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Development of Student Worksheets Based on Discovery Learning to Improve Students' Critical Thinking Skills

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ABSTRACT

This study aims to develop a Discovery Learning-based Student Worksheets (LKPD) that is feasible, practical, and effective to improve students' critical thinking skills. This research is classified as development research using the ADDIE model, which includes the stages of analysis, design, development, implementation, and evaluation. The research subjects were fifth-grade students at MIS Maura El-Mumtaz, Binjai City, North Sumatra, totaling 21 students. Based on the results of the study in terms of feasibility, the material expert obtained a score of 98% categorized as feasible, and the media expert obtained a score of 95% categorized as feasible. In terms of practicality, the results from the educators' responses showed an average score of 94% classified as very practical, and the results from the teachers' responses showed a score of 96% categorized as very practical. In terms of effectiveness, the Student Worksheets were tested through a pretest and posttest using critical thinking indicators. The average pretest score was 7.86, while the average posttest score was 19.50. The average n-gain score obtained was 0.94, categorized as very effective. Thus, the Discovery Learning-based Student Worksheets developed are feasible, practical, and effective for use in science learning at the elementary school level to improve students' critical thinking skills.

Keywords: discovery learning, student worksheets, critical thinking

INTRODUCTION

Science learning is a field of study that encompasses various concepts closely related to phenomena in the surrounding environment. Science learning not only conveys factual knowledge but also aims to foster curiosity, sharpen critical thinking skills, and train students in solving various real problems in their daily lives [1].

Science learning at the elementary school level plays a crucial role for students. Although the material delivered is still limited to basic concepts, the knowledge acquired at this stage will provide a strong foundation and support students' understanding of science material at the next level of education[2]. Considering the importance of science learning at the elementary school level, teachers have a strategic role in creating an enjoyable and meaningful learning atmosphere. Teachers are not only responsible for delivering the material but also actively involved in training students' thinking skills, such as understanding basic concepts, developing learning materials, and connecting the material with everyday life [3]. There are several ways to deliver learning material through learning media, including the use of pictures, photographs, films, or videos that are relevant to the subject matter. The selection of appropriate learning media greatly depends on the learning objectives, the type of material delivered, and the students' learning styles. The use of effective media can increase student engagement, strengthen concept understanding, and enhance the attractiveness of the learning process. In addition, learning media also help save the use of words and time, make the delivery of material more efficient, and ensure the consistency of information received by students [4].

Science learning does not merely emphasize the mastery of facts, concepts, or principles, but is also closely related to activities of exploring information and understanding various phenomena in an orderly and systematic manner. Therefore, science learning emphasizes the active involvement of students in the process of scientific discovery as part of the development of scientific thinking skills [5]. Although the current curriculum encourages the use of project-based approaches, experiments, and interactive discussions, in reality, many science teachers still tend to rely on lecture and memorization methods. Such conventional approaches result in students being less actively involved in the learning process, as well as having limited opportunities to think critically, ask questions, and participate directly. This situation causes students' ability to think critically in understanding scientific concepts deeply to remain low, which impacts the lack of critical thinking skills. This is affected by the

implementation of teacher-centered learning models, where the dominance of the teacher's role leads to students being passive in the learning process [6].

Students' critical thinking skills in Indonesia are still low, as shown by the results of the Programme for International Student Assessment (PISA) study, where Indonesia's literacy score reached only 382, placing it 64th out of 65 countries. Based on this report, the majority of Indonesian students were only able to solve questions at levels 1 and 2 out of a total of 6 available levels. This indicates that students' critical thinking skills are still far from expectations. In addition, the 2018 PISA results released by the OECD revealed that the average science score of Indonesian students was 389, while the average score of OECD countries reached 489. These data indicate a significant gap in the achievement of Indonesian students' science competence compared to international standards [7].

Critical thinking is the skill of evaluating reasoning accurately, weighing relevant evidence, and identifying errors, which is outlined in five important indicators of critical thinking, namely simple explanation, basic support, conclusion drawing, advanced explanation, and strategies or tactics [8]. Therefore, critical thinking skills need to be developed from the elementary school level, especially in higher-grade students. This ability plays an important role in helping students recall information and understand learning materials more deeply. By cultivating logical, analytical, and systematic thinking patterns from an early age, students will be better prepared to face various academic challenges at the next levels of education. The development of critical thinking skills requires an active and meaningful learning process, in which students are encouraged to discover new concepts through a learning environment that supports activities of questioning, analyzing, and evaluating information in a profound and in-depth manner [9].

Based on the results of interviews and observations conducted by the researcher at MIS Maura El-Mumtaz (Maura El-Mumtaz Private Islamic Elementary School), it was found that students in the learning process still tended to rely solely on the textbook as their primary source of learning. This occurred due to the limited media and supporting facilities available at the school, resulting in a monotonous learning process and less encouragement for the application of innovative learning methods. This phenomenon causes students to have low critical thinking skills. In fact, science learning should not only focus on the delivery of theoretical knowledge but also be directed toward developing critical thinking skills, analytical abilities, and experimental skills in students. If the learning approach used is more varied and contextual, students will find it easier to understand abstract scientific concepts and relate them to events or experiences in daily life, making learning more meaningful and impactful. Based on the identified problems, a solution is therefore needed through the use of appropriate media and learning models.

The Student Worksheets (LKPD), previously known as the Student Worksheets (LKS), is a printed teaching material that contains a summary of the material and learning guidelines for students, and its preparation must be adjusted to the applicable basic competencies [10]. The Student Worksheets aim to help students discover a concept while also helping them apply and integrate various concepts that have been learned. In addition, the Student Worksheets also function as a learning guide, a reinforcement tool, and a guide in conducting practicum activities [11]. Thus, it can be concluded that the Student Worksheets are a teaching material designed to help students learn independently or in groups through a series of structured tasks. The Student Worksheets usually contain instructions, brief material, questions, or activities that encourage students to be actively involved in learning, both theoretically and practically.

In the learning process at the elementary school level, an approach is needed that not only delivers material verbally but also encourages students to be actively involved in the process of discovering concepts. Especially in science learning, students are expected to develop critical thinking skills through meaningful learning experiences. Therefore, a learning model that allows students to construct their own understanding through exploration and investigation is highly required. One of the approaches that corresponds to this need is Discovery Learning. The definition of Discovery Learning is a learning method that encourages students to ask questions and draw conclusions based on general principles obtained through real experiences [12]. Thus, it can be concluded that Discovery Learning is a learning model that positions students as discoverers of concepts, where the teacher only acts as a facilitator who provides stimuli, while students are given the opportunity to explore, investigate, and discover knowledge through the process of problem-solving.

Previous studies have shown that the development of Discovery Learning-based Student Worksheets has been proven effective in improving the critical thinking skills of elementary school students [13]. The Student Worksheets developed from this study received a high feasibility rating from material, language, and media experts, as well as very good responses from educators and students. The trial results showed a significant improvement in students' concept understanding and critical thinking skills, with an N-Gain score of 0.7 in the medium category, indicating that this Student Worksheets is feasible to be used in science and Social Science (IPAS) learning at the elementary school level.

Previous research conducted showed that the development of Discovery Learning-based Student Worksheets on mathematics ratio material was declared feasible, very practical, and effective in improving students' mathematical critical thinking skills. The feasibility test by experts obtained an average percentage above 76%, students' responses reached the very practical category with an average above 90%, and the test results showed an improvement in critical

thinking skills in the medium category [14]. Thus, this Student Worksheets is feasible to be used as a learning medium that supports the achievement of mathematics competence in a more meaningful way.

Based on the previous studies that have been described, there is still a gap in the development of Discovery Learning-based Student Worksheets. Most of the previous studies focused more on concept understanding or general learning outcomes, without specifically targeting the improvement of students' critical thinking skills. In addition, the Discovery Learning approach has not been widely integrated effectively into the design of Student Worksheets to encourage students to think analytically, evaluatively, and reflectively. The gap is also evident from the lack of efforts to connect Student Worksheets activities with real contexts relevant to students' lives. This study has novelty in the development of Discovery Learning-based Student Worksheets specifically designed to improve the critical thinking skills of fifth-grade elementary school students. Different from previous studies that only focused on concept understanding or general learning outcomes, the product produced in this study was developed based on five indicators of critical thinking. In addition, this Student Worksheets was also designed with a contextual and exploratory approach; thus, each learning activity encourages students to actively observe, ask questions, analyze data, and draw conclusions through the stages of Discovery Learning syntax. This product not only functions as a learning aid but also as an instrument to cultivate the habit of logical and reflective thinking from an early age.

RESEARCH METHOD

This study is a development research. Development research is a type of research defined as a scientific way to investigate, design, produce, and test the feasibility of a product that has been developed [15]. This development research was carried out by following the stages contained in the ADDIE development model, including the analysis stage, in which the researcher conducted a needs analysis, an analysis of student characteristics, and an analysis of the curriculum to identify learning problems and determine the direction of development. Second, the design stage was carried out by arranging the content structure of the Student Worksheets, selecting the appropriate format, and creating the initial product design. Third, in the development stage, the Student Worksheets were fully developed and tested for feasibility by material experts and media experts, then revised based on the feedback obtained. Fourth, the implementation stage was conducted by trying out the Student Worksheets with students to examine its effectiveness and the students' responses to the product. Lastly, the evaluation stage was carried out formatively and summatively to assess the quality of the Student Worksheets as well as its impact on improving students' critical thinking skills [16]. The researcher decided to use the ADDIE development model because it offers a systematic approach with structured steps. In this model, each stage is accompanied by an evaluation and revision process, so that the resulting product can be more optimal and feasible for use.

In the product trial stage, the researcher used a one-group pretest-posttest design, which is a type of research design conducted by administering a pretest to students before the use of the learning media. Subsequently, students were given treatment in the form of learning using the developed media, namely the Discovery Learning-based Student Worksheets. After the treatment was given, a posttest was conducted to determine the changes in students' critical thinking skills.

The data collection techniques in this study were observation, interview, test, and questionnaire. The instruments in this study included expert feasibility test sheets (material and media), teacher and student response questionnaire sheets, as well as pretest and posttest questions developed based on the five indicators of critical thinking.

This study used a Likert scale to assess the feasibility and appropriateness of the developed media. The Likert scale is an instrument used to measure respondents' perceptions and opinions toward a social phenomenon. This Likert scale consists of two types of questions, namely positive questions and negative questions. The following is the Likert scale guideline table used by the researcher:

Table 1. Guidelines for Instrument Response Criteria

Score	Category
5	Strongly Agree
4	Agree
3	Doubtful
2	Disagree
1	Strongly Disagree

The data analysis techniques included feasibility, practicality, and effectiveness tests as described below;

1. Feasibility Data Analysis

   The feasibility analysis of the Student Worksheets was calculated using the formula [17]:

$$V = \frac{\sum X}{N} x100\%$$

The results of the feasibility test calculation of the Discovery Learning-based Student Worksheets were then converted into the following assessment criteria:

Table 2. Product Feasibility Criteria

Percentage (%)	Category
85 – 100	Very Feasible
75 – 85	Feasible
60 – 75	Fairly Feasible
50 – 60	Less Feasible
< 50	Very Less Feasible

2. Practicality Data Analysis

The practicality analysis of the Student Worksheets was calculated using the formula:

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

The results of the practicality test calculation of the Discovery Learning-based Student Worksheets were then converted into the following assessment criteria [18]:

Table 3. Product Practicality Criteria

Percentage (%)	Category
81 – 100	Very Practical
61 – 80	Practical
41 – 60	Fairly Practical
21 – 40	Less Practical
0 – 20	Not Practical

3. Effectiveness Data Analysis

The effectiveness analysis of the Student Worksheets was calculated using the formula:

$$\text{N-}Gain = \frac{\text{Spost} - \text{Spre}}{\text{Smax} - \text{Spre}} \text{ x } 100$$

The results of the effectiveness test calculation of the Discovery Learning-based Student Worksheets were then converted into the following assessment criteria [19] :

Table 4. N-Gain Score Criteria

Normalized Gain Value	Criteria
-1.00 < g < 0.0	Very Ineffective
g = 0.0	Ineffective
0.0 < g < 0.30	Fairly Effective
0.30 < g < 0.70	Effective
0.70 < g < 1.00	Very Effective

RESULTS AND DISCUSSION

1. Analysis Stage

The researcher carried out the analysis stage in this study through several important analyses, namely needs analysis, student analysis, and curriculum analysis, which served as the basis for designing the Discovery Learning-based Student Worksheets. In the needs analysis, the researcher conducted interviews with the fifth-grade science teacher, and the results showed that learning was still teacher-centered, lacked active student involvement, and most of the Student Worksheets used were still textual, less interactive, and had not fully implemented the syntax of the Discovery Learning model. In addition, the activities in the Student Worksheets tended to focus on practice questions and material summaries, without providing sufficient space for students to conduct exploration, observation, and independent conclusion drawing. This indicates a need for more interactive learning media that encourage student engagement, particularly in developing students' critical thinking skills.

Furthermore, in the student analysis, the researcher conducted a study of the students' characteristics, both in terms of academic ability and level of activeness in learning. It was found that the students' academic skills were quite varied. In addition, the level of student activeness in learning activities was relatively low. Students tended to be passive, lacked confidence in asking questions, and were rarely involved in group discussions. This was caused by the learning method that was still dominated by lectures, which did not provide sufficient space for students to think independently or critically.

In the curriculum analysis, the researcher examined the syllabus, teaching modules, and the teacher's book to ensure the suitability of the material with the applicable basic competencies. The topic of human respiratory organs was selected because this material requires students not only to memorize but also to understand the functions of the organs, recognize respiratory disorders, and apply healthy lifestyle patterns. Therefore, this material has strong potential to be developed through a learning approach that encourages observation, investigation, analysis, and reflection, as in the syntax of Discovery Learning.

The main finding of this stage is that the science learning process has not yet been able to encourage the development of students' critical thinking skills optimally. This is caused by several factors, such as a less interactive learning approach, limited learning

media that facilitate higher-order thinking processes, and the absence of a learning model that integrates exploration, observation, and reasoning.

The analysis stage has several advantages that strengthen the foundation for the development of the Student Worksheets in this study. First, the researcher conducted a needs analysis directly through interviews and classroom observations, so that the data obtained were contextual and reflected the actual conditions in the field. Second, the analysis was carried out comprehensively, covering needs analysis, student characteristics, and curriculum, so that the product to be developed has a holistic foundation and is in accordance with the actual conditions of science learning in elementary schools. However, this stage also has weaknesses. One of them is the limited scope of the analysis subjects, which involved only one teacher and one class from a single school, thereby limiting the generalizability of the findings.

The results of this study are in line with the findings of studies [20], [21], [22], which showed that conventional methods still dominate science learning and require media that can encourage students to think critically. This study strengthens the previous findings by focusing on the development of Discovery Learning-based Student Worksheets that systematically integrate the five indicators of critical thinking. The implication is that the product produced is not only relevant to the learning needs in the classroom but also contributes theoretically to the development of learning media based on critical thinking skills at the elementary school level.

2. Design Stage

The design stage in this study was carried out to develop the initial draft of the Discovery Learning-based Student Worksheets. The researcher conducted three main steps, namely the preparation of the Student Worksheets content, the selection of the format, and the preparation of the initial product draft. In the content preparation stage, important components such as the title of the material, basic competencies, achievement indicators, learning objectives, instructions for use, teaching material, and two exploratory learning activities were systematically arranged and adjusted to the topic of human respiratory organs. The selection of the format was also a primary concern, considering elements of attractive visual design, logical structure, and the use of language appropriate to the abilities of elementary school students. Meanwhile, the initial product draft was arranged based on the syntax of Discovery Learning, namely stimulation, problem statement, data collection, data processing, verification, and generalization, which were designed to guide students in actively and reflectively constructing their own knowledge.

The results of this stage show that the design of the Student Worksheets not only focuses on the delivery of material but is also directed toward building students' critical thinking processes through exploratory activities. Each part of the Student Worksheets is designed so that students not only read and answer questions but also analyze data, relate information to experiences, and draw conclusions independently.

This design stage is in line with previous studies, namely, studies [23], [24], [25] which emphasized the importance of developing teaching media that not only contain material but also promote critical thinking skills through discovery-based activities. The implication of this stage is the development of an initial design of the Student Worksheets that can serve as a model in preparing teaching materials based on higher-order thinking skills, particularly at the elementary school level. In terms of contribution, this stage highlights the importance of planning based on analysis and learning theory as the foundation for developing effective, contextual media that align with the current curriculum direction.

3. Development Stage

The development stage in this study first involved the researcher collecting sources or references from the relevant Merdeka Curriculum syllabus. Second, the Student Worksheets were written based on the previously designed outline, and then visually developed using the graphic design application Canva to enhance their visual appeal and usability for students. Third, the researcher prepared assessment instruments, which included expert feasibility questionnaires for material experts and media experts, as well as student response questionnaires.

The Discovery Learning-based Student Worksheets on the topic of Human Respiratory Organs were declared feasible for trial implementation with some minor adjustments. This assessment was obtained based on the results of the feasibility test by experts through evaluation sheets, which showed that the components in the Student Worksheets had met the feasibility criteria according to the indicators in the aspects of material and media. The complete results of the feasibility test process are presented in the following table.

Table 5. Feasibility Test Results from Validators

Type of Validator	Percentage (%)	Category
Material Expert	98	Very Feasible
Media Expert	95	Very Feasible

Based on Table 5, the feasibility test results show that the Discovery Learning-based Student Worksheets developed are categorized as very feasible. The assessment from the material expert, which included the aspects of content feasibility and material accuracy, obtained a score of 98% and was

categorized as very feasible. This indicates that the content of the Student Worksheets is in accordance with the learning objectives, basic competencies, and relevant to the cognitive development level of elementary school students. Meanwhile, the feasibility test by the media expert obtained a score of 95% in the very feasible category, which signifies that the aspects of appearance, visual design, layout arrangement, and the integration of text and images are in line with the principles of good instructional media development. With these feasibility test results, it can be concluded that this product is feasible for use in the learning process because it has met quality standards in terms of both material and media, and has the potential to assist teachers and students in achieving learning objectives effectively and engagingly.

The advantages of these feasibility test results indicate that thorough and analysis-based planning is an important factor in producing a feasible product. In addition, the use of good visual design principles and the complete syntax of Discovery Learning also affected the overall quality of the product. Nevertheless, this study still has limitations, particularly in terms of the number of validators and the scope of media trials, which were still limited to a specific context.

Compared with previous studies [26], [27], [28] the development results in this study share similarities in terms of product feasibility. However, this study has an advantage by explicitly incorporating critical thinking indicators into the Student Worksheets activities, as well as developing a feasibility test instrument that includes aspects of content, media, and critical thinking skills, a feature not previously explored in previous studies. The implication of this development stage is the creation of a feasible Student Worksheets that is ready to be implemented in science learning. In terms of contribution, this product can serve as an example for teachers or other media developers in preparing structured and feasible teaching materials that are oriented toward the development of 21st-century skills, particularly critical thinking skills.

4. Implementation Stage

The implementation stage was carried out to examine the applicability and effectiveness of using the Discovery Learning-based Student Worksheets in the science learning process. The Student Worksheets, which had been previously tested for feasibility, were applied to 21 fifth-grade students of MIS Maura El-Mumtaz. The implementation was conducted in the form of face-to-face learning, and the researcher facilitated the learning process according to the stages of the Discovery Learning syntax. At this stage, the researcher also administered a pretest and posttest using completion questions developed based on the five indicators of critical thinking to measure changes in students' abilities before and after the use of the Student Worksheets.

The findings from this implementation stage can be seen in the following table:

Table 6. Students' Pre-test and Post-test Results According to Indicators

Critical Thinking Indicator	Pretest Average	Posttest Average	N-gain Score	Category
Indicator 1 (Simple Explanation)	7.33	19.52	0.965	Very Effective
Indicator 2 (Basic Skills)	7.67	19.48	0.958	Very Effective
Indicator 3 (Conclusion Drawing)	7.62	19.29	0.945	Very Effective
Indicator 4 (Advanced Explanation)	7.76	19.67	0.974	Very Effective
Indicator 5 (Strategies and Tactics)	8.90	19.52	0.960	Very Effective
Average	7.86	19.50	0.960	Very Effective

Based on the data in Table 6, it can be seen that all critical thinking indicators experienced a significant improvement after the implementation of the Discovery Learning-based Student Worksheets. In Indicator 1 (Simple Explanation), the N-Gain score was 0.965, which falls into the very effective category. This indicates that students were able to provide initial explanations of problems or concepts more clearly after the learning process. In Indicator 2 (Basic Skills), the N-Gain score was 0.958, which is categorized as very effective. This improvement reflects the students' ability to identify important information, understand facts, and connect them with prior knowledge. In Indicator 3 (Conclusion Drawing), the N-Gain score was 0.945, which is categorized as very effective. This shows that after using the Student Worksheets, students were better able to draw logical conclusions based on the information they obtained during the learning process. In Indicator 4 (Advanced Explanation), the N-Gain score was 0.974, which was the highest score among all indicators. This indicates that students were not only able to provide simple explanations but also able to provide more detailed and comprehensive reasoning for their understanding. In Indicator 5 (Strategies and Tactics), the N-Gain score was 0.960, which is categorized as very effective. This improvement shows that students' ability to plan and apply strategies in solving problems critically has also developed very effectively.

This success was affected by several factors. First, the Student Worksheets designed with the Discovery Learning flow allowed students to explore and discover concepts independently. Second, contextual and exploratory activities stimulated students' curiosity and increased their engagement in learning. However, this implementation also had shortcomings, such as limited learning time and

students' dependence on teacher guidance in some parts of the activities, which indicates the need for further training in applying the discovery learning model independently.

Compared with other studies [29], [30], [31] this study showed an advantage in terms of effectiveness, where all critical thinking indicators achieved an N-Gain above 0.94. In addition, the Student Worksheets developed in this study were designed with contextual and exploratory activities relevant to students' daily lives, thereby encouraging active engagement and comprehensive improvement of students' critical thinking skills. This implementation stage implies that the Discovery Learning-based Student Worksheets have been proven effective as a means of enhancing students' critical thinking skills. Its contribution includes providing a learning tool capable of shifting the approach from teacher-centered to student-centered, as well as offering a concrete illustration of how instructional media can affect students' ways of thinking in the science learning process.

5. Evaluation Stage

The evaluation stage in this study was obtained from the completion of questionnaires, enabling the researcher to assess the practicality of the Student Worksheets from the user's perspective. In addition, the evaluation results were also supported by students' pretest and posttest data to measure the extent to which the Student Worksheets were able to improve critical thinking skills. This evaluation served as the basis for concluding that the developed product is very practical for use in learning. The conclusion was derived from the responses (questionnaires) of teachers and students regarding the use of the Discovery Learning-based Student Worksheets in fifth-grade elementary school science learning.

Table 7. Results of Teacher and Student Responses

Respondent	Number of Respondents	Percentage (%)	Category
Teacher	1 person	96	Very Practical
Students	21 persons	94	Very Practical

Based on the data in Table 7 above, the teacher's assessment of the practicality of the developed Student Worksheets through the questionnaire showed a score of 96%, which is categorized as very practical. Meanwhile, the average assessment from students through the student response questionnaire reached 94% with the interpretation of very practical. Based on the responses from the teacher and students, no negative comments or suggestions were found. In general, the responses provided were positive, and the developed learning media could be used properly without causing difficulties in its application.

The findings in this evaluation stage confirm that the Student Worksheets are not only feasible in terms of content and design but also practical in implementation and effective in outcomes, thereby making it a comprehensive teaching media. In addition, the strength of this evaluation stage lies in the use of comprehensive evaluation instruments covering aspects of content, usability, and learning impact. However, its weakness is that the evaluation has not included long-term effects or the subsequent effect on students' learning in other themes or topics, and it has not yet been evaluated by more than one teacher, which could strengthen the objectivity of the practicality assessment.

Compared with studies [32], [33], [34] the evaluation in this study was more focused on critical thinking skills, with assessments detailing each indicator based on the five indicators of critical thinking. This study also enriched previous research by combining quantitative data from trials and qualitative data from user responses, making it more comprehensive in assessing the quality of the media. This evaluation stage implies that the developed Student Worksheets are not only feasible to use but can also be recommended as one form of implementing the Merdeka Curriculum, which promotes active learning and critical thinking. Its contribution includes providing empirical evidence that the development of Discovery Learning-based Student Worksheets is very practical, thereby enhancing students' critical thinking skills in science learning at the elementary school level.

CONCLUSION

This study successfully developed a Discovery Learning-based Student Worksheets (LKPD) that is feasible to be used to improve students' critical thinking skills on the topic of Human Respiratory Organs in fifth-grade elementary school. Based on the feasibility test results from the material expert of 98% and the media expert of 95%, the Student Worksheets were categorized as very feasible. The practicality test showed that the Student Worksheets were very practical to use, with the teacher's assessment at 96% and the students' assessment at 94%. The effectiveness of the Student Worksheets was shown by the pretest and posttest results, in which all critical thinking indicators had N-Gain values above 0.94, categorized as very effective. Thus, the Discovery Learning-based Student Worksheets developed were proven to be feasible, practical, and effective, and can serve as an alternative teaching material in science learning to encourage the improvement of students' critical thinking skills.

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