

Development of Student Work Sheet Based *Discovery Learning* on The Material Human Respiratory System Class XI Madrasah Aliyah

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Abstract: This study aims to develop *Discovery Learning* Based Worksheets and to determine the level of validity, practicality and effectiveness. This study uses the Research and Development (R&D) research method with the ADDIE model (*Analyze, Design, Development, Implementation, Evaluation*). The research subjects were class XI MIA at MAS Al-Washliyah 22 Tembung, which consisted of 34 people. The research instrument was an analysis of teacher needs, validation sheets, educator response questionnaires and student questionnaires. Based on the results of research in terms of validity, material experts get a score of 100% in the "*Very Valid*" category, media experts get a score of 81.05% in the "*Valid*" category. Meanwhile, in terms of practicality, from the results of the educator's response, an average response of 95% was classified as "*Very Practical*". In the results of the assessment of students have an average proportion of 90.47% with the criteria "*Very Interesting*". In terms of effectiveness, the pretest results averaged 61.18 while the posttest results averaged 74.26. With an n-gain value obtained of 0.34 which is the "*Effective*" criterion. Thus, the LKPD based on *Discovery Learning* that has been developed is declared valid, effective, and practical to use, and can increase activeness in solving problems. The implication of this research is that *Discovery Learning-based* LKPD products are expected to have instructions where students are more active in finding material from relevant sources in the LKPD.

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Introduction

Learning is a learner-centered activity by creating fun and challenging conditions to develop their creativity, and providing a variety of learning experiences. Learning also contains values, ethics, aesthetics, logic, and kinesthetics (Nurhadi, 2004:30). The learning process has content in the form of teaching materials or learning materials that originate from the curriculum in an educational program, in which there are steps or stages that must be passed by educators and students to achieve learning goals. So that the teacher is not only tasked with completing the subject matter but must prioritize attitude and quality. So the role of a teacher is very important in the learning process (Sardiman, 2010: 146).

In learning Biology students should be more active in solving a problem together. Because the subject of biology is related to how to find out and understand systematically, not only mastering a collection of knowledge in the form of facts, concepts and principles, but also

a process of discovery. From these problems, it is necessary to do research using the right model. One of the learning models that can make students active is by applying the Discovery Learning model (Nilgun, 2016).

As for other problems namely based on the results of an interview that the researcher conducted with a Biology teacher at MAS Al-Washliyah 22, stated that the process of teaching and learning biology is still lacking in activating students in learning, meaning that most of the learning process is more teacher-centered. So that teachers also experience difficulties in learning biology. Ignorance of students regarding Biology concepts causes them to quickly get bored and not interested in Biology lessons, and the use of learning methods is still focused on textbooks or textbooks. Therefore according to (Hidayat, 2010.), it is necessary to have a learning method that can make it easy for students to study Biology properly and correctly. This method is expected that students can find answers to a problem or a new concept by using the tools and information provided by educators which emphasizes the active involvement of students in the learning process (Sugiarti, 2017). Based on this, we need a learning model that can activate learning in the classroom by using the right learning model, so that teachers can build patterns of interaction and emphasize the process of actively forming student knowledge. Application of the *Discovery Learning* model (Divine & Takdir, 2012).

Learning uses the *Discovery Learning* model intended to encourage students to be active in discovering concepts (Rosdiana et al., 2017). In this case according to the meaning of *Discovery Learning* process that the teacher is only a facilitator to provide stimulation so that students feel challenged to be involved in the learning process and students are the subject (Putrayasa, 2014: 9). The way to increase the activeness of students in the learning process is to identify and help students who are less involved by investigating the causes and what efforts can be made to increase student activity, adapting teaching to the individual needs of students. In this case according to the meaning of *Discovery Learning* in the learning process that the teacher is only a facilitator to provide stimulation so that students feel challenged to be involved in the learning process and students are the subject (Putrayasa, 2014: 9).

The *Discovery Learning* model can encourage student activity, one of which is at the stages of data collection, data processing, proof, and drawing conclusions, namely students questioning and explaining something that has not been explained. From this process students will answer questions or explain something so that they will practice speaking in front of other people, curiosity, mental training, self-confidence, and strong beliefs. They will think hard about how to find a concept and form several characters. From the various opinions above, it can be concluded that the characteristics of the *Discovery Learning* model include: (1) exploring and solving problems to form, combine and gather knowledge, (2) focus on students, and (3) the activity of combining new knowledge and existing knowledge (Hamalik, 2015:29). Furthermore, as a form of effort to develop activities in biology learning, the *Discovery Learning* model step is integrated in the LKPD.

LKPD is teaching material consisting of sheets of paper containing material, summaries, and instructions for implementing learning tasks that must be done by students and in accordance with the basic competencies to be achieved (Roza, 2017: 420-28). LKPD also functions as a study guide for students and makes it easier for students and teachers to carry out teaching and learning activities (Katriani, 2014). Development of LKPD (Student Worksheets) based on the *Discovery Learning* model, which is expected to increase the activity of students, thereby achieving better results, and providing convenience to teachers in their efforts to provide material on the human respiratory system.

The problem that was found next was that there were teacher complaints about difficulties in making LKPD. These complaints are of course not without cause. In general, there are several obstacles found in LKPD learning, the obstacles referred to include teacher problems that are difficult to make LKPD, the availability of material regarding LKPD that is difficult for teachers to find, the use of instructional media rarely uses LKPD which can improve mastery of concepts and skills in solving problems by students. students, so that students experience difficulties and even experience mistakes during learning. The previous LKPD only focused on developing students' scientific thinking skills so that *Discovery Learning*-based Student Worksheets were needed to increase student activity in the learning process. With the use of *Discovery Learning*-based worksheets, it is expected that learning conditions can change from Teacher Centered to Student Centered so that mastery of concepts and skills can increase the activity of these students.

Based on research related to the Development of *Discovery Learning*-based LKPD that has been carried out, namely Masdi (2018) developed Ecosystem material, Osin (2019) on Social Arithmetic material, Mirawati, et al (2021), on the Submatter of the Heart and Circulatory Process in Humans, Patricia et al. , (2018), on Dynamic Fluid material and Umar (2019) on Cell material. This proves that researchers developed LKPD based on *Discovery Learning* on the Human Respiratory System, namely to increase student activity in learning and its use in learning which can help teachers direct their students to find concepts through their activities in learning.

Therefore, based on the description of the problems mentioned above, the researcher is interested in conducting research entitled "*Development of LKPD Based on Discovery Learning on Respiratory System Material for Class XI MA*"

Research Methods

This research uses *Research and Development* (R&D) method. Developmental research is a research method used to produce certain products, and test the effectiveness of products. In this development research, researchers used the ADDIE development model to produce learning media based on *Discovery Learning* which has stages. This media development research was carried out in steps according to the steps in the ADDIE development model. The ADDIE model consists of five stages including Analysis (*Analyze*), Design (*Design*), Development (*Development*), Implementation (*Implementation*) and Evaluation (*Evaluation*). The material in the media to be designed by researchers is material for the Human Respiratory System in Class XI MA.

The data used in this study are validation sheets for material expert and media expert validators and student response sheets. The validation sheet technique was given to the validator (*lecturer/teacher*) to validate the learning tools that were made and data collection was carried out using a questionnaire model, namely a teacher and student response questionnaire using a Likert scale.

There are three data collection techniques in this study, namely: Determining the validity of LKPD Assessment of product practicality consisting of observation sheets of the implementation of learning activities, student response questionnaires expert validation in the form of questionnaires related to content feasibility, suitability and effectiveness of products for the benefit of LKPD revisions and tests for measuring the level of potential effect of LKPD and increasing understanding of the concept through N-gain.

1. Validity Test

The validator's assessment of LKPD consists of 4 categories, namely very invalid (1), quite valid (2), valid (3), and very valid (4). The validity data obtained from the assessment of media expert lecturers and teachers is then calculated using the following formula:

$$V = \frac{\sum X}{N} \times 100\%$$

Information :

V = Validation

$\sum X$ = Total validation score

N = Maximum total score

Table 1. Product Validity Criteria

Score Intervals	Category
85.01 – 100.00%	Very Valid
75.01 – 85.00%	Valid
60.01% - 75.00%	Valid Enough
50.01% - 60.00%	Invalid
<50.00%	Very Invalid

Source: Utomo, 2018:4

LKPD is said to be valid if the validation results of material experts, media experts and learning experts reach a minimum valid level with the criteria of 75.01% - 85.00%.

2. Practicality Test

Practicality can be fulfilled if experts and teachers consider that LKPD can be used and the reality shows that it is easy for teachers and students to use LKPD (Novrini et al, 2015).

$$P = \frac{\sum X}{N} \times 100\%$$

Information :

P = Practical

$\sum X$ = Total validation score

N = Maximum total score

Table 2. Product Practicality Criteria

Criteria	Category
81.01% - 100%	Very Practical
61.01% - 80.00%	Practical
41.01% - 60.00%	Pretty Practical
21.01% - 40.00%	Less Practical
00.00% - 20.00%	Impractical

Source: Riduwan, 2010:89

LKPD is said to be practical if the assessment of the teacher and student response questionnaire reaches at least a practical level with the criteria 61.01% - 80.00%.

3. Effectiveness Test

The effectiveness of the developed LKPD was analyzed through pretest and protest measurement data. Pretest and protest measurement data of students were analyzed quantitatively with descriptive statistics to measure students' mastery of the material after learning was finished. The analysis used is N-Gain. This test is used to determine the effectiveness of the treatment given. The following is the formula used to calculate the normality of the gain (Guntara, 2020: 2).

$$N\text{-Gain} = \frac{S_{\text{post}} - S_{\text{pre}}}{S_{\text{maks}} - S_{\text{pre}}}$$

Information:

N-Gain: Stating the Gain Normality Test Value

S_{Post} = Stating the Pretest Score

S_{Pre} = Declare the Posttest Score

S_{max} = Declare the Maximum Score

Table 3. Criteria for the N-Gain Value
Gain Normality Value **Criteria**

$-1.00 < g < 0.0$	Very Less Effective
$g = 0.0$	Less effective
$0.0 < g < 0.30$	Effective enough
$0.30 < g < 0.70$	Effective
$0.70 < g < 1.00$	Very effective

Source : Hake Sundayana, 2014:151

Results and Discussion

Results

This research and development resulted in a product in the form of a Discovery Learning-based worksheet on the material of the Class XI Human Respiratory System at MAS Al-Washliyah 22 Tembung.

A. Discovery Learning-Based Student Worksheet Development Stages

1. Analysis Phase (*Analyze*)

At this stage the researcher conducted interviews with the science teacher and made observations in one of the XI MIA classes. The results obtained from the interviews were that the learning was still teacher-centered and the LKPD used was still very simple and did not follow the requirements for preparing LKPD so that there was a lack of activate students. So, it is carried out in the form of innovation and creativity from LKPD which creates LKPD based on Discovery Learning to activate students. Furthermore, an analysis of students was carried

out, in which the researcher conducted an analysis of students in terms of students' academic abilities and the level of student activity.

The next step is material analysis, where the material specified in the developed LKPD is material for the human respiratory system. This material was chosen because in the 2013 curriculum, material on the human respiratory system, students are encouraged to analyze various organ systems in the human body. Therefore, the researcher chose the human respiratory system material because it is in accordance with the product to be developed, namely Discovery Learning-based Student Worksheets.

From the results of the analysis obtained above, it can be concluded that the problem faced by teachers at MAS Al-Washliyah 22 schools, especially at XI MIA, is to develop LKPD through an approach. The approach applied should refer to the discovery of concepts that are directed in solving problems. With this approach, learning objectives can be planned clearly and more effectively.

2. Design Stage (*Design*)

This stage is carried out with the aim of designing LKPD products to be developed and has 3 stages, namely: preparation of LKPD, format selection and initial design. The preparation of this LKPD consists of material titles, basic competencies, competency achievement indicators, learning objectives, instructions for use, learning materials and the existence of 2 learning activities that contain questions related to the material that has been studied. Furthermore, the selection of formats is carried out to determine what format is used in developing LKPD, which is used in developing LKPD refers to the requirements for preparing LKPD. In the initial design there were 5 procedures, namely LKPD product design, Assessment Instruments, Validity Instruments, Practicality Instruments and Effectiveness Instruments.

3. Development Stage (*Development*)

At this stage the development of LKPD was carried out which was developed into teaching materials which aimed to broaden the scope of students' knowledge and make it easier for students to understand the material on the Human Respiratory System. As for the aspects, namely the design of the cover display or LKPD cover, content design, validation process (*material validation and media validation*), revision process, and results of validation of research instruments (*educational and student questionnaires*). The cover and envelope design pictures on the LKPD are:

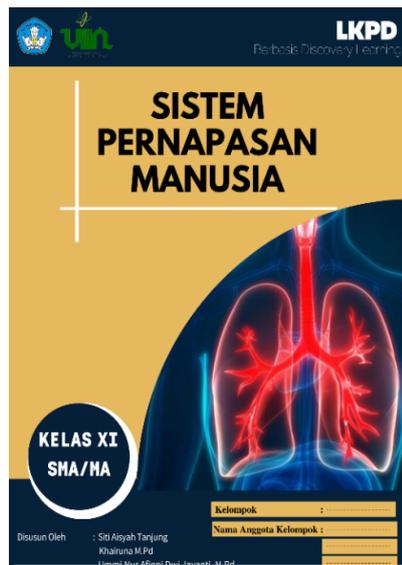


Figure 1. Front Cover



Figure 2. Back Cover Design

4. Implementation Stage

At this stage, it is carried out by testing the effectiveness of the product being developed to find out how far the learning outcomes of students have increased by testing the effectiveness of giving questions in the form of a pretest before the LKPD is applied and in the form of a posttest after the LKPD.

Table 4.1 The overall results of the pretest and posttest that is:

Respondents	Pretest Score	Posttest score	N-Gain Score
34 Students	2080	2525	11.44
Average value	61.18	74.26	0.34

From the results data obtained N-Gain 0.34 has a medium category with effective criteria. Based on table 4.10 above, the number of students who took part in the pretest and posttest was 34 students. The values obtained from the pretest total 2080 with an average value of 61.18. While the value of the posttest totaled 2525 with average 74.26 which means the average value has exceeded the KKM. This shows that learning outcomes in the cognitive domain increase after the use of Discovery Learning-based worksheets in learning. In the n-gain category, the pretest and posttest values obtained for the n-gain value are equal to 0.34 and meet the range of $0.30 < g < 0.70$ in the moderate category with effective criteria.

5. Evaluation Stage

This stage only measures student perceptions such as product content, tools and materials used in the product, the ease of using the product, and the teacher's explaining style.

B. Syntax *Discovery Learning*

1. *Stimulation* (Stimulation / Providing Stimulation)

At this stage students are given problems that are faced with something that causes confusion, then there is a desire to investigate this. Faced with this problem can foster the

curiosity of students to get to know more about the discussion of the respiratory organs of active, passive smokers and healthy lungs.

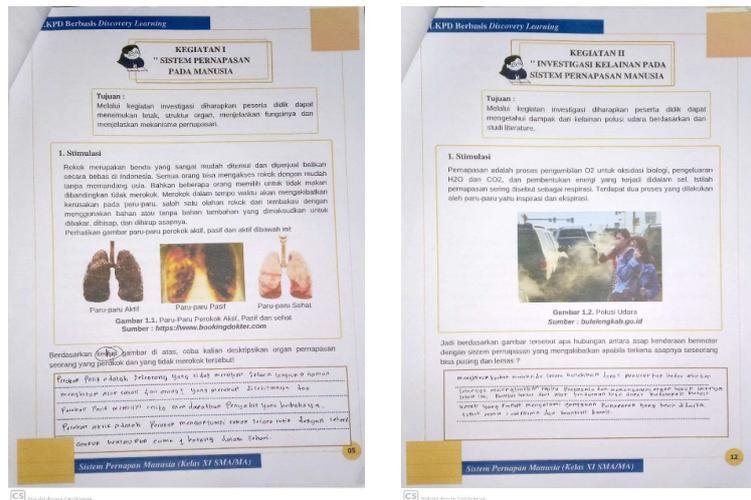


Figure 3. Activities 1 & 2
 Stimulation (Stimulus Giver)

2. *Problem Statements (Statement/ Problem Identification)*

This second stage comes from student questions that have been accommodated by the teacher. The benefits obtained by students in the Problem Statement are that they provide opportunities for students to identify and analyze the problems they have faced which are useful in building students' understanding so that they are accustomed to finding problems.

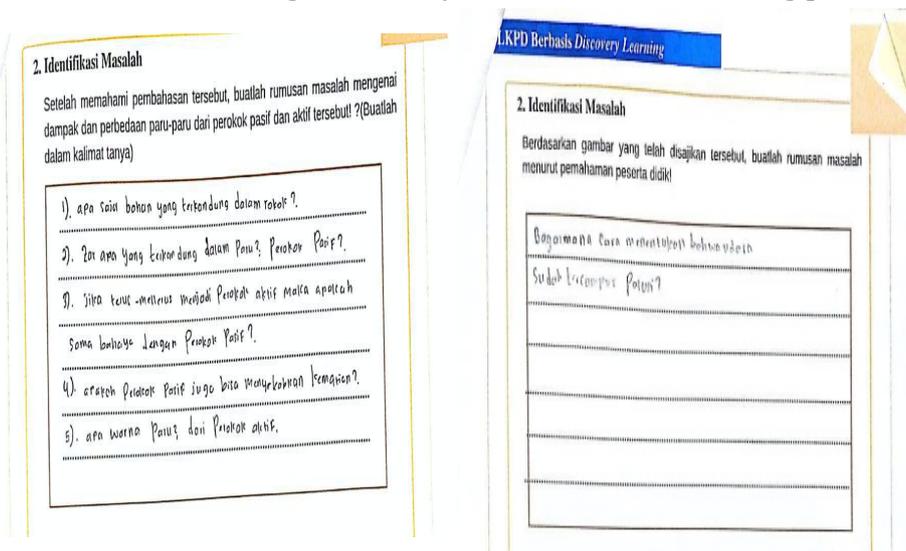


Figure 4. Activities 1 & 2
 Problem Statements(Statement/Problem Identification).

3. *Data Collections (Data collection)*

This activity is carried out in groups. For the distribution of groups tends to be homogeneous in terms of gender, besides that because the number of students is quite a lot, the division of groups consists of 8 groups consisting of 4-5 students. Each group gets several questions to look for and collect data. So that students have the opportunity to collect various relevant information, read literature, observe objects related to the problem, interview with problem-related sources, and conduct independent trials.

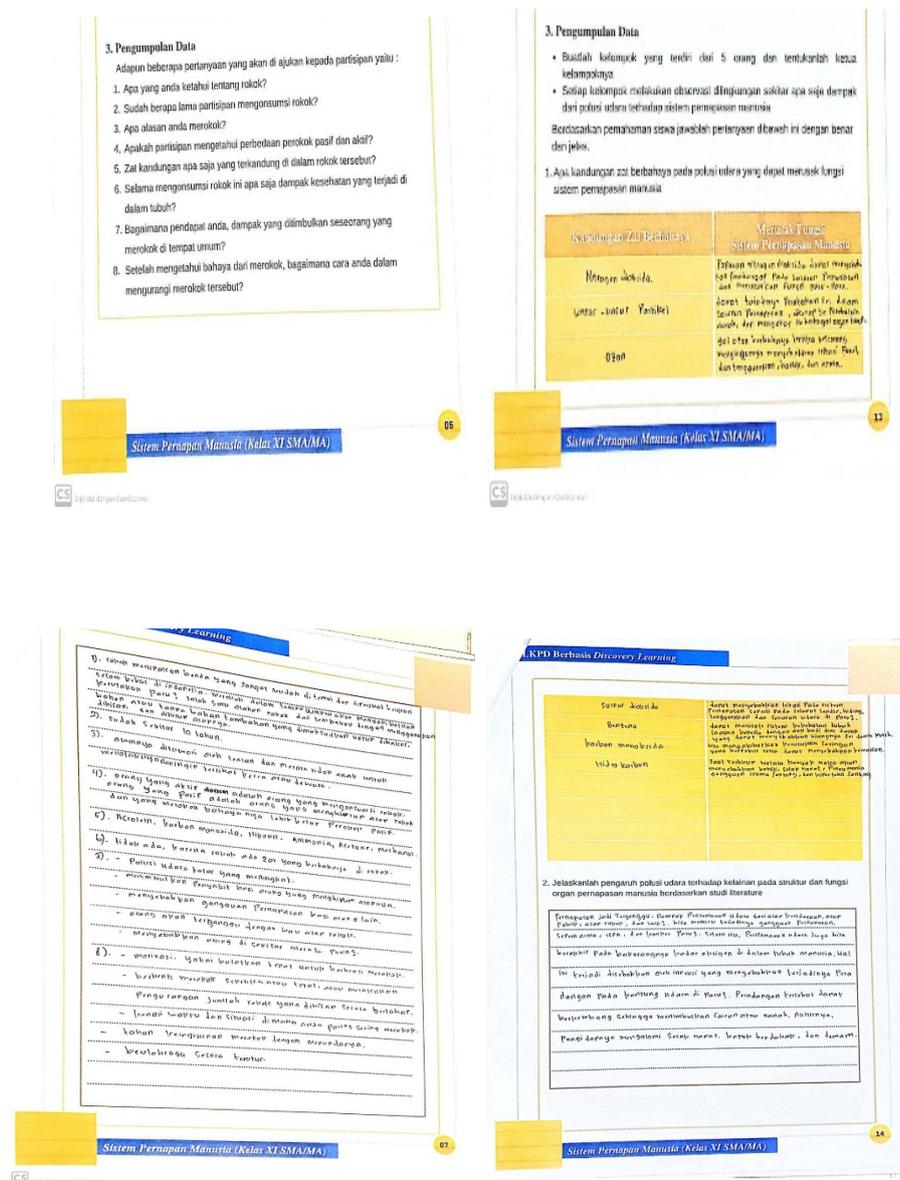


Figure 5. Activities 1 & 2
 Data Collections (Data collection)

4. Data Processing (Data processing)

At this stage, the activities carried out by students are by determining several questions that have been provided in the form of pictures of respiratory organs, starting from the structure,

function of questions and also the mechanism of the respiratory system, where each group answers these questions with short and clear sentences. In addition to getting the data and information, students can also compare the data and information they already have.

LKPD Berbasis Discovery Learning

4. Pengelolaa Data
 Jawablah pertanyaan berikut dengan kalimat yang singkat dan jelas!

1. Perhatikan gambar berikut ini!

Temukan nama organ, struktur penyusun organ serta fungsinya dalam tabel dibawah ini!

No.	Nama Organ	Struktur Penyusun Organ	Fungsi
1	Kerangka hidung	- tulang-tulang kerangka hidung - tulang-tulang rongga hidung - tulang-tulang langit-langit	untuk melindungi saluran pernapasan bagian atas
2	Pengalir mulut	- lidah - epiglotis	menyalurkan udara ke saluran pernapasan bagian bawah
3	Faring	- epiglotis - epiglotis - laring	saluran pernapasan bagian atas
4	Laring	- tulang-tulang laring - epiglotis - epiglotis	saluran pernapasan bagian atas
5	Trachea	- tulang-tulang trachea - epiglotis - epiglotis	saluran pernapasan bagian atas
6	bronchus	- tulang-tulang bronchus - epiglotis - epiglotis	saluran pernapasan bagian atas

Sistem Pernapasan Manusia (Kelas XI SMA/MA)

LKPD Berbasis Discovery Learning

No.	Nama Organ	Struktur Penyusun Organ	Fungsi
7	Diaphragma	- otot-otot diafragma - tulang-tulang diafragma	memisahkan rongga dada dan rongga perut
8	Alveolus	- epiglotis - epiglotis - epiglotis	tempat pertukaran gas
9	Epiglotis	- epiglotis - epiglotis	menutupkan saluran pernapasan bagian atas

2. Pernapasan adalah kegiatan mengambil udara (oksigen) dan mengeluarkan udara (karbondioksida) dengan bantuan alat pernapasan, yang bersifat elastis. Volume dan tekanan paru-paru diatur oleh bagian-bagian yang membatasinya, yaitu rongga dada dan perut, sehingga dikenal ada 2 macam mekanisme pernapasan pada manusia, yaitu pernapasan dada dan pernapasan perut. Tentukan jenis pernapasan serta mekanisme sistem pernapasan pada gambar dibawah ini!

Gambar	Jenis Pernapasan	Mekanisme
	Pernapasan Dada	gerakan tulang rusuk dan diafragma
	Pernapasan Perut	gerakan diafragma

Sistem Pernapasan Manusia (Kelas XI SMA/MA)

LKPD Berbasis Discovery Learning

Gambar	Jenis Pernapasan	Mekanisme
	Pernapasan Dada	gerakan tulang rusuk dan diafragma

Sumber: Buku Biologi, Heaven Johnson, (2003)

3. Analisislah link video dibawah ini tentang dampak bahaya rokok yang mempengaruhi fungsi di dalam tubuh, menguraikan sumber yang relevan!

<https://www.youtube.com/watch?v=...>

Sistem Pernapasan Manusia (Kelas XI SMA/MA)

LKPD Berbasis Discovery Learning

4. Perhatikan gambar berikut ini!

Gambar 4.1. Membran Paru-Paru
 Sumber: hot.grid.id

Paru-paru perokok akan berwarna lebih hitam dan padat. Paru-paru non perokok akan berwarna lebih merah dan lunak. Paru-paru perokok akan mengalami kerusakan dan penebalan yang disebabkan oleh partikel berbahaya yang masuk ke paru-paru dan merusak jaringan paru-paru. Paru-paru perokok akan mengalami penebalan dan kerusakan jaringan paru-paru. Paru-paru perokok akan mengalami penebalan dan kerusakan jaringan paru-paru.

Sistem Pernapasan Manusia (Kelas XI SMA/MA)

Figure 6. Activities 1 & 2
 Data Processing (Data processing)

5. Verification (Proof)

At this stage students examine carefully in proving whether or not the hypothesis set with alternative findings, which is then linked to the results of the data that has been processed.

Based on the findings that have been processed and the hypotheses that have been formulated previously, it will then be checked whether the findings have been answered or proven.

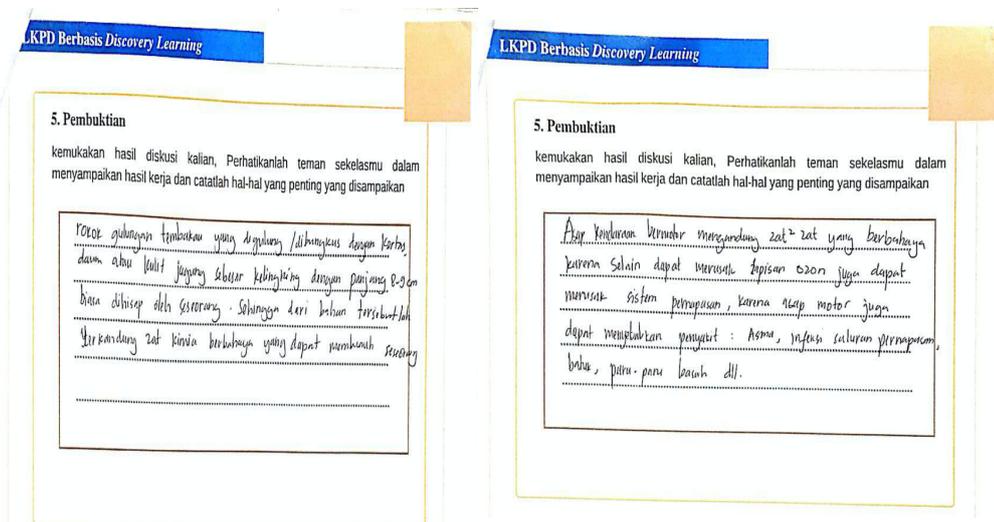


Figure 7. Activities 1 & 2
 Verification (Proof)

6. *Generalizations* (Drawing Conclusions/ Generalizations)

This stage is drawing conclusions where the process draws a conclusion that will be used as a general principle and applies to all the same events or problems, taking into account the verification results.

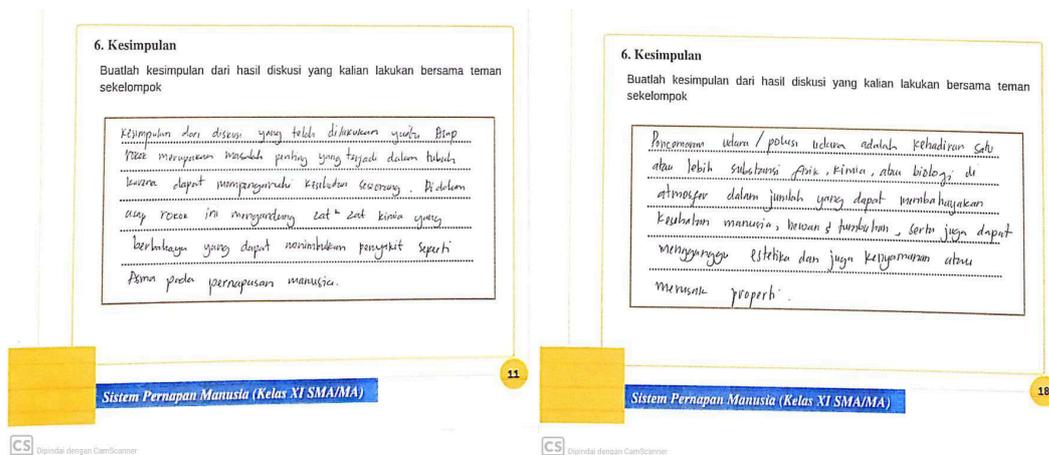


Figure 8. Activities 1 & 2
 Generalizations (Drawing Conclusions/Generalizations)

Discussion

A. The Validity of Student Worksheets (LKPD) Based on Discovery Learning

The LKPD based on Discovery Learning on the human respiratory system material that was created and developed is declared valid and can be tested with minor revisions because the components or aspects of the theory are contained in the validation sheet which has been filled in by the validator. The validation results obtained from the assessment of material experts which include aspects of content feasibility and aspects of material accuracy in the validation process by material experts obtain a score of 100% in the "Very Eligible" category. While validation by media experts gets a score of 80% in the "Valid" category. A valid product means that the product is suitable for use by students and teachers because it can assist in the learning process.

The product is said to be valid if it includes several components, namely (1) the content eligibility component includes SK and KD compatibility, needs, substance truth, benefits, moral values, and social values. (2) Presentation components, including clarity of goals to be achieved, order of presentation, motivation, attraction, interaction (stimulus and response), which then all components will be assessed by the validator on the validation sheet to determine the level of product validity based on validity criteria/

B. The Practicality of Student Worksheets (LKPD) Based on Discovery Learning

The student response questionnaire that was made consisted of 21 statements relating to the learning process using *Discovery Learning*-based worksheets. Meanwhile, the teacher's response questionnaire consisted of 15 statements related to the *Discovery Learning*-based LKPD. Based on the results of trials on learning, the results of the teacher's assessment of the practicality of the LKPD developed using the teacher's response questionnaire were 95% which were categorized as "Very Practical". And the average student assessment results using a student response questionnaire is 90.47% with the interpretation criteria achieved "Very Interesting". Thus, the practicality criteria of the developed *Discovery Learning*-based LKPD are achieved.

From the resultspractical test of LKPD based on *Discovery Learning* it can be concluded that the level of implementation of LKPD in class is in accordance with the lesson plan that has been made which helps students understand the concept of the material that has been presented and solve problems from activities that are in the LKPD.

C. The Effectiveness of Student Worksheets (LKPD) Based on Discovery Learning

The effectiveness of the developed LKPD was analyzed through data on measuring student learning outcomes with the pretest and posttest. The learning result test is given to students after the LKPD has been implemented. The learning outcomes test each consists of 20 questions in the form of multiple choice questions, where the material contained is in accordance with basic competencies and indicators.

The pretest results that have been carried out are the average value obtained by **61.18** which means it is under KKM 70. The next step is the posttest activity. This posttest is carried out after completing learning activities using LKPD based *Discovery Learning* on the material of the human respiratory system. The application of learning with LKPD based on Discovery Learning allows students to learn independently and improve their own knowledge. In addition, the attractive and modern appearance of LKPD makes learning new and interesting, does not make students get bored quickly in the learning process. The value obtained from the posttest activity is the average value of **74.26** which means the average value has exceeded the KKM. This shows that learning outcomes in the cognitive domain increase after the use of Discovery Learning-based worksheets in learning. In the n-gain category, the pretest and posttest values

obtained for the n-gain value are equal to 0.34 and meet the range of $0.30 < g < 0.70$ in the moderate category with effective criteria.

This is also supported by research conducted by Putri Intan (2022: 75) that the effectiveness of the Discovery Learning-based LKPD can be seen from the test results of students using the Post-test. So that the results of its effectiveness can be seen from the post-test score which has a score above the KKM of 80 %.

Conclusion

Based on the results of the research and discussion that has been carried out in the development of Discovery Learning-based worksheets on Human Respiratory System Materials using ADDIE, it can be concluded that:

1. In terms of validity, which includes aspects of content feasibility and aspects of material accuracy in the validation process by material experts, a score of 100% is obtained in the "Very Eligible" category. While validation by media experts gets a score of 80% in the "Valid" category. So that the LKPD based on Discovery Learning on the material of the human respiratory system is very suitable for use in the learning process.
2. From a practical standpoint, measured through data analysis of student response questionnaire results and teacher response questionnaires. The student response questionnaire consisted of 21 statements while the teacher response questionnaire consisted of 15 statements. Based on the results of the educator's response, an average percentage of 95% was obtained which was categorized as "Very Practical". And the average student assessment results using a student response questionnaire is 90.47% with the interpretation criteria achieved "Very Interesting"
3. In terms of Effectiveness, analyzed through measurement data of student learning outcomes with the pretest and posttest. The pretest results that have been carried out are the average value obtained by 61.18 which means it is under the KKM 70. Meanwhile, the score obtained from the posttest activity is the average value of 74.26 which means the average value has exceeded the KKM. In the n-gain category, the pretest and posttest values obtained for the n-gain value are equal to 0.34 and meet the range of $0.30 < g < 0.70$ in the moderate category with effective criteria.

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