Pegem Journal of Education and Instruction, Vol. 13, No. 4 , 2023 (pp. 1-12)

RESEARCH ARTICLE WWW.PEGEGOG.NET

Development of Student Worksheets (LKPD) Based on Critical Thinking Skills Environmental Change and Waste Recycling Materials

Henny Setiawati[1]*, Asti Setiawati[1], Nur Ismirawati[1], Asrullah Syam[1], Nurhasanah[1]
1Universitas Muhammadiyah Parepare, Indonesia.

Abstract

Critical thinking skills are one of the main competencies to be achieved in learning. Critical thinking skills can be taught through various methods, such as integrating through student worksheets (LKPD).Observations on the use of LKPD conducted at SMA Negeri 1 Parepare showed that the LKPD used did not support the development of students' critical thinking skills. In this regard, it is necessary to develop worksheets based on critical thinking skills.This study aims to produce worksheets that integrate critical thinking skills.This type of research is research and development (R&D) by adapting the learning development model from Thiagarajan known as 4-D namely defining, designing, developing, and disseminating. However, the development results in this study are only at the develop stage, namely only producing student worksheets based on critical thinking skills. Based on the results of the validation analysisobtained the average value of the total validation is 1,with a valid interpretation. The results of the teacher's questionnaire analysis obtained a total average value of 96% with very practical interpretations and student questionnaire analysis obtained a score of 85.11% with very practical interpretations. Thus a based LKPD has been producedSkills think critically on the basic competencies of environmental change and waste recycling for class X SMA that are valid, feasible and practical. LKPD development based on critical thinking skills is recommended to continue to be developed on other basic competencies so that students are trained to use their critical thinking skills.

Keywords: Student worksheets, critical thinking skills.

Introduction

The 21st century biology learning emphasizes the achievement of at least 6 main competencies to become independent learners. Critical thinking is one of the competencies that must be possessed besides creative, communicative, collaborative, compassionate, and logical computing thinking. Learning should be designed according to the achievement of these competencies. Critical thinking is a skill that can help students acquire knowledge and attitudes which are aspects of competence in the implementation of the 2013 Curriculum. According to Setiawati and Corebima (2017), critical thinking skills are not inherited, but must be learned.

Critical thinking skills are skills to examine, analyze, interpret, and evaluate (Hidayah, et al, 2017). Same opinion by Karim & Normaya (2015) that the ability to think critically is very important to have, because having the ability to think critically can help us think rationally in solving problems and looking for and developing alternative solutions to these problems. Critical thinking skills must be taught to help students gain competence in accordance with learning objectives. Students must be trained so that they have the ability to construct their knowledge through real experiences carried out in learning (Fong et al., 2017; Shim & Walczak, 2012; Setiawati & Corebima, 2019).

Implementation of critical thinking skills in learning is still limited. Learning at the senior high school level should have integrated learning to think, including critical thinking. Learning is generally classical in nature, which runs according to the completion time of the school year period. According to Kahar, et al. (2021), there are still many educators who do not implement innovation or learning development because of a lack of creativity, mastery of classes, soft skills, and laboratories. Khoiri, et al. (2019) stated that innovative student worksheets that are oriented to higher-order thinking skills are indispensable.

The process of learning critical thinking skills requires teaching materials that can help the process of achieving critical thinking skills. One of the teaching materials that can be used is in the form of Student Worksheets (LKPD) as independent learning guides for students. According to Purnamawati, et al. (2017);

Corresponding Author e-mail: hennysetiawati030473@gmail.com

https://orcid.org/0000-0001-5513-5306

Howtocitethisarticle: SetiawatiH,SetiawatiA,IsmirawatiN,SyamA, Nurhasanah (2023). Development of Student Worksheets (LKPD) Based on Critical Thinking Skills Environmental Change and Waste Recycling Materials. Pegem Journal of Education and Instruction, Vol. 13, No. 4, 2023, 1-12

Source of support: Nil

Conflict of interest: None.

DOI: 10.47750/pegegog.13.04.01

Received: 23.09.2022

Accepted: 10.12.2022 **Publication:** 01.10.2023

Ulas, et al. (2012), student worksheets can be used as a reference to support the learning process and guidelines in assessing the level of competence of students.

LKPD is a teaching material that contains material, summaries, and instructions for implementing learning tasks that must be carried out by students to achieve basic competencies delivered by educators (Rahayuningsih, 2018). LKPD is one of the important teaching materials to be used in learning. According to Anggraini, et al, (2017), LKPD plays a role in facilitating and directing the implementation of the learning process for students. Even so, the LKPD used is often still limited to providing questions or questions that have been prepared based on indicators that have not integrated the empowerment of thinking skills. The developed LKPD does not use the real conditions that exist in the environment around students. Learning becomes less meaningful.

The developed LKPD should be in accordance with indicators that consider the integration of thinking skills based on the environmental conditions of students, in addition to basic competencies in the curriculum. Some research results reveal that the LKPD used has not integrated students' thinking skills. Research result Ulas et al (2012) stated that student worksheets often did not fully meet competency standards and did not consider their substance. As well as Pratama & Retnawati (2018) stated that classrooms currently have limited learning innovation, low interest in reading, and poor quality of material, as well as the complexity of teaching materials, which has an impact on students' laziness and weakness in learning science.

Other research related to the lack of development of teaching materials, especially student worksheets, was also disclosed by Anggraini, et al (2016) also stated that the results of observations of idealized learning often did not materialize in reality at school. Likewise Fatmawati (2016), the results of the situation analysis and initial observations at the school showed minimal development of learning tools in biology subjects, including concepts Environmental pollution.

The same thing was also seen when making observations at SMA Negeri 1 Parepare. The learning process is less varied in giving assignments, so that students tend to have the skills to remember, memorize concepts, and do not apply worksheets that support the development of students' critical thinking skills. The available LKPD only contains material summaries and practice questions prepared and designed by the publisher, even though good LKPD can be made by educators themselves based on the needs of students so that they can build their own concepts in solving problems.

Therefore, it is necessary to develop or innovate worksheets that integrate higher-order thinking skills to increase students' understanding of learning material and help improve student learning activities. Research result Arafah, et al. (2012), stated that LKPD based on critical thinking on animalia material could improve student learning outcomes and activities. Likewise, Pangesti's research report (2012) states that the development of critical thinking teaching materials shows an attractive appearance on LKPD in terms of content and presentation so that it is an effective teaching material. The same is expressed Suryawati, et al (2012) that the average critical thinking ability of class XI IPA students increased from 63.85 to 74.10. LKPD development can improve critical thinking skills higher than learning that does not use LKPD, this proves that critical thinking skills can be developed using teaching materials in the form of LKPD. As well as Kahar, et al (2021) reported that the LKS design effectively improves students' high-order thinking skills which is shown through learning outcomes in the good category.

METHOD

Research design

The research conducted was Research and Development by adapting the learning development model from Thiagarajan known as 4-D namely defining, designing, developing, and disseminating. The subjects of this research were class X students of SMA Negeri 1 Parepare.

Research procedure

This research follows the stages of developing instructional design 4 D Thiagarajan (1974). This research consists of the stages of defining, designing, and developing strategies and tools in learning biology in high school, as well as the dissemination stage on a limited scale. Research conducted in SMA Negeri 1 Parepare with research subjects are teachers and students. The research procedure consists of the Define, Design, Development, and Disseminate stages which are generally explained as follows.

Defining Stage (define)

Stage Define (Define)

The purpose of this stage is to determine and define learning requirements which begin with an analysis of the objectives of the material boundaries, including the main steps, namely the Front end analysis aims to find out the basic problems faced in learning biology. Student analysis was also carried out to determine students' academic abilities. Task analysis includes content structure analysis and procedural analysis. Concept analysis includes identifying the concepts being taught and formulating learning objectives.

The results form the basis for preparing learning tools in the form of Student Worksheets (LKPD).

Design stage (design)

This stage aims to produce a LKPD learning device design, which consists of five steps, namely (a) media selection, (b) LKPD format selection, (c) initial design.

a. Media Selection

Media selection is based on material analysis and task analysis. In addition to the characteristics of the material, the characteristics of the students and the characteristics of the facilities in the school are also considered. The media used is related to the teaching materials used in research.

b. Format selection

The developed Student Worksheet Format (LKPD) is adapted to indicators of critical thinking skills, namely interpretation, analysis, evaluation, inference, explanation, and self-regulation.

c. Initial Design

The result of this stage is a prototype of a learning device in the form of an LKPD. The design of LKPD based on critical thinking skills includes the following components:

1. The first part consists of a cover, table of contents, instructions for using LKPD, core competencies, and basic competencies;
2. The second part contains teaching materials that have been arranged in an integrated manner according to a predetermined theme accompanied by supporting pictures; and
3. In the third part there are indicators of critical thinking skills, namely:understand the problems in the questions given, provide reasons based on relevant facts/evidence at each step of decision making and conclusions, draw conclusions,using all the information relevant to the problem,andthoroughly scrutinizing or re-examining from start to finish

Development Stage (develop)

This stage produces LKPD which has been revised based on input from experts, followed by testing the test instrument by students, which is then used as a basis for determining the validity of the items and the reliability of the test. This stage produces learning tools used in experimental research that have been validated.

Stage of Dissemination (Disseminate)

This stage is the next research stage, namely the stage of using the tools that have been developed, modified into experimental research using validated worksheets.

Research Instruments

The instruments used in this study were LKPD validation sheets, educator response questionnaires to LKPD, and student response questionnaires to LKPD. Information related to the research instrument is described in detail as follows.

a. Validity uses the LKPD validation sheet

The validity of the LKPD is assessed through the validation sheet. This type of instrument plays a role in collecting qualitative data because it contains input for improvement and suggestions that can be applied to LKPD so that its use can be maximized. Information obtained from this instrument is used as a reference and consideration in revising the product being developed. This validation sheet will be used and given to validators who are experts in their fields to be assessed as appropriate or not. The feasibility aspects are related to format, content, language, and benefits.

1) Format

a) The title is in accordance with the LKPD material
b) Basic Competencies, goals, and indicators in accordance with the LKPD material
c) Clear numbering system
d) Professional/standard fonts and sizes
e) Balanced layout of images, graphs and tables
f) Balanced text and illustrations
g) Student identity
h) Indicators of critical thinking skills sequentially

2) Fill

a) Material refers to the 2013 Curriculum (K-13)
b) LKPD is made in accordance with the Core Competencies and Basic Competencies to be achieved.
c) Literature/Theory review

3) Language

a) The language and terms used in LKPD are easy to understand
b) The language used is correct according to Enhanced Spelling (EYD)

4) Benefits/Use of LKPD

a) guidelines for educators in learning
b) guidelines for students in learning.

b. Educator Response Questionnaire to LKPD

This response questionnaire was made with the aim of knowing the responses of educators to the developed LKPD. Educators at the school where the research was conducted assessed that all stages of the LKPD had been carried out properly or not and assessed the quality of the LKPD that had been developed by the researcher.

c. Questionnaire of Student Responses to LKPD

This questionnaire is used to find out student responses after being given and using LKPD based on critical thinking skills. In addition, this questionnaire also contains student

suggestions for improving LKPD in the future.The indicators used in the questionnaire consist of students' understanding of the integration of indicators of critical thinking skills in learning, the learning methods applied, the use of illustrations, and the use of language.

Data Collection Tool

Data for the development of skill-based LKPD were obtained from research instruments. This development assessment instrument aims to assess products that have been developed. The instruments needed in this study are as follows:

1) Data Validity Using LKPD Validation Sheet

The validation sheet is used to measure the validity of the Student Worksheet (LKPD) based on critical thinking skills. The sheet contains LKPD assessment columns based on the developed critical thinking skills. The validator's assessment is represented by providing a checklist (√) on the part that is considered appropriate. The rating scale is given with a value range of one (1) to four (4). The division of the assessment categories, namely Very Good (SB) was given a value of 4, Good (B) was given a value of 3, Less Good (K) was given a value of 2, and Very Poor (SK) was given a value of 1.

2) Practicality Data

a. Educator Response Questionnaire to LKPD

Aspects that were addressed by educators included: the suitability of the contents of the LKPD, the physical appearance of the LKPD, the language in the LKPD and the application of the LKPD. Filling in the instrument is done by putting a check mark (√) in the teacher column that is in accordance with the observations. The number of items in the educator's questionnaire is 4 items. Each item in this questionnaire was given a score of 1 to 5, for a positive statement score consisting of Strongly Agree (SS) was given a score of 5, Agree (S) was given a score of 4, Disagree (KS) was given a score of 3, Disagree (TS)) was given a score of 2, and Strongly Disagree (STS) was given a score of 1. As for the negative statement score,

b. Questionnaire of Student Responses to LKPD

This questionnaire contains student statements about the LKPD they use. The responses seen relate to the instructions for using the LKPD, the appearance of the LKPD, the language used in the LKPD, and the contents of the LKPD itself. The instrument was filled in by students by giving a tick (√) in accordance with what they experienced when using LKPD based on critical thinking skills. The scoring guidelines are divided into 4 types of categories whose scale starts from a score of one (1) to a score of four (4). The division of the assessment categories, namely Strongly Agree (SS) is given a value of 4, Agree (S) is given a value of 3, Disagree (KS) is given a value of 2, Disagree (TS) is given a value of 1.

Data analysis

The data in this study will be analyzed descriptively qualitatively. The purpose of descriptive analysis is to describe the validity results given by the validator after being validated. Instrumentused has been validated by experts and analyzed in the following way:

1) Data Analysis Validity

The formula used to determine the overall content validity is the Gregory formula (2007). In this formula, two expert validators are needed to check the suitability between the indicators and instrument items, in the form of an assessment of whether the instrument that has been made is valid or not. There are two categories in Gregory's analysis, namely the first category is irrelevant (score 1) and less relevant (score 2) is recategorized as a category of weak relevance. For the second category, which is quite relevant (score 3) and very relevant (score 4), a category of strong relevance is made. Furthermore, after determining the relevance of each point, contingency was made to recategorize the two experts and categorize each aspect into letters to be able to calculate the Gregory index as shown in Tables 1 and 2.

Gregory analysis is determined using the following formula:

$$\textit{Content validity}(\mathrm{CV}) = \frac{\mathbf{D}}{\mathbf{A+B+C+D}}$$

With;

A : the number of items that are less relevant according to the two validators

B : the number of items that are less relevant according to validator I and relevant according to validator II

C : number of items that are relevant according to validator I and irrelevant according to validator II

D :number of relevant items according to both validators

Table 1: Contingency recategorization of two experts to Gregory analysis

		Rater 1	
		Weak	*Strong*
Rater 2	Weak		
	Strong		

Table 2: Contingencies for calculating Gregory index

		Rater 2	
		Weak	*Strong*
Rater 2	Weak	A	B
	Strong	C	D

The criterion used is if the CV ≥ 0.75 then the instrument is categorized as valid. The product resulting from the development of LKPD based on critical thinking skills is said to be valid if the validation value of each criterion is included in the valid category.

2) Practical Data Analysis

a. Educator Response Questionnaire Data Analysis

The analysis to calculate the percentage of the number of educators who answered each category listed on the questionnaire using the formula:

$$PRS=\frac{A}{B}x\ 100\%$$

Information :
PRS : percentage of educator responses
A : the total score of educators
B : maximum number of response questionnaires

Interpretation of educator response data on LKPD is shown in Table 3. The interpretation of educator responses is adapted from Riduwan & Sunarto (2013).

The decision to determine if the LKPD has an adequate level of implementation is that the minimum PRS value is in the practical category (60.0% - 80.0%), meaning that the LKPD is not revised anymore. Conversely, if the PRS value is below 60.01%, the LKPD must be revised again.

b. Analysis of Student Response Data

The activity carried out to analyze student response data was to count the number of students who responded according to the aspects listed on the student response questionnaire, then calculate the percentage. Analysis to calculate the percentage of students and educators who answered each category listed on the questionnaire using the formula:

$$PRS=\frac{A}{B}x\ 100\%$$

Information :
PRS : percentage of educator responses
A : the total score of educators
B : maximum number of response questionnaires

The decision to determine if the LKPD has an adequate level of implementation is that the minimum PRS value is in the practical category (60.0% - 80.0%), meaning that the LKPD is not revised anymore. Conversely, if the PRS value is below 60.01%, the LKPD must be revised again.

Table 3: Interpretation of Educator Response Data

Percentage of educator responses to the learning process	*Interpretation*
0.0% - 20%	Not practical
20.1% – 40%	Less practical
40.1% – 60%	Practical enough
60.1% – 80%	Practical
80.1% – 100%	Very practical

Source: Riduwan & Sunarto (2013)

Table 4: Interpretation of Student Response Data

Percentage of student responses to the learning process	*Interpretation*
0.0% - 20%	Not practical
20.1% – 40%	Less practical
40.1% – 60%	Practical enough
60.1% – 80%	Practical
80.1% – 100%	Very practical

Source: Riduwan & Sunarto (2013)

Findings

The research carried out is research and development (R&D) using the 4D development model (Define, Design, Development, Disseminate), to develop Student Worksheets Based on Critical Thinking Skills. LKPD developed on environmental change material and waste recycling for class X MIPA students.

Discussion

The results obtained from each activity carried out at each stage are as follows:

Description of the Results of the Defining Stage (Define)

Beginning-end analysis

This process is carried out by determining the fundamental problems faced by educators in carrying out learning and to improve critical thinking skills. This process begins with a field study that identifies the curriculum used in schools, LKPD that is often used, and problems that are often faced by educators during the learning process.

Based on the results of observations made at SMA Negeri 1 Parepare, it is known that the curriculum used in that school is Curriculum 2013. The activity carried out is to examine the learning tools used so far. Especially for student worksheets (LKPD). The results of the LKPD identification used by students are in the form of questions that have not yet developed critical thinking skills. This can be seen from the indicators developed from basic competencies which are at the level of remembering, knowing, and understanding. Students focus on answering questions on LKPD so that students are relatively passive and students' critical thinking skills have not been empowered. Students are not trained to use interpretation, analysis, evaluation, inference, explanation, or self-regulation skills.

Based on this, a LKPD is needed that supports the implementation of the 2013 Curriculum and trains students in using their critical thinking skills.The results of the initial analysis show that the problems encountered in the learning process make students not active in class and have low critical thinking skills. These problems can be solved by using LKPD based on critical thinking skills. LKPD has the characteristic of being able to activate students, because it contains indicators of critical thinking focus, reason, inference, situation, clarity, and review, which can help students develop critical thinking skills and improve their learning outcomes.

Student analysis

This step is carried out to determine the characteristics of students through observation of academic ability. Based on the results of the interviews conducted, some information was obtained about the characteristics of the students.

The learning process of student participation tends to be passive so that student learning activities in learning activities are low. Learning activities do not support students to express the results of their thoughts. In addition, students are not used to answering questions and giving reasons so that students' critical thinking skills do not develop properly because students are only able to remember and explain in simple terms what they have learned during learning. Students still find it difficult to reach the next level such as the ability to analyze, synthesize, and create.

The initial analysis conducted on students showed different interests and abilities in learning biology. It was seen that a few students paid close attention to each material delivered by the teacher. The activeness of students in the learning process is low. Students' critical thinking skills are low. This can be seen from the ability to carry out the process of analysis, explanation, evaluation, interpretation, inference and low self-regulation. Participants are very dependent on the teacher's instructions continuously. The independence of students is very lacking. Critical thinking skills can be trained through the development of indicators on basic competencies that have been defined in the curriculum. This indicator was developed by integrating critical thinking skills so that students have these skills. Activities designed in LKPD can measure the achievement of learning indicators. Critical thinking skills can be owned by students if taught.

Concept analysis

Concept analysis is important to fulfill the principle of adequacy in building material concepts that are used as a means of achieving basic competencies and core competencies. This curriculum analysis serves to determine the basic competencies to be developed and the learning model to be used. The basic competencies used in this study are:

3.10 Analyzing data on environmental changes and the impact of these changes on life

4.10 Solving environmental problems by designing waste recycling products and environmental preservation efforts

This basic competence was chosen because environmental change material has characteristics that are able to make students analyze directly in observing the phenomena of changes that occur in the surrounding environment and find solutions to the problems they observe so that they can develop their critical thinking skills.

This concept or material analysis is used to map the main parts of the material used in each meeting with the time allocation that has been determined in the curriculum. The activities carried out at this stage are identifying, detailing, finding solutions and systematically compiling the main concepts to be studied related to the material to be delivered to students referring to the 2013 Curriculum.

Task analysis

Task analysis is carried out to identify the knowledge possessed by students to design tasks that must be completed by students during learning activities based on concept (material) analysis. This analysis begins with knowing the types of assignments that have been done by students. The results obtained were that students were given assignments by educators to work on the questions listed in the handbook in the form of essay questions. The students' answers to the questions given looked almost the same. Students lack confidence in solving problems in assignments. Students need to be trained to work on essay questions whose answers are not just copying from textbooks, but the results of their own thinking. Questions that have been designed in student worksheets facilitate domination of student activities. According to Suciati, et al (2022), discussing the questions given and communicating the results of these discussions will indirectly train the skills of answering and asking questions so as to develop students' critical thinking processes.

Determining what types of questions will be given to students next, namely designing questions with reference to indicators that have been prepared beforehand, so that after students work on assignments, the learning objectives in this material can be achieved properly. LKPD contains tasks based on critical thinking skills which consist of several indicators namely Focus, Reason, Inference, Situation, Clarity, and Overview. This task aims to develop students' knowledge so that learning objectives can be achieved. According to Hasbullah (2016), LKPD encourages and inspires students to think critically, analytically, and precisely in identifying, understanding, solving problems, and applying substance or learning material.

Formulation of Learning Objectives

The formulation of learning objectives is based on basic competencies (KD) in the 2013 Curriculum. After the basic competencies are determined, the next activity is to formulate indicators and subject matter that will be outlined in LKPD. Furthermore, these indicators are combined with aspects of critical thinking skills. Where these aspects are described in learning activities.

Formulation of learning objectives on environmental change material and waste recycling.

3.10.1 Students can explain the concept of environmental change
3.10.2 Students can interpret environmental changes that are classified as environmental pollution
3.10.3 Students can analyze the causes of environmental pollution
3.10.4 Students can evaluate forms of environmental preservation
3.10.5 Students can review conservation efforts that can be carried out
3.10.6 Students can sort the types of waste
3.10.7 Students can determine the type of waste recycling
3.10.7 Students can conclude the benefits of recycling waste

Description of the Results of the Design Phase

Media Selection

This stage is carried out to identify learning media that are in accordance with the characteristics of the material and at the time of implementing the LKPD. The selection of media is based on concept analysis, task analysis, student characteristics and facilities available in the school environment.

Format Selection

This stage is the determination of the LKPD design based on the critical thinking skills that will be developed. Includes paper size and organization, namely covers, table of contents, instructions for using LKPD, KD and learning objectives, materials, stages of critical thinking skills, evaluation questions and bibliography. While the LKPD development steps include writing, adapting, editing, and reviewing. This step is carried out by collecting written materials related to environmental change and recycled materials, namely concepts, designs, and illustrative images.

The components contained in the LKPD are presented in the following form:

Paper size: A4, portrait
Organizing:
1.) Cover
2.) List of contents
3.) Instructions for using LKPD
4.) KD and learning objectives; The intent here relates to the learning activities contained in the LKPD
5.) Teaching materials;
6.) Observe; The results of this observation will be used as a reference for students to formulate problems.
7.) Give reasons for the problem; This stage is placed after formulating the problem and providing conclusions
8.) Draw a conclusion; This stage writes down the conclusions they can draw after formulating the problem and contains reasons
9.) Use all the information appropriate to the problem
10.) Thoroughly researching or re-examining from start to finish
11.) evaluation questions; Evaluation questions are presented in accordance with the learning objectives to be achieved.
12.) Reference; contains references used in compiling LKPD both material and images used.

a. Initial Design

The initial design was carried out after analyzing the learning activities carried out by educators, student activities, selected materials to assist students in developing critical thinking skills and the availability of learning tools in the form of lesson plans and worksheets. The next activity is to determine the LKPD format, educator response questionnaires, student response questionnaires. After the format is compiled, it is followed by the validation stage to see the format of the LKPD draft and response questionnaire.

Description of the Results of the Development Stage (Develop)

The development stage is carried out after the LKPD format and response questionnaire are in accordance with the design by looking at the suitability of the desired variables, including critical thinking skills, and adjustments to the learning model. This stage aims to produce revised LKPD so that it is suitable for use in research subjects. Apart from LKPD, the tools and instruments used during the research were also validated and the formula used to determine overall validity was the Gregory formula. The stages in this development are as follows:

Expert Rating

A learning tool can be said to be feasible or not usable, through validation. This validation process is carried out by experts who are competent in their fields. Expert validated tools include; (1) Learning Implementation Plans (RPP), (2) Student Worksheets (LKPD), (3) educator response questionnaires, (4) student response questionnaires. Apart from that, the validator usually also provides notes in the form of parts that need to be revised.

The results of the expert validation of learning tools are described as follows:

1) RPP

The Learning Implementation Plan (RPP) used in the limited trial stage is validated in advance with the aim that the time for the implementation of learning is in accordance with the time set by the LKPD. In addition, so that the learning activities or steps are in accordance with the syntax of the learning model used and the implementation of the trial does not become confusing because previously there was an overview of how to use the developed LKPD in the learning process. Validation assessment includes purpose, language, and content. The results of the recategorization of two RPP experts are shown in the following Table 5, 6, and 7.

The parts of the RPP that underwent revision can be seen in Table 8.

The results of expert validation after referring to the criteria for determining validity are obtained in Table 9.

The results of expert validation after referring to the criteria for determining validity obtained the result that the average total validation was 1, the validation results were categorized as valid because they were at a value of. The level of validity is measured from the results of the analysis according to predetermined criteria. As explained by Fitria et al, (2017) that a learning device is said to be valid if the results match predetermined criteria.

The general assessment of the lesson plan for each validator, namely the assessment of the first and second validators, states that the lesson plan can be used with minor revisions. These suggestions become input for researchers to make revisions. Referring to this, RPP is suitable for use in limited trials. This means that this learning tool has been able to describe the facts, concepts, and principles contained in the Core Competencies (KI) and Basic Competencies (KD). According to Mustami (2017) a good lesson plan is one that is systematic and able to describe KI and KD into each stage/ content of the lesson plan.

Student Worksheets (LKPD)

At this stage, the developed LKPD is given to the expert validator along with its assessment tools which consist of several components including: format, content, language, and benefits/uses of LKPD. The results of the recategorization of the two LKPD experts are obtained in Table 10, 11, 12, 13, 14 and 15.

The results of expert validation after referring to the criteria for determining validity are obtained in Table 15.

The results of expert validation after referring to the criteria for determining validity obtained the result that the average

Table 5: Two Expert Re-category Contingencies on the Objectives of the RPP

		Rater 1	
		Weak	*Strong*
Rater 2	Weak	0	0
	Strong	0	5

Table 6. Two Expert Contingency Re-categorize the material presented in the lesson plan

		Rater 1	
		Weak	*Strong*
Rater 2	Weak	0	0
	Strong	0	6

Table 7. Contingency Category for Repetition of Two Experts in RPP Learning Resources

		Rater 1	
		Weak	*Strong*
Rater 2	Weak	0	0
	Strong	0	6

Table 8. Contingencies of Two Experts Repetition Categories in RPP Learning Models and Activities

		Rater 1	
		Weak	*Strong*
Rater 2	Weak	0	0
	Strong	0	6

Table 9: Revised RPP

No	*Pre-Revised RPP*	*RPP After Revised*
1	Provide a brief explanation of the contents of the material referred to in the section according to the references to learning resources in the syllabus	There is a brief explanation of the contents of the material in accordance with the references to learning resources
2	The learning activity column must clearly contain the activities of students and educators	There is a column for student and educator learning activities
3	Using the term educator to characterize the use of the 2013 Curriculum	The term educator is used in learning activities
4	The time allocation prepared in each main activity can be clearly broken down in each activity item	Time allocation for each activity is clearer and more detailed

total validation was 1, the validation results were categorized as valid because they were at a value of ≥ 0.75. This is in accordance with what was stated by Fatmawati (2016) which shows that learning tools such as LKPD are classified as valid categories with a percentage of ≥70% based on established criteria. The general assessment of the LKPD for each validator, namely the assessment of the first and second validators, stated that the LKPD could be used with minor revisions. Referring to this, LKPD can be tested.

Based on the LKPD validation data from two expert validators, this product validation assessment includes four aspects or components, namely the format aspect, the content aspect, the language aspect, and the benefit/usefulness aspect of the LKPD. This is in accordance with the provisions of the National Education Standards Agency (BNSP) (2014), that LKPD must meet the criteria for material or content, presentation, and language. In this regard, the developed LKPD is able to be a guide for students in improving critical thinking skills in biology subjects, Basic Competencies in environmental change and recycling systems.

Table 10. Expert validation after referring to the criteria for determining validity

No	*Assessment aspect*	*CV*	*Notes:*
1	Format	1	Legitimate
2	Fill	1	Legitimate
3	Language	1	Legitimate
4	Benefits/Use of LKPD	1	Legitimate
	Average amount	1	Legitimate

Table 11. Contingencies of Recategorizing Two Experts in LKPD Format

		Rater 1	
		Weak	*Strong*
Rater 2	Weak	0	0
	Strong	0	6

Table 12. Contingency Recategorization of Two LKPD Content Experts

		Rater 1	
		Weak	*Strong*
Rater 2	Weak	0	0
	Strong	0	6

The advantages of LKPD based on critical thinking skills include;

a) In accordance with the demands of the 2013 Curriculum,
b) The contents of LKPD can train students to be involved in discovering concepts through the scientific method, and
c) The use of LKPD can develop students' critical thinking skills.

LKPD based on critical thinking skills developed in this study is shown in Figure 1.


LKPD1

Materi : Pencemaran Lingkungan

Lingkungan hidup merupakan kesatuan ruang dengan semua benda, daya keadaan, dan makhluk hidup, termasuk di dalamnya manusia dan perilakunya. Komponen lingkungan terdiri dari faktor abiotik (tanah, air, udara, cuaca, suhu) dan faktor biotik (tumbuhan dan hewan, termasuk manusia). Lingkungan hidup baik faktor biotik maupun abiotik berpengaruh dan dipengaruhi manusia.

Kondisi alami lingkungan dengan segala keragaman interaksi yang ada mampu untuk menyeimbangkan keadaannya namun tidak tertutup kemungkinan kondisi demikian dapat berubah oleh campur tangan manusia dan bencana alam. Campur tangan manusia yang mampu mengubah lingkungan berhubungan dengan adanya kegiatan pemanfaatan sumber daya alam yang mana apabila tidak memperhatikan tatanan lingkungan maupun melaksanakan pengelolaan lingkungan maka akan mengakibatkan perubahan lingkungan seperti kerusakan hutan atau pencemaran lingkungan. Oleh karena itu, selain memanfaatkan sumber daya alam dari lingkungan, manusia harus tetap melestarikan lingkungan melalui pengelolaan lingkungan yang baik dan benar. Berikut adalah gambar tentang pencemaran lingkungan

Gambar.1. Pencemaran Lingkungan. (Sumber : ilmulingkungan.com)

Apa yang kalian pikirkan mengenai Gambar.1. ? Gambar tersebut merupakan gambar pencemaran lingkungan atau perubahan lingkungan ke arah yang kurang baik. Menurut

LKPD Berbasis Keterampilan Berpikir Kritis| 1

Fig. 1: LKPD Material Based on Critical Thinking Skills

Table 13. Contingency Category for Repetition of Two Experts in Language LKPD

		Rater 1	
		Weak	*Strong*
Rater 2	Weak	0	0
	Strong	0	2

Table 14. Two Expert Recategory Contingencies regarding the Benefits of LKPD

		Rater 1	
		Weak	*Strong*
Rater 2	Weak	0	0
	Strong	0	2

Complete Data: Appendix A2. page 77

Table 15. Summary of Revised LKPD Records

No	*LKPD Before Revision*	*LKPD After Revision*
1	There is no description of indicators of critical thinking skills	Added a description of the indicators for critical thinking skills
2	The color of the picture is very striking	Image colors are toned down
3	The font size is too large	The font size is reduced

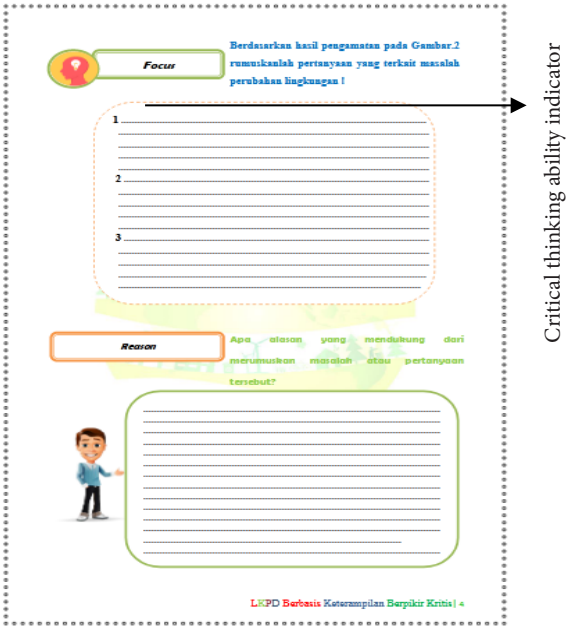

Fig. 2: Indicators of Critical Thinking Skills

LKPD at the focus stage is an indicator of critical thinking skills. This stage shows students understandi problems that exist in the readings that have been observed and analyze it. The final design of LKPD is based on critical thinking skills which have been validated by expert validators which are then used by students in the research process to be used to develop critical thinking skills and for educators to be used as learning tools.

3) Educator Response Questionnaire

The teacher's response questionnaire instrument aims to assess the effectiveness of the LKPD that has been made. This instrument was validated by 2 experts.Validation assessment includes construction and language. The results of recategorization by two experts are shown in Tables 16 and 17.

The results of the expert validation after referring to the criteria for determining the validity obtained the result that the average total validation was 1 and the validation results were categorized as valid because they were at a value of ≥ 0.75. Referring to this, the educator's response questionnaire is feasible to use.

4) Student Response Questionnaire

The student response questionnaire instrument aims to assess the effectiveness of the LKPD that has been made. This instrument was validated by 2 experts.Validation assessment includes construction and language. The results of the contingency category by two experts are obtained in Table 19 and 20.

The results of expert validation after referring to the criteria for determining validity are obtained in Table 21.

Table 19: Re-Category of Two Construction Experts Student Responses

		Rater 1	
		Weak	*Strong*
Rater 2	Weak	0	0
	Strong	0	4

Table 20: Re-Category of Two Language Experts Student Responses

		Rater 1	
		Weak	*Strong*
Rater 2	Weak	0	0
	Strong	0	3

Table 21: Expert validation after referring to the criteria for determining validity

No	*Assessment aspect*	*CV*	*Notes:*
1	Construction	1	Legitimate
2	Language	1	Legitimate
	Average amount	1	Legitimate

The results of expert validation after referring to the criteria for determining validity obtained the result that the average total validation was 1, the validation results were categorized as valid because they were at a value of ≥ 0.75. The full validation analysis results can be seen in Appendix A4. Referring to this, the student response questionnaire is feasible to use.

a. Development Experiment

1) Results of Educator Response Analysis

Analysis of educator responses aims to determine the effectiveness of the LKPD that has been made based on the views of the Biology subject teacher at SMA Negeri 1 Parepare. This instrument was validated by 2 experts. Details of the results of the analysis of educator responses after using LKPD based on critical thinking process skills can be seen in Table 22.

The results of the analysis show that the average response of 2 educators, in this case two Biology teachers at SMA Negeri 1 Parepare, is in the very practical category with a score of 96%.

2) Results of Student Responses

Student response analysis aims to determine the effectiveness of the LKPD that has been made based on the views of 36 class

Table 22: Results of Educators' Responses to LKPD

No	*Percentage of Educators' Responses to LKPD*	*Number of Educators*	*Interpretation*
1	81.00 - 100 < 20	2	Very practical
2	61.00-80.00	0	Practical
3	41.00 – 60.00	0	Practical enough
4	21.00-40.00	0	Less practical
5	<20	0	Not practical

Table 23: Results of Student Responses to LKPD

No	*Percentage of Student Responses to LKPD*	*Amount Learners*	*Interpretation*
1	81.00 – 100	25	Very practical
2	61.00 - 80.00	11	Practical
3	41.00 – 60.00	0	Practical enough
4	21.00-40.00	0	Less practical
5	<20	0	Not practical

X students. This instrument was validated by 2 experts. Details of the results of the analysis of student responses after using LKPD based on critical thinking skills can be seen in Table 23.

The results of the analysis show that the average student response in this case is 36 students of class X MIPA SMA Negeri 1 Parepare, 11 people with a percentage of 61.00-80.00 with a practical interpretation and 25 people with a percentage of 81.00-10.00 with a very practical interpretation.

Practicality based on developed critical thinking skills is measured through a questionnaire on the responses of educators and students. This questionnaire is used to find out how educators and students respond to the learning tools developed. This questionnaire was given to respondents after the series by using LKPD based on critical thinking skills. This questionnaire consists of 10 items with five different value categories. Respondents to the questionnaire were 2 educators and 36 students responded to the questionnaire. According to Mustami (2015) Learning devices are said to meet practicality criteria if 50% of students give positive responses to several aspects listed on the student response questionnaire sheet.

Based on the teacher's response analysis, an average percentage of data was obtained by 96%, while the student response analysis obtained an average percentage of data by 85.11% with a very practical interpretation. This is in accordance with what was stated by Santi & Santosa (2016) that the implementation of learning can be said to be practical if it is in very good criteria or the percentage exceeds 80%. According to Fitria et al, (2017) an assessment of an LKPD is said to be practical if it meets two criteria, namely the tools developed can be determined according to expert judgment, and the tools developed can be applied in practice in the field.

The entire data obtained shows that the results of the limited trial worksheets based on critical thinking skills meet valid and practical criteria. Therefore, the revised LKPD after trials based on data analysis of all aspects and criteria, obtained LKPD based on critical thinking skills on the basic competencies of environmental change and waste recycling that are valid and practical.

Conclusion

Based on the results of research and discussion, it can be concluded as follows:

1. The validity of the LKPD based on critical thinking skills on the basic competencies of environmental change and waste recycling has been validated and the LKPD product validation rating is 1 with a valid interpretation.
2. The practicality of the LKPD based on critical thinking skills on the basic competencies of environmental change and waste recycling that was developed is in the very practical category with a score of 96% from the results of the analysis of the teacher's response questionnaire and a score of 85.11% from the student response questionnaire with a very practical interpretation.

Recommendation

The study recommends that educators should provide factual learning design to stimulate students' thinking skills in each class. For teachers, the development of higherorder thinking skills-based worksheets can become the model in designing learning activities according to the complexity level of the material.

References

Anggraini, R., Wahyuni, S., & Lesmono, A. (2016). Pengembangan Lembar Kerja Siswa (LKS) berbasis keterampilan proses di SMAN 4 Jember. *Jurnal Pembelajaran Fisika*, 4(4), 350-365.

Anggraini, W., Anwar, Y., & Madang, K. (2017). Pengembangan Lembar Kerja Peserta Didik (LKPD) berbasis learning cycle 7e materi sistem sirkulasi pada manusia untuk Kelas XI SMA. *Jurnal Pembelajaran Biologi: Kajian Biologi dan Pembelajarannya*, 3(1), 49–57.

Arafah, S.F., Bambang., Saiful, R. (2012). Pengembangan LKS berbasis berpikir kritis pada materi animalia. *Unnes Journal of Biology Education,* 1(1), 75-81. ISSN: 2252-6579

BSNP. (2014). *Permendikbud Nomor 59 Tahun 2014 tentang standar proses pendidikan dasar dan menengah*. Kemendikbud. Jakarta.

Fatmawati, A. (2016). pengembangan perangkat pembelajaran konsep pencemaran lingkungan menggunakan model pembelajaran masalah berdasarkan untuk SMA Kelas X. 4(2). DOI: 10.23971/eds.v4i2.512.

Fitria, A.D., Mustami, M.K., & Taufiq, A.U. (2017). Pengembangan media gambar berbasis potensi lokal pada pembelajaran materi keanekaragaman. *Auladuna Jurnal Pendidikan Dasar Islam*, 4(2), 14–28.

Fong, A. C. J., Kim, Y., Davis, C. W., Hoang, T., Kim, Y. W., & Kim, Y.W. (2017). A Meta-analysis on critical thinking and community college student achievement. *Thinking Skills and Creativity*, *26*, 71–83. https://doi.org/10.1016/j.tsc.2017.06.002.

Hasbullah, H. (2016). Pengembangan Lembar Kerja Siswa berorientasi keterampilan proses dalam pembelajaran saintifik terhadap hasil belajar siswa pada pokok bahasan sistem pencernaan manusia. *Bioedukasi*. *Jurnal Pendidikan Biologi*, 7(2), 121–128.

Hidayah, R., Salimi, M., & Susiani, T.S. (2017). Keterampilan berpikir kritis: konsep dan indikator penilaian. *Jurnal Taman Cendekia*, 1(2), 842.

Kahar, M.S., Syahputra, R., Arsyad, R.B., Nursetiawan, N., Mujiarto, M., (2021). Design of student worksheets oriented to hihger

order thinking skills (HOTS) in physics learning. *Eurasian Journal of Educational Research*, 96, 14-29. *www.ejer.com.tr*, DOI: 10.14689/ejer.2021.96.2

Karim, K., & Normaya, N. (2015). Kemampuan berpikir kritis siswa dalam pembelajaran matematika dengan menggunakan model jucama di sekolah menengah pertama. Edumat: *Jurnal Pendidikan Matematika*, 3(1).

Khoiri, A., Kusumawati, I., Kahar, M.S., & Mursidi, A. (2019). Analysis of three Representation in Problem Solving on Additional Relativistic Velocities, 67-68.

Mustami, M.K, & Irwansyah, M. (2015). Pengembangan Lembar Kerja Peserta Didik (LKPD) berorientasi pendekatan saintifik pada mata pelajaran biologi. Lentera Pendidikan Jurnal Tarbiyah dan Keguruan. Vol. 18, No 2. DOI: https://doi.org/10.24252/ lp.2015v18n2a8

Mustami, M.K. (2017). Validitas, kepraktisan, dan efektivitas perangkat pembelajaran biologi integrasi spiritual islam melalui pendekatan saintifik. *Al-Qalam*. Vol. 23, Edisi 1, hal. 70).

Pangesti, F. (2012). P*engembangan bahan ajar pendidikan berpikir (kritis dan kreatif) berbahasa Indonesia SMA melalui pembelajaran lintas mata pelajaran*. Skripsi. Universitas Negeri Malang. http://journal.um.ac.id.

Pratama, G.S., & Retnawati, H. (2018). Urgency of Higher Order Thinking Skills (HOTS) content analysis in mathematics textbook, 35-56. *Journal of Physics: Conference Series,* Vol 1097. The 5th International Conference on Research, Implementation, & Education of Mathematics and Sciences 7–8 May 2018, Yogyakarta, Indonesia. Published under licence by IOP Publishing Ltd. **DOI** 10.1088/1742-6596/1097/1/012147.

Purnamawati, D., Ertikanto, C., & Suyatna, A. (2017). Keefektifan Lembar Kerja Siswa berbasis inkuiri untuk menumbuhkan keterampilan berpikir tingkat tinggi. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni, 6*(2), 209-219. doi:https://doi.org/10.24042/jipfalbiruni.v6i2.2070.

Rahayuningsih, D.I. (2018). Pengembangan Lembar Kerja Peserta Didik (LKPD) dengan Pendekatan Saintifik untuk Meningkatkan Hasil Belajar Mata Pelajaran IPS Bagi Siswa Kelas IV Sekolah Dasar. Review Jurnal Pendidikan Dasar: *Jurnal Kajian Pendidikan dan Hasil Penelitian*, 4(2), 726.

Riduwan & Sunarto. (2013). *Pengantar Statistika untuk Penelitian Pendidikan, Sosial, Ekonomi, Komunikasi, dan Bisnis*. Bandung: Alfabeta.

Santi, I.K.L., & Santosa, R.H. (2016). Pengembangan perangkat pembelajaran menggunakan pendekatan saintifik pada materi pokok geometri ruang SMP. *Jurnal Pendidikan Matematika*, 11(1), 35.

Setiawati, H., Corebima, AD (2017). Empowering critical thinking skills of the student having different academic ability in biology learning of senior high school through PQ4R-TPS Strategy. *The International Journal of Social Sciences and Humanities Invention (*theijsshi), Vol.4, No.5., 3521-3526. https://valleyinternational.net/ index.php/theijsshi/article/view/796. https://doi.org/10.18535/ijsshi/v4i5.09

Setiawati, H. & Corebima, A.D. (2019). Integration of the PQ4R-TPS strategy in biology learning to retention of indonesian students. *Jour of Adv Research in Dynamical & Control Systems*, 11 (Issue-07), 236-244.

Shim, W., & Walczak, K. (2012). The Impact of Faculty Teaching Practices on the Development of Students' Critical Thinking Skills. *International Journal of Teaching and Learning in Higher Education*, 24(1), 16–30.

Suciati, R., Gofur, A., Susilo, H., Lestari, U. (2022). Development of textbook integrated of metacognition, critical thinking, islamic values, and character. *Pegem Journal of Education and Instruction*, Vol. 12, No. 4, (pp. 20-28). DOI: 10.47750/pegegog.12.04.03.

Suryawati, E., Syafii, W., Aulia, A. (2012). Pengembangan pembelajaran kontekstual rangka berbasis pendidikan karakter untuk meningkatkan sikap ilmiah dan keterampilan berpikir kritis siswa sma dalam pembelajaran biologi. https://repository.unri.ac.id> jspui>bitstream.

Ulaş, A. H., Sevim, O., & Tan, E. (2012). The effect of worksheets based upon 5e learning cycle model on student success in teaching of adjectives as grammatical components. *Procedia-Social and Behavioral Sciences, 31*, 391-398. doi:https://doi.org/10.1016/j.sbspro.2011.12.072.