

Design of Discovery Learning-Based Student Worksheets on Environmental Change Material for 10th Grade Senior High School

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ABSTRACT

One of the issues encountered in high school education is the limited teaching materials that facilitate students in enriching their experiences, building knowledge and engagement, and supporting problem-solving skills. This study aims to develop discovery learning-based student worksheets on environmental change material. The research method used is Research and Development (R&D), adopting the 4D model: Define, Design, Develop, and Disseminate. The data analysis used includes quantitative and qualitative analysis. The study used two types of validation: media expert and material expert. Validation results indicate that the worksheets developed is valid and suitable for trial, with media validation at 83% and material validation at 84%. The trial results show a student response rate of 89% and a teacher response rate of 99%, indicating that the discovery learning-based worksheets on environmental change is practical for use in teaching.

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INTRODUCTION

A good learning process cannot be separated from other aspects such as teaching materials. Teaching materials are used in the learning process to help convey each lesson more effectively, making it easier for students to understand. Currently, teaching materials play an important role in supporting the learning process. Teaching materials should meet the criteria as learning resources because many of the materials used in learning activities tend to contain only subject-specific information, have less communicative language, and low-quality teaching materials can result in lower student achievement (Nuryasana & Desiningrum, 2020).

In the implementation of the 2013 Curriculum, innovative teaching materials are crucial for effective learning activities. However, the phenomenon observed is that many of the teaching materials used are not innovative and are not suitable for the 2013 Curriculum. The learning

process is designed to be student-centered to encourage motivation, interest, creativity, initiative, inspiration, independence, and enthusiasm for learning, using a scientific approach that includes observing, questioning, concluding information, reasoning or associating, and communicating (Zuriah, Sunaryo, & Yusuf, 2016). In the 2013 Curriculum, the discovery learning model is also one of the recommended models to be applied. Discovery is the mental process by which students assimilate a concept or principle. This mental process includes observing, explaining, grouping, drawing conclusions, and so on. Students are prepared to plan their own learning research to formulate learning conclusions (Salmi, 2019).

Students using the developed worksheet showed higher interest and were able to understand concepts more easily because the materials connected well with real-life applications (Dayanti, Khuzaini, Febriyanto, Gunadi, & Fricelaa, 2022). The Student Worksheet contains a set of fundamental activities that students must perform to maximize their understanding in developing basic skills according to the learning outcome indicators that need to be achieved (Astuti, 2021).

RESEARCH METHODOLOGY

The research method used is the Research and Development (R&D) method. Research and Development is a process or series of steps to develop a new product or improve an existing product in a responsible manner (Sugiono, 2017). This study adopts a modified Four-D model (Define, Design, Develop, and Disseminate), with the Disseminate stage not being conducted.

The data collection techniques used in this study include validation sheets for validators and response sheets for students. The questionnaire is used to measure the validity of the developed product. For the validation sheets, data collection is performed using a questionnaire with a Likert scale. The validator's assessment of the worksheet consists of 5 categories: very unsuitable (1), unsuitable (2), somewhat suitable (3), suitable (4), and very suitable (5). For the response sheets for students and teachers, a similar questionnaire model with a Likert scale is used. Respondents are asked to read each question carefully and then answer it with options: very interesting (5), interesting (4), somewhat interesting (3), not interesting (2), and very uninteresting (1).

The instrument used in this study is a questionnaire with a Likert scale. The data used in the validation of worksheet is quantitative data, based on 5 assessment criteria, as shown in Table 1.

Table 1. Assessment Categories for the Likert Scale (Sa'dun Akbar, 2017).

Description	Number
Strongly agree	5
Agree	4
Somewhat agree	3
Disagree	2
Strongly disagree	1

The total validity is then calculated as a percentage using the following formula:

$$P = \frac{\sum x}{n} \times 100$$

Description :

P = Validity percentage

$\sum x$ = Total score obtained for each criterion

n = Maximum score

The percentage obtained from the validation formula on the questionnaires, including expert validation, educator response questionnaires, and student response questionnaires, is adjusted according to the criteria of achievement levels and qualifications as follows:

Table 2. Achievement Levels and Qualifications (Sa'dun, 2013)

Percentage %	Description	Qualification
81-100%	Very good	Very suitable, no revision needed
61-80%	Good	Suitable, no revision needed
41-60%	Fairly good	Less suitable, revision needed
21-40%	Poor	Not suitable, revision needed
< 21%	Very poor	Very unsuitable, revision needed

The developed worksheet teaching materials can be considered suitable for use in the learning process if the results of the validation percentage obtained are between 61% and 100%.

RESULT

This research aims to produce student worksheets based on discovery learning for the topic of Environmental Changes for 10th-grade high school/Madrasah Aliyah students. The process involved two rounds of validation by the media expert and two rounds by the material expert.

1. Results of Media Expert Validation

The media expert validation aims to assess the quality and suitability of the discovery learning worksheet product for the topic of Environmental Changes that has been developed. This validation was performed twice. In the first validation, a score of 55 was obtained from 20 assessment points, with a maximum score of 5 and a minimum of 1. After revisions, the second media expert validation resulted in a score of 83 from 20 assessment points, with a maximum score of 5 and a minimum of 1.

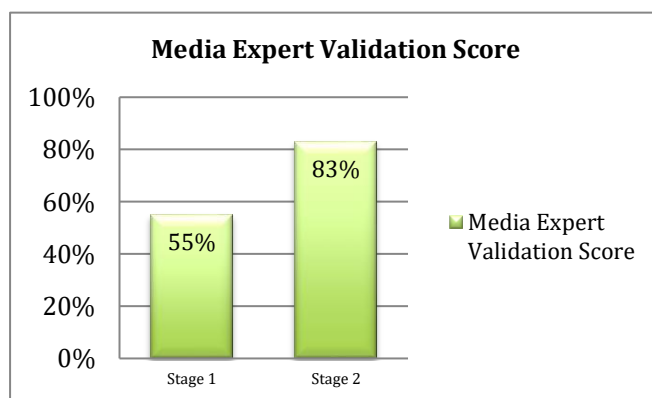


Figure 1. Diagram of Expert Media Validation Results

1. Expert Material Validation Results

The purpose of material expert validation is to assess the quality and presentation appropriateness of the discovery learning worksheet product on Environmental Changes that has been developed. Validation was conducted twice. The first validation resulted in a score of 73 out of 20 evaluation points, with a maximum score of 5 and a minimum of 1. Following revisions, the second expert media validation yielded a score of 84 out of 20 evaluation points, with a maximum score of 5 and a minimum of 1.

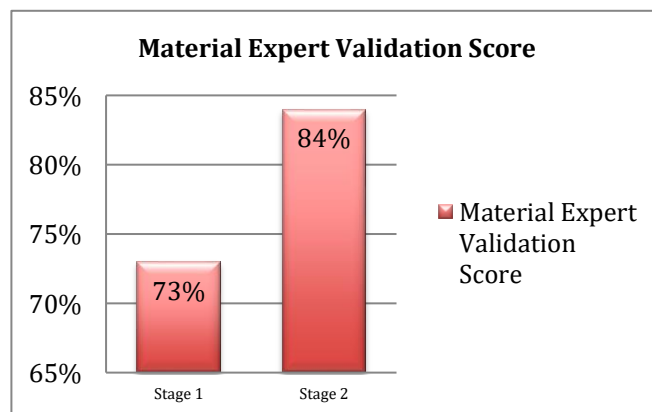


Figure 2 Diagram of Expert Material Validation Results

2. Results of Teacher and Student Responses

The product trial was conducted with one educator, a biology teacher, on May 24, 2023, using a teacher assessment questionnaire. The teacher's response score was 74 out of 15 evaluation points, with a maximum score of 5 and a minimum of 1. The student response data showed a percentage of 88.8% from 10 respondents, with 10 evaluation points, where the maximum score was 5 and the minimum was 1.

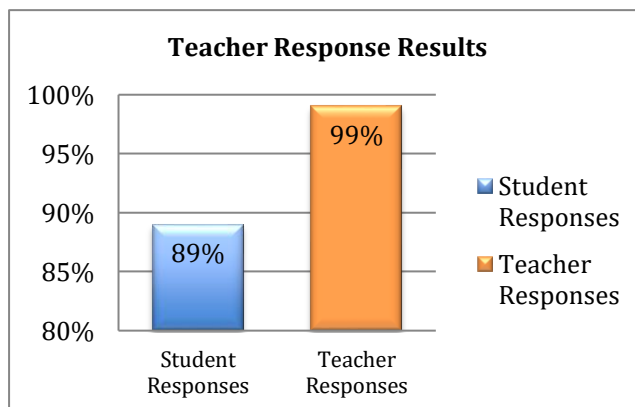
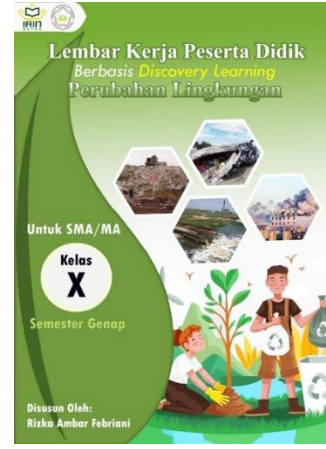




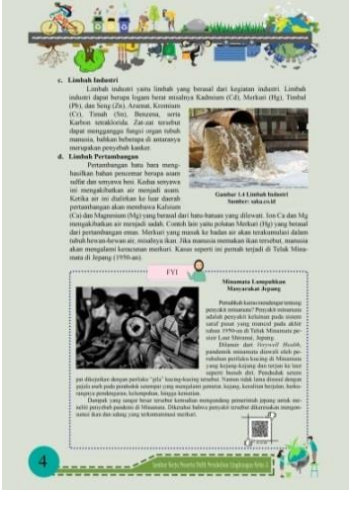
Figure 4.3 Diagram of Teacher and Student Response Results



3. Suggestions and Comments from Media Experts

The data consisting of suggestions and comments from media experts were used to improve the discovery learning worksheet product on Environmental Changes. The suggestions and comments from media experts are presented in the following table:

Table 3. Suggestions and Comments from Media Experts

NO	Suggestions and Comments from Media Experts	
1.	The previous design was less realistic.	
	Before Revision	After Revision
		
2.	The background was removed because it was distracting.	



	Before Revision	After Revision
3.	The border on the image captions was removed, and each image icon was enlarged.	
	<p style="text-align: center;">Before Revision</p> 	<p style="text-align: center;">After Revision</p> 



4.	The introductory sentence of the usage instructions is less effective.	
	Before Revision	After Revision
		













4. Suggestions and Comments from Material Experts

The data consisting of suggestions and comments from material experts were used to refine the discovery learning worksheet product on Environmental Changes. The suggestions and comments from material experts are presented in the following table:

Table 4. Suggestions and Comments from Material Experts

NO	Suggestions and Comments from Material Experts	
1.	Add a 'For Your Information' section about mercury contamination in Minamata Bay, Japan, to the mining waste material.	
	Before Revision	After Revision
		
2.	Add an image of the Air Pollution Index to the air pollution material.	

	Before Revision	After Revision
3.	Add handling methods to the household waste material.	Add handling methods to the household waste material.
	<p style="text-align: center;">Before Revision</p> 	<p style="text-align: center;">After Revision</p> 

4.	Add handling methods for commonly encountered medical waste at home, such as expired medications, to the medical waste material.				
	<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th data-bbox="491 383 869 427">Before Revision</th> <th data-bbox="869 383 1244 427">After Revision</th> </tr> </thead> <tbody> <tr> <td data-bbox="491 427 869 981">  <p>31</p> </td> <td data-bbox="869 427 1244 981">  <p>33</p> </td> </tr> </tbody> </table>	Before Revision	After Revision	 <p>31</p>	 <p>33</p>
Before Revision	After Revision				
 <p>31</p>	 <p>33</p>				
5.	Add a sentence encouraging the protection of tourism environments to the tourism waste material.				
	<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th data-bbox="491 1048 869 1093">Before Revision</th> <th data-bbox="869 1048 1244 1093">After Revision</th> </tr> </thead> <tbody> <tr> <td data-bbox="491 1093 869 1682">  <p>31</p> </td> <td data-bbox="869 1093 1244 1682">  <p>34</p> </td> </tr> </tbody> </table>	Before Revision	After Revision	 <p>31</p>	 <p>34</p>
Before Revision	After Revision				
 <p>31</p>	 <p>34</p>				

6.	Add an explanation to the composting section.	
	Before Revision	After Revision

DISCUSSION

Based on the results of the worksheet product validity test, it can be concluded that the product meets the feasibility criteria. According to (Muslim, 2017), the presentation of images in textbooks must also have aesthetic value to attract students to read and understand the text content. The developed product meets this aspect. In line with the research conducted by (Asyhari, Wati, & Saidah, 2016), the students' responses to the provided worksheet were very positive. (Salirawati, 2004) mentions three requirements for a student worksheet to be considered suitable: didactic requirements, construction requirements, and technical requirements. The didactic requirement relates to meeting the principles of effective learning within an worksheet. The construction requirement pertains to language use. The technical requirement involves writing in accordance with established rules. According to the National Standards Agency, several aspects must be included in the development of an worksheet, including content feasibility, language, presentation, and graphical aspects.

Penelitian yang dilakukan oleh (Ariani & Meutiawati, 2019) dan (Syahputri, Solikhin, & Nurhamidah, 2023) Both studies highlight that worksheet based on discovery learning not only facilitate a deeper understanding of the material but also increase student motivation to actively participate in the learning process, which is essential for developing their problem-solving skills more effectively.

CONCLUSIONS

The LKPD product was validated by two experts, media and material experts, to assess the suitability of the developed product. Media expert validation was conducted twice, resulting in a final score of 83% with the qualification of "very feasible." Following this, material expert validation was also conducted twice, yielding a final score of 84% with the qualification of "very feasible." Based on these validation results, the developed LKPD on environmental changes is deemed suitable for pilot testing.

The layout design, made as attractive as possible, along with the information presented in an engaging way, is expected to increase students' interest in learning. This is in line with (Junaedi, 2016) statement that aesthetic value serves as a benchmark used by subjects to assess the beauty or ugliness, and the attractiveness or unattractiveness of an object.

The biology teacher at MA Muhammadiyah Purbolinggo rated the product with a score of 99% and the qualification of "very feasible." Additionally, student responses to the developed LKPD on environmental changes resulted in a score of 89% with the qualification of "very feasible." This indicates strong approval from both the biology teacher and students regarding the developed teaching material. Based on these average percentages, the LKPD on environmental changes is considered appropriate for use in school learning. It is hoped that further research can be conducted to determine the level of understanding and learning outcomes of students.

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