between educators and students. The function of education is to prepare students. Preparing means that students are not ready in essence, but need to be prepared and are preparing themselves (Hamalik, 2013). The ability to think critically is one of the higher-order thinking skills that students must have, so it is in accordance with the objectives of the 2013 curriculum that wants to make students able to think critically. Critical thinking is the ability to think using logic and implementation of the 2013 curriculum so that critical thinking is positioned as central in the 2013 curriculum. Critical thinking skills are very important mastered by a student to be able to develop creativity, curiosity, be able to solve problems and be able to apply learning in everyday life

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(Rasiman, 2013). Education must be able to provide critical thinking skills so that it can produce students who can overcome various life problems that will be faced with the ability to reflect on learning experiences in solving problems independently and responsibly (Rusman, 2010).

Discovery Learning is a learning strategy in which in the process is not presented a concept in finished form (final), but students are required to organize their own way of learning in finding concepts. *Discovery* is done through observation, classification, measurement, prediction, and determination. The process is called *cognitive process,* while *discovery* itself is the mental *process of assimilating concepts and principles in the mind* (Robert B. Sund, 1982). Wilcox (Nur, 2000) says that in *discovery learning*, students are encouraged to learn actively through their own active engagement with concepts, principles, and teachers encourage students to have experiences and conduct experiments that allow them to discover principles for themselves. In general, the definition of Student Worksheets (LKPD) is the same as Student Worksheets (LKS). It's just that in the 2013 curriculum there was a name change as a substitute for Student Worksheets (LKS) to Student Worksheets (LKPD). According to Andi Prastowo (2012) LKPD or often called LKS is printed teaching materials in the form of sheets of paper containing material, summaries and instructions for the implementation of learning tasks that must be done by students, which refers to basic competencies and goals that must be achieved.

Research Method

The research method used in this study is the type of development research or *Research and Development* (R & D). The purpose of this study is to determine the level of feasibility, practicality and effectiveness of LKPD based on *Discovery Learning*. This research was conducted at SMA PAB 4 Sampali. The subjects of this study were class XI science students with a total of 36 people and the object in this study was 36 student worksheets (LKPD) based on *Discovery Learning* respiratory system material to train students' critical thinking skills.

Research instruments include: LKPD validation sheets (material experts and media experts) by lecturers as an assessment of the validity and feasibility *of LKPD based on Discovery Learning, questionnaire sheets for teacher and student responses as an assessment of the practicality of LKPD based on Discovery Learning, and pre-test and* post-test *questions as an assessment of the effectiveness of LKPD based* on Discovery Learning. The development model of this research is a 4-D model consisting of 4 stages, namely the defining stage (*define), the design stage (*design*), the development* stage (develop*) and the deployment stage (*desseminate). The 4-D development model developed by S. Thagarajan, Dorothy S. Semmel, and Melvin I Semmel in 1974 is: 1) Defining Stage (*Define*), This stage is the initial part of research preparation to find gaps in teaching and learning activities by conducting an analysis of learning needs so that the need for product development is found. 2) Design Stage, the design stage is a stage that aims to prepare learning media used in research, namely LKPD which can be used as teaching materials in biology learning. 3) Development Phase, the development stage is carried out to produce the final product after validation is carried out and then there is a revision by experts, with the aim of creating a revised draft LKPD according to expert advice so as to make the LKPD declared valid, practical, and effective. In this process, discovery learning-based LKPD is revised under the guidance of supervisors, material & media expert validators, field practitioners, and students.

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Data analysis techniques by assessing the quality of student worksheets by converting data in the form of scores into percentages.

a. Eligibility Analysis

Validity analysis is carried out by validation experts, then validation data is obtained from assessments by material and media expert lecturers. Product assessment will be given based on the validity criteria in Table 1

Table 1 LKPD Validity Criteria

Score	Criterion
81-100%	Highly Valid
61-80%	Valid
41-60%	Quite Valid
21-40%	Less Valid
0-20%	Very Less Valid

Source: Arikunto, 2021

After getting the score, the calculation is then carried out using the formula as follows:

$$\text{Learning Outcome Value} = \frac{jumlah\ skor\ yang\ diperoleh}{Skor\ maksimal} \times 100\%$$

The score results obtained based on validation are interpreted based on eligibility criteria. The criteria are contained in table 2 below:

Table 2 Eligibility Criteria

Interval (%)	Criterion
0-20%	Very Unworthy
21-40%	Not Worth It
41-60%	Pretty Decent
61-80%	Proper
81-100%	Very Worth It

Source (Cholifah &; Novita, 2022)

b. Practicality

Practical data was obtained from the questionnaire response scores of biology teachers and grade XI science students. The resulting value of the response is calculated according to the following formula:

$$\text{Learning Outcome Value} = \frac{jumlah\ skor\ yang\ diperoleh}{Skor\ maksimal} \times 100\%$$

With the criteria for interpretation of the LKPD practicality observation score in table 3 according to Riduwan (2013), which are as follows:

Table 3 Practicality Criteria

% percentage score	Practicality
0% - 40%	Impractical
41% - 55%	Less practical
56% - 70%	Quite practical
71% - 85%	Practical
86% - 100%	Very practical

(source: Ridwan, 2013)

c. Effectiveness

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Data on the effectiveness of LKPD is known from the value of learning outcomes (pre-test and post-test) measured using written tests. For the value of learning outcomes from the pre-test and post-test, the gain value is calculated by the following formula:

$$\text{N-Gain} = \frac{Skor Posttest - Skor\ Pretest}{Skor\ Ideal - Skor\ Pretest}$$

The results of the N-Gain calculation are then interpreted using the classification of the division of the N-Gain Score in table 4 and the category of interpretation of the effectiveness of N-Gain in table 5

Table 4 N-Gain Classification

Limitation	N-Gain Category
g>0.7	Tall
0.3 ≤ g ≤ 0.7	Keep
g < 0.3	Low

(source: Hake in Meltzer, 2002)

Table 5 Categories of Interpretation of N-Gain Effectiveness

Categories Interpretation of N-Gain Effectiveness	
Percentage (%)	**Interpretation**
<40	Ineffective
40-55	Less Effective
56-75	Quite Effective
>76	Effective

Source : Hake, R.R, 1999

Last stage 4) Dispersal Stage (*Dessiminate*) This stage is the final stage of product development. The dissemination stage was carried out in class XI IPA SMA PAB 4 Sampali in limited numbers and to class XI science biology teachers with a total of 36 students. This deployment stage is an advanced stage from the previous stage. The distributed LKPD is tailored to the needs and circumstances.

Result and Discussion

The results of the research obtained were carried out to determine the feasibility, practicality and effectiveness in the development of LKPD based *on Discovery Learning*. The results of data analysis and description of the development carried out are described based on the 4-D model, so the following results are obtained:

Eligibility/Validity

Material Validation At the validation stage, the development of LKPD based *on Discovery Learning* on respiratory system material is validated by material experts in the field of biology, the results of the assessment from material expert validators before revision. Data on the number of validation assessment scores were obtained of 36 with an average of 2. . If the percentage is calculated, it gets:

$$\text{Percentage Result} = \frac{36}{72} \times 100\% = 50\%$$

Based on the number of assessment scores, it is known that the validation of LKPD material is included in the score of 41-60% in the LKPD validity criteria table, which is

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"quite valid" and in the table of key criteria, LKPD enters the interval of 41-60% with the criteria of "feasible enough".

Then the assessment results from the material expert validators after revision. Data on the number of validation assessment scores was obtained at 62 with an average of 3.44. If the percentage is calculated, it gets:

$$\text{Percentage Result} = \frac{62}{72} \times 100\% = 86{,}1\%$$

Based on the number of assessment scores after revision, it is known that the validation of student worksheet material is included in the score of 81-100% in the LKPD validity criteria table, which is "very valid" and in the LKPD keyness criteria table, it enters the 81-100% interval with the "Very Feasible" criteria.

Media expert validation is carried out to determine the feasibility level of Discovery Learning-based Student Worksheet (LKPD) products . Assessment results from media expert validators. Data obtained on the number of validation assessment scores of 51 with an average of 3. If the percentage is calculated, it gets:

$$\text{Percentage Result} = \frac{51}{68} \times 100\% = 75\%$$

Based on the number of assessment scores, it is known that the validation of student worksheet media based on the LKPD validity criteria table contained in table 3.2 is included in the score of 61-80% with "valid" criteria and in the LKPD eligibility criteria table enters into the interval of 61-80% with "feasible" criteria.

Practicality

Product practicality test is a test carried out on a product. LKPD products test practicality by means of teacher and student responses. Assessment conducted by teachers of biology subjects class XI IPA SMA PAB 4 Sampali. From filling out the questionnaire response the assessment score was 46 with an average of 3.2 so that if calculated the percentage obtained:

$$\text{Percentage Result} = \frac{46}{56} \times 100\% = 82,14\ \%$$

Based on the number of teacher response assessment scores, it is known that the LKPD developed by researchers shows that the scale of criteria obtained is included in the score of 71-85% in the LKPD practicality criteria table, namely the "practical" criterion.

The results of the assessment of the response assessment of grade XI IPA SMA PAB 4 Sampali students totaling 36 students obtained an assessment score with an average of 66.77 so that if calculated the percentage obtained.

$$\text{Percentage Result} = \frac{66{,}78}{80} \times 100\% = 83{,}475\%$$

Based on the number of student response assessment scores, it is known that the LKPD developed by researchers shows the scale of practicality criteria obtained into a score of 71-85% in the LKPD practicality criteria table, namely the "practical" criterion.

Effectiveness

The effectiveness of LKPD *Based on Discovery Learning* can be seen from the results of student learning tests (*Pre-Test &*; Post-Test) after LKPD is tested in class. It was concluded that the use of the method was effective because the N-Gain normality value obtained was between $0.30 < g < 0.70$ with the "effective" criterion. Then for the N-Gain score value of 0.62, this value is in the medium category because the N-Gain score of 0.62 is between 0.3-07 with the category "medium N-Gain".

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Discussion

The development of LKPD begins with the definition analysis stage (define), namely by determining Core Competencies (IC), Core Competencies (KD) and Standard-Based Learning Materials for K13 content. Then the LKPD design stage is carried out by designing a prototype based on LKPD discoveries or projects. At the design stage, an initial draft of LKPD will be produced before testing the validity, practicality and effectiveness of each validator and students.

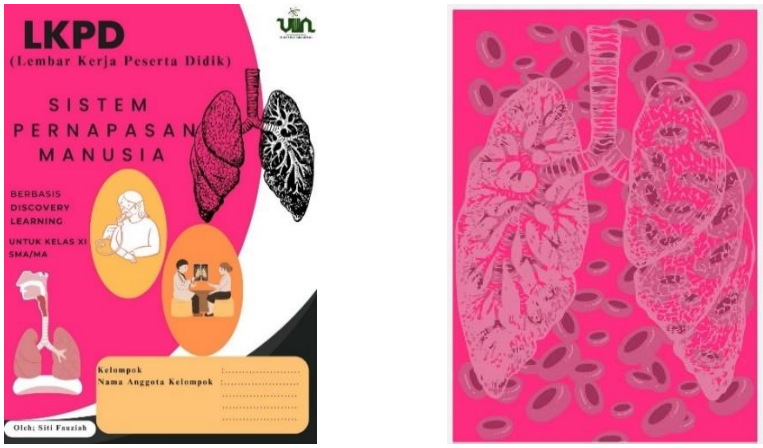

Figure I LKPD front and rear cover design

Development stage, carried out to produce the final product after validation then revision from validators. Assessment of the results of material validation is carried out twice, before revision and after revision. The results of the assessment before the revision were validation assessment scores of 36 with an average of 2 with a percentage of 50% with LKPD validity criteria of "quite valid" and eligibility criteria of "decent enough". After the revision, the validation assessment score of 62 with an average of 3.44 with a percentage of 86.1% entered the LKPD validity criteria, namely "very valid" and "very feasible" criteria. Unrevised media validation with a validation assessment score of 51 with an average of 3 percentages, 75% with "valid" criteria and with "eligible" criteria. The practicality test of the product was assessed from the teacher and student response questionnaire, from filling out the teacher response questionnaire the assessment score was 46 with an average of 3.2 percentage obtained 82.14% with the "practical" criterion. Then the student response assessment score obtained was with an average of 66.77 percentage obtained 83.47% with the "practical" criterion. The effectiveness of the product test is seen from the results of the students' learning tests (*Pre-Test &*; Post-Test) after the LKPD is tested in the classroom. The test given is in the form of *essay questions* totaling 10 questions. The calculation results are known in table 4.8. The results of the Pre-test and Post-test calculations obtained an average N-Gain score of 62.14%, so it can be concluded that the use of the method has been effective because the N-Gain normality value obtained between $0.30 < g < 0.70$ with the "effective" criterion. Then for the N-Gain score value of 0.62, this value is in the medium category because the N-Gain score of 0.62 is between 0.3-07 with the category "medium N-Gain".

Finally, the Dissemination stage (*dessiminate*) this stage is the final stage of product development. The dissemination stage was carried out in class XI IPA SMA PAB 4 Sampali in a limited number of 36 students and to class XI biology teachers. The distributed LKPD is tailored to the needs and circumstances.

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Conclusion

From the results of the study entitled "Development of LKPD Based *on Discovery Learning* on Respiratory System Material to Train Students' Critical Thinking Skills" it can be concluded: 1) Sieve: For feasibility assessment according to media experts, it is included in the interval of 61-80% with the criteria of "feasible" and for material experts where before the revision according to the material expert is included in the interval of 41-60% with the criteria of "feasible enough", but after revision it enters into the interval of 81-100% with the criteria of "very feasible". 2) Practicality: The level of practicality is obtained from teacher and student response questionnaires. The response of the teacher of biology class XI science subject with a total assessment score of 82.14% entered into a score of 71-85% with the criteria of "practical". The response of class XI science students of SMA PAB 4 Sampali as many as 36 students with a total assessment score of 83.475% entered into a score of 71-85% with the criteria of "practical". 3) Effectiveness: The level of effectiveness obtained from the calculation of Pre-test and Post-test obtained The average value of N-Gain score is 62.14%, so it can be concluded that the use of the method is effective because the N-Gain normality value obtained is between 0.30 $< g <$ 0.70 with the criterion "effective". Then for the N-Gain score value of 0.62, this value is in the medium category because the N-Gain score of 0.62 is between 0.3-07 with the category "medium N-Gain".

Recommendation

The suggestions for developing student worksheets based on discovery learning are:
1) This study was tested only in limited trials. So it is suggested that further researchers conduct trials on a large scale and reach the stage of application or implementation.
2) The materials developed are not only limited to respiratory system materials but other biological materials.

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