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DEVELOPMENT OF INQUIRY-BASED LKPD TO IMPROVE CRITICAL THINKING AND PROBLEM SOLVING SKILLS OF CLASS IX STUDENTS AT JUNIOR HIGH SCHOOL

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Abstract

This research aims to develop an inquiry-based Student Worksheet (LKPD) on crossover material in class IX of SMP Negeri 1 Bungku, using the Research and Development (R&D) model with a 4-D model consisting of the Define, Design, Develop and Disseminate stages. The research population was all class IX students with a purposive sample of 30 students from class IXA. Research instruments include validation sheets, observation sheets, student response questionnaires, as well as pretests and posttests. Validation by experts shows that the LKPD meets the valid criteria with an average score of 3.7. Readability tests and trials in class IXA show that the teacher's ability to manage learning and student activities meets the minimum criteria of good. Student responses to inquiry-based LKPD were very positive with a percentage of ≥ 80%. Data analysis using effect size shows a value of 0.95, indicating a large effect of using LKPD on improving students' critical thinking and problem solving skills. Based on research results, inquiry-based LKPD is proven to be valid, practical and effective in improving students' critical thinking and problem-solving skills.

Keywords: Inquiry-based LKPD, critical thinking skills, problem solving abilities, 4-D model

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Introduction

The scientific method in science research has the ability to identify problems, design and carry out experiments, and produce new knowledge that can support technological development (Okpatrioka, 2023). In learning that emphasizes process, the teacher's role is as a guide and director, while the students themselves drive the process (Lusidawaty et al., 2020). Every biological concept is related to problems faced by living creatures. In this way, it is hoped that students can innovate well using biological concepts in 21st century civilization. One form of appropriate support is learning using inquiry-based guidance methods (Marleni, 2016).

Inquiry-based Student Worksheets (LKPD) can help students gain knowledge and skills not only from remembering facts and events, but also from discovering science concepts for themselves so that their critical thinking abilities and learning outcomes improve (Firdaus & Wilujeng, 2018). This research aims to test students' problem solving skills during the learning process using guided inquiry-based LKPD (Azzahra et al., 2023). The teaching materials used in biology learning on genetics are worksheets based on the guided inquiry model, which supports every experiment carried out by students. The learning process becomes more focused by using guided inquiry as the basis for preparing worksheets. Guided inquiry supports each student's understanding process in using concepts during the experiment. The use of LKPD in learning is nothing new, but the LKPD that is usually used only contains routine practice questions which are less effective because they are monotonous and do not train thinking processes and improve students' problem solving abilities. Therefore, this research aims to obtain scientific evidence regarding increasing students' mathematical problem solving abilities by developing worksheet worksheets that are specifically designed with certain learning models (Septiani et al., 2022).

The guided inquiry learning model is an approach that encourages students to develop critical thinking skills and problem solving abilities through the investigation process. The inquiry learning model is a series of activities that emphasize student activity in discovering material concepts based on the problems posed (Suhada, 2017). The main benefit of inquiry model learning is that it increases student involvement in the learning process, encouraging them to ask questions, identify problems, and look for solutions. This active involvement can increase students' motivation and make them feel responsible for their own learning (Khadijah, 2018). Apart from that, inquiry model learning also trains students in critical thinking skills and problem solving

abilities (Hambali & Handayani, 2018). The main aim of the inquiry model is to expand intellectual skills, think responsively, and be able to solve scientific problems (Hambali & Handayani, 2018). The guided inquiry model facilitates students' learning process to find and understand the right concepts in analyzing problems (Marleni, 2016).

Students often face difficulties in developing their abilities, especially in critical thinking skills and problem solving abilities. Through learning, they are invited to analyze information, evaluate evidence, make inferences, and conclude their own findings, which can also improve problem-solving abilities because students are given the opportunity to face real problems and challenges. One effective learning model for improving students' critical thinking skills is the guided inquiry learning model. This model involves several stages, namely orientation, formulating problems, creating hypotheses, collecting data, analyzing data or testing hypotheses, and drawing conclusions (Sugiarti & Dwikoranto, 2021).

In improving problem solving abilities, students often experience difficulties in understanding certain knowledge, especially because the new knowledge received is not related to previous knowledge (Fajarianingtyas & Hidayat, 2019). Based on the importance of problem solving abilities, it needs to be measured to determine the level of students' understanding. This ability is usually emphasized in the teaching and learning process. Therefore, teaching materials are needed that are appropriate to heterogeneous environmental conditions in the learning process. One of the appropriate models to support these teaching materials is guided inquiry. The guided inquiry model facilitates the process of student learning activities to find and understand the right concepts in analyzing a problem. Teachers must be able to choose learning strategies that activate students physically and mentally and increase their understanding in solving problems. The learning strategy that can be used is the inquiry learning strategy (Marleni, 2016).

Critical thinking is the ability to think logically, reflectively, systematically and productively which is applied in making judgments and making good decisions. Someone is said to be able to think critically if they can think logically, reflectively, systematically and productively in making decisions and considerations (Arifin, 2022). According to Anggareni et al. (2013) aspects of critical thinking include interpretation, inference, evaluation, analysis, explanation, and self-regulation. One alternative for training critical thinking skills is through an inquiry learning model which consists of six learning steps: problem orientation, formulating problems, formulating hypotheses, conducting experiments, analyzing data, and making conclusions.

The results of observations at the junior high school where the research took place in science subjects showed that student achievement in several aspects of learning was below the expectations or standards set, namely below the KKM score of 75. Based on the description above, I am interested in conducting research with the title "Development of LKPD Inquiry Based to Improve Critical Thinking and Problem Solving Skills of Class IX Students at SMP Negeri 1 Bungku".

Based on previous research, it has not involved how LKPD and learning models can improve students' critical thinking and problem solving skills. It is important to carry out research that examines this. Therefore, an in-depth study is needed regarding the development of inquiry-based LKPD to improve the critical thinking and problem solving skills of class IX students at SMP Negeri 1 Bungku.

Methods

This research uses the Research and Development (R&D) method with a 4D model developed by Thiagarajan et al. (1974), consists of four stages: Define, Design, Develop, and Disseminate. This research is the development of a learning instrument, namely an inquiry-based LKPD on hybrid material in class IX of SMP Negeri 1 Bungku, which will be carried out from January until completion with material on fully dominant monohybrid, incomplete dominant and dihybrid, where there will be 3 meetings.

The research population was all students in class IX of SMP Negeri 1 Bungku, totaling 150 students, with a sample taken by purposive sampling of 30 students from class IXA, consisting of 16 boys and 14 girls, with an average age of 13,5 years.

The research procedure follows the four stages of the 4-D model: Define (determining and defining learning requirements), Design (designing the initial inquiry-based LKPD product), Develop (validating and testing), and Disseminate (implementing the LKPD to measure its effectiveness). Data collection techniques include validation by three experts using validation sheets, observation of teacher abilities and student activities, questionnaires for student responses, as well as pretest and posttest with essay questions to measure the effectiveness of the LKPD.

Data analysis techniques include validation analysis of LKPD (LKPD is said to be valid if each aspect gets a score of 3 or 4 from the validator), analysis of teacher and student observations (teacher abilities and student activities are assessed as at least good if each aspect gets a

score of 3 or 4), questionnaire response analysis students (positive response if the percentage value is ≥ 80%), and test analysis (measuring the increase in students' ability to use *effect Size*). *Effect Size* to see whether LKPD has a big effect on students' critical thinking abilities. *Effect size* calculated using the formula Cohen's (2007) as follows:

$$S_{of} = \sqrt{\frac{Spre^2 + Spost^2}{2}} \qquad (1)$$

Effect Size d can be calculated as:

$$d = \frac{\bar{d}}{S_{of}} \qquad (2)$$

Information:

S_{of} = Standard deviation of test scores

$\bar{d}$ = Average test score ($M_{Posttest}$ - $M_{Pretest}$)

S_{pre} = Pretest standard deviation

S_{post} = Posttest standard deviation

Spears et al. (2013) states that standard deviation is best for paired designs and also as an option *standardizer* the best is S_{of}.

Research instruments include validation sheets to assess LKPD, teacher observation sheets to assess teachers' abilities in managing learning, student activity observation sheets to observe student activities during learning, student response questionnaires to measure student responses to LKPD and learning, and assessment sheets in the form of test questions for measure students' abilities before and after learning.

Results and Discussion

The LKPD created is validated by expert validators. The purpose of this validation is to measure and evaluate the level of validity of the product being developed. The validation instrument uses a scale *Likert.* The results of the LKPD validation analysis can be seen in Table 1.

Table 1. Student worksheet validation results (LKPD)

No	Assessment Aspects	validator	
		1	2
1	Head	3,4	3,8
2	Format	3,2	3,7
3	Language	3,8	3,8
4	Score	10,4	11,3
5	Rate-rate	3,5	3,8
	Shoes total 2 validator	3,8	

Based on Table 1 and referring to the criteria set out in Chapter III, it can be concluded that the results of the validator's assessment of the LKPD show valid criteria. This shows that the inquiry-based LKPD is effective and suitable for use to help students develop critical thinking skills because it guides students through the stages. -stages such as formulating problems, collecting data, analyzing data and drawing conclusions. Based on the results of the effect size, students' critical thinking skills show an effect size value of 0.95, which indicates a very large effect from the use of LKPD on student learning outcomes, indicating that the use of inquiry-based LKPD is effective in improving students' critical thinking skills.

Inquiry-based LKPD development using the 4-D model

The learning tool developed in this research is an inquiry-based Student Worksheet (LKPD). The development of this learning tool uses a 4-D development model, which consists of four stages, namely defining, designing, developing and disseminating. The description for each stage is explained as follows:

Definition Stage (Define)

a. Start-Finish Analysis

At this stage, researchers made observations at SMPN 1 Bungku. The results of the observations are as follows:

The curriculum used in class IX of SMPN 1 Bungku is the 2013 Curriculum. This curriculum requires a learning process that is more active for students, but in its implementation it is still dominated by teachers. In other words, learning is still teacher-centered and students are not given the opportunity to construct their own knowledge.

Teachers rarely provide LKPD in learning activities. The assignments prepared by the teacher are taken from the textbook. When teaching crossover material, teachers usually use the lecture method. For the sub-material of fully dominant and not fully dominant monohybrid crosses, the teacher only explains to the students in a simple way without paying attention to the extent of the students' understanding of the material.

To overcome the problems above and be in line with the demands of the 2013 Curriculum used in the school, a learning model is needed that is more active for students. Apart from that, learning theories such as Piaget's and Vygotsky's learning theories also support this. Based on the observations above, appropriate learning alternatives are needed. One model of student-centered learning is the guided inquiry learning model. Because the learning tools used in schools are not adequate, it is necessary to develop an appropriate LKPD. Therefore, in this research an inquiry-based LKPD was developed.

b. Student Analysis

The students who are the subjects of this research are class IX students of SMP Negeri 1 Bungku for the 2023/2024 academic year. Student analysis includes students' academic abilities, information obtained by reviewing student data documents and interviews with teachers. The results of this analysis show that the characteristics of students' academic abilities in the five

classes are almost the same, namely that there are students with high, medium and low abilities. The results of this student analysis become a reference in choosing one type of inquiry learning, namely the guided inquiry model which will be used in inquiry-based Learning Implementation Plans (RPP) and LKPD, as well as selecting trial classes and implementation classes.

c. Concept Analysis

Concept analysis aims to identify and systematically organize the main concepts in the inheritance material that students will study as well as detailing the relevant prerequisite material. Concept analysis begins by reviewing the basic competencies for crossover material in the 2013 Curriculum.

Planning Level (Design)

a. Preparation of Tests

At this stage, the researcher prepared a pretest and posttest based on the results of the formulation of learning objectives for cross material with full dominant monohybrid, intermediate and dihybrid cross sub-material. The questions used for the pretest and posttest are the same.

b. Media Selection

The media used in implementing learning to present cross-sectional material with the guided inquiry model is inquiry-based LKPD.

c. Format Selection

The Learning Implementation Plan (RPP) format used is adapted to the process standards in the 2013 Curriculum. Learning activities in the LKPD refer to the guided inquiry model.

d. Early Planning

At this stage an initial design of learning tools is produced. The resulting learning tools are inquiry-based Student Worksheets (LKPD) and Learning Outcome Tests (THB). At this stage, research instruments were also designed in the form of teacher ability sheets in managing learning, student activity observation sheets, and student response questionnaire sheets to learning.

1) Inquiry-based Student Worksheets (LKPD).

Student worksheets are equipped with work instructions to make it easier for students to solve the problems given. From the problems presented, students are directed to write temporary answers. Writing temporary answers in inquiry-based LKPD is placed after presenting the problem. LKPD contains instructions as a means for students to collect data. Next, students are directed to formulate conclusions. Writing conclusions is placed at the end of the LKPD.

2) Learning Results Test (THB)

Learning Outcome Tests are used to measure student understanding before and after learning.

Development Stage (Develop)

a. Expert Validation (Validator)

The validators provide an assessment of the learning tools on the inquiry-based Student Worksheet (LKPD) validation sheet.

b. Readability Test

The readability test is carried out after the device is declared valid by the validator. This activity aims to ensure that the LKPD can be read clearly and is easily understood by partner teachers and students. LKPD and THB readability tests are carried out by partner teachers.

c. Trial of Learning Tools

The learning tools were tested in class IX A of SMP Negeri 1 Bungku, which consisted of 30 students. The trial implementation involved a partner teacher, an observer tasked with assessing the teacher's ability to manage learning, and an observer tasked with observing student activities. Observations of student activities were carried out on one student with high ability, one student with medium ability, and one student with low ability. The observation sheet on the teacher's ability to manage learning and observation of student activities used has been validated and declared valid by the validator.

Level of Dissemination (Disseminate)

The distribution stage in this research was carried out in the same school. The learning tools that were declared good in the previous stage were used in Dewi Sartika's class IX. This implementation activity aims to determine the effectiveness of learning using the tools that have been developed.

The results of development and research show that (1) the characteristics of guided inquiry-based LKPD include the stages of making predictions, conducting investigations, collecting data, interpreting data, and developing conclusions; (2) guided inquiry LKPD is suitable for use in science learning; (3) there was an increase in students' critical thinking skills with an effect size value of 0.95, which indicates a very large effect from the use of LKPD on student learning outcomes,

Improved critical thinking skills

The value of student learning outcomes, after being analyzed using effect size, is in the large effect category with a value of 0.95. This means that the use of inquiry-based LKPD in cross-sectional material significantly improves students' critical thinking skills. These results are in line with the findings of Ikhwan (2020), which shows that inquiry-based LKPD is effective in developing critical thinking skills. This research underlines the importance of implementing inquiry-based LKPD in learning to encourage students to develop their analytical and critical thinking skills, especially in the context of science learning. This also shows that interactive and student-centric learning methods can produce significant

improvements in learning outcomes, both in terms of conceptual understanding and critical thinking abilities.

Improved problem solving abilities

Based on the results of the analysis with an effect size value of 0.95, it can be concluded that the use of inquiry-based LKPD (Learner Worksheets) has a big effect in improving students' abilities in solving problems related to the material being taught. A high effect size value indicates that the difference in learning outcomes between before and after using LKPD is very significant. This indicates that inquiry-based LKPD is effective in stimulating students' abilities to think analytically, solve problems, and develop their understanding of subject matter, especially in science learning contexts such as intersectional material.

1. N-gain calculation results for critical thinking skills

a) Results of Validation and Revision of Learning Tools

1. RPP validation results

Table 2. Learning Implementation Plan (RPP) validation results

No	Assessment aspects	Validator	
		1	2
1	Head	11	11,7
	Average	3,7	3,9
2	Format	9	12
	Average	3	4
3	Language	10.3	9.9
	Average	3.4	3.3
	Average score	3.4	3.7
	Shoes total 2 validator	3.6	

Based on Table 2, the results of the validator's assessment of the RPP show valid criteria, because the basic competencies and indicators of competency achievement that students must master are in accordance with the applicable curriculum.

2. LKPD validation results

The results of expert validation of the inquiry-based LKPD can be seen in Table 1. The results of the validator's assessment of the LKPD show valid criteria. This shows that the inquiry-based LKPD is effective and suitable for use to help students develop critical thinking skills because it guides students through stages such as formulating problems. , collect data, analyze data and draw conclusions.

3. Results of Question Validation (Learning Results Test) critical thinking skills

Table 3. Validation results of critical thinking skills learning outcomes tests

No	Assessment aspects	validator	
1	Science Content	1	2
	Science Content	10	12
	Average	3,3	4
2	Construction	16	18
	Average	3,2	3,6
3	Language	20	19
	Average	4	3.8
Average total score		3.5	3.8
Average total score of 2 validators		3.7	

Based on Table 3, the results of the validator's assessment of critical thinking skills assessment questions show valid criteria, this shows that the questions are effective because they are relevant to the material that has been studied and have clear instructions or instructions that are easy for students to understand.

4. Problem solving ability test validation results

Table 4. Validation results of problem solving ability learning outcomes tests

No	Assessment aspects	validator	
1	Science Content	1	2
	Science Content	10	11
	Average	3,3	3,6
2	Construction	15	18
	Average	3	3,6
3	Language	18	19
	Average	3.6	3.8
Shoes total		9.9	11
Average total score		3.3	3.7
Skor rata-rata 2 validator		3.5	

Based on Table 4, the results of the validator's assessment of the problem solving ability questions show valid criteria, so the questions are effective and appropriate for measuring students' problem solving abilities, besides that the test questions provide a relevant and real context or situation, have clear and clear instructions and instructions. easy to understand.

1. Device test results

The data obtained from testing learning devices is in the form of teacher ability data in managing learning, student activity data, pretest data and posttest data.

a. Teacher's Ability to Manage Learning

The results of observations of teachers' abilities in managing learning are presented in the following table.

Table 5. Results of observations of teachers' abilities in managing trial class learning

No	Observation aspect	2nd meeting		
		1	2	3
1	Problem orientation	12	12	12
	Average	4	4	4
2	Presenting a problem	4	3	3
	Average	4	3	3
3	Formulate a hypothesis	3	4	4
	Average	3	4	4
4	Collect data and test hypotheses	4	4	3

	Average	4	4	3
5	Formulate a conclusion	7	7	7
	Average	3.5	3.5	3.5
6	Reflection	3	3	4
	Rate-rate	3	3	4
	Shoes total	21.5	18.5	18.5
Rate-rate		3.6	3.1	3.1
Average total score			3.2	

Based on Table 5, the results of observing the teacher's ability to manage learning in the trial class meet the minimum good criteria, because the teacher in managing learning has demonstrated various aspects of learning management, namely having a Learning Implementation Plan (RPP), Infocus and LKPD, the teacher shows in-depth mastery of the material. taught, are able to explain concepts clearly, and the teacher uses teaching methods that suit the needs of students.

b. Student activities

Observations of student activities are carried out at every learning activity meeting. The results of observing student activities are presented in the following table.

Table 6. Results of observation of student activities in trial class learning activities.

No	Student activities	Students with abilities			
			Height	Currently	Low
1	Listen and pay attention to the teacher's explanation	1	4	4	3
		2	4	3	3
		3	3	3	3
2	Read/pay close attention to the problems presented in the LKPD	1	4	4	4
		2	4	4	3
		3	4	4	3
3	Have a discussion to formulate a hypothesis	1	4	4	4
		2	4	3	3
		3	4	3	3
4	Collect the necessary data and test the hypothesis (group discussion to complete the LKPD)	1	3	3	3
		2	3	3	3
		3	3	3	3
5	Discuss to formulate conclusions	1	3	3	3
		2	3	3	3
		3	3	3	3
6	Present the results of group discussions or respond to the results of other group discussions	1	4	3	3
		2	4	3	3
		3	4	3	3
	Rate-rate		3.6	3.2	3.1
	Average total score			3.3	

Based on Table 6, the results of observations of student activities in learning activities in the try-out class meet the minimum good criteria, because it is caused by the active involvement of students showing interest and enthusiasm in following the lesson, students interacting well with the teacher and students in their class, showing ability. collaborate and communicate effectively.

c. Student response

From providing student response questionnaires which were filled out by 30 students after following learning using the guided inquiry model for cross-sectional material, the following results were obtained.

Table 7. Results of student response questionnaires to trial class learning tools

No	Statement	Student response		Percentage (%)	
		Of	No	Of	No
1	I feel happy learning using LKPD	28	2	93,3	6,7
2	I am interested in the appearance (writing, images and location of images) contained in the LKPD	27	3	90	10
3.	I can clearly understand the sentences used in the LKPD and THB.	26	4	86,7	13,3
4	I am interested in taking part in learning using learning tools as has been done	30	0	100	0

Table 8. Results of student response questionnaires to trial class learning activities.

No	Statement	Student Response		Percentage (%)	
		Of	No	Of	No
1	The guided inquiry learning model makes science lessons more interesting to learn.	26	4	86,6	13,3
2	I am more active during the learning process with the guided inquiry model	27	3	90	10
3	The problems given are related to everyday life, encouraging me to complete the task well	26	4	86,6	13,3
4	I can find concepts myself with the learning that has been done	29	1	96,6	3,33
5	Group discussions helped me to better understand the lesson material	28	2	93,3	6,7
6	I can express ideas in group discussions	30	0	100	0
7	I find it easier to participate in learning activities because the teacher always provides help when I encounter difficulties.	30	0	100	0
8	I am interested in following this way of learning again for other material	30	0	100	0

Based on Tables 7 and 8, students' responses to learning in the trial class were positive, so the learning

tools were not revised. In accordance with the description above, it can be concluded that the quality of the cross-sectional inquiry-based LKPD produced is good due to several factors, namely students' positive responses to the methods, materials and learning environment that have been provided by the teacher. Students show a good understanding of the material being taught which is demonstrated through test results. High interest and motivation in participating in learning, students also show an active attitude of asking questions and curiosity in understanding the material. The inquiry-based LKPD has met the criteria of being valid, practical and effective with the following details

Table 9. Achievement of validity, practicality and effectiveness criteria

Criteria	Data Analysis Results
Valid	a. Every aspect of the learning tool meets valid criteria based on the validator's assessment. b. The learning outcomes test meets the criteria for at least sufficient test item validity, at least sufficient reliability, and is sensitive.
Practical	a. The teacher's ability to manage learning meets the minimum criteria of good. b. Student activities meet the minimum good criteria
Effective	a. Student responses to positive learning b. Students completed classically, namely 80% of students obtained a score ≥ 70

2. Description of learning effectiveness

To answer the third question, analysis was carried out on data resulting from implementation activities carried out at the dissemination stage. The research subjects in the implementation class were class IX Hasanudin SMPN 1 Bungku with a total of 30 people. Partner teachers and observers are the same as the trial class. Implementation was carried out in 3 meetings with the detailed schedule as follows.

The data collected in the learning effectiveness test using guided inquiry-based LKPD includes data on the teacher's ability to manage learning, student activity data, student response data and student learning outcomes (posttest). The description for each data is explained as follows.

1. Observation results of teachers' abilities in managing learning

The results of observations of teachers' abilities in managing learning using guided inquiry-based LKPD in implementation classes are presented as follows.

Table 10. Observation results of teachers' ability in managing implementation class learning

No	Observation Aspect	2nd meeting		
		1	2	3
1	Step 1: orientation	12	12	12
2	Step 2: Present the problem	4	4	4
3	Step 3: Formulate a hypothesis	4	4	4
4	Step 4: Collect data and test hypotheses	4	4	3
5	Step 5: Formulate the conclusion	8	8	8
6	Step 6: Reflection	4	4	4
	score	36	36	35
	Average	4	4	3,9

Based on Table 10, the results of observations of teachers' abilities in managing learning in implementation classes meet the minimum criteria of good.

2. Results of student activity monitoring

Observations of student activities are carried out at each meeting using a student activity observation sheet. Results of observations of student activities. The results of observations of student activities in participating in learning are presented in the following table.

Table 11. Results of observation of student activities in implementation class learning activities

No	Student activities	First Meeting	Students with abilities		
			Height	Currently	Low
1	Listen and pay attention to the teacher's explanation	1	4	4	3
		2	3	3	3
		3	4	4	4
2	Read/pay close attention to the problems presented in the LKPD	1	4	4	3
		2	4	4	3
		3	4	4	3
3	Have a discussion to formulate a hypothesis	1	4	4	3
		2	4	4	3
		3	4	4	3
4	Collect the necessary data and test the hypothesis (group discussion to complete the LKPD)	1	4	4	3
		2	3	4	3
		3	3	4	3
5	Discuss to formulate conclusions	1	4	4	3
		2	4	3	3
		3	4	4	3
6	Present the results of group discussions or respond to the results of other group discussions	1	4	4	3
		2	4	4	3
		3	4	3	3
7	Work on independent tasks	1	4	3	3
		2	4	4	3
		3	3	3	3
	score		80	79	64
	Average		3.8	3.8	3.0

Based on Table 11, the results of observing student activities in the implementation class meet the minimum good criteria, this can be seen from high interest and motivation, active involvement, good understanding.

3. Student response questionnaire results

The student response questionnaire was filled in by 30 implementation class students after taking part in the learning and posttest. The results of the student response questionnaire are presented in tables 7 and 8 that student responses to learning in implementation classes are positive.

4. Student learning results (Posttest)

Data on student learning outcomes was obtained from the posttest which was attended by 30 implementation class students. This data is used to determine the mastery of classical student learning.

5. Achieving learning effectiveness

Achieving the effectiveness of science learning using guided inquiry-based LKPD is determined based on the teacher's ability to manage learning, student activities, student responses and classical student learning completeness can be seen in the following table.

Based on the table above, it can be seen that science learning using guided inquiry-based LKPD meets the four indicators that have been determined. So it can be concluded that science learning using guided inquiry-based LKPD for cross-sectional material in class IX is effective.

Inquiry-based LKPD development

Based on the effect size analysis of students' critical thinking skills, it was found to be 0.95, which is included in the category of having a large effect. This shows a significant improvement and indicates that the use of inquiry-based LKPD is effective in improving students' critical thinking skills.

Several factors that need to be further evaluated on inquiry-based LKPD include the way the material is presented, the level of difficulty of the questions, or student involvement in the learning process. Students may require more intensive mentoring and special guidance to develop their critical skills.

Learning environmental factors are also very influential. A supportive classroom atmosphere will help students feel comfortable in expressing ideas and thinking critically. Students who are motivated and have an interest in the topic being taught tend to be more active in the inquiry process and more easily develop critical thinking skills. Teachers must act as facilitators who help and support students during the learning process, providing guidance, guiding asking questions, and helping students overcome the difficulties they face.

The background of students' parents also has a significant influence. Higher levels of parental education tend to be more accustomed to critical thinking because they have experience and knowledge of modern teaching methods that emphasize critical thinking, inquiry and discussion skills. Highly educated parents often read books with their children, discuss the content of the stories, and ask questions that encourage children to think critically.

Based on the effect size of 0.95, which indicates a very large effect from the use of LKPD on student learning outcomes, indicating that the use of inquiry-based LKPD is effective in improving students' critical thinking skills. This can be influenced by the parents' educational background or the time and duration of learning. Inquiry-based learning requires sufficient time for problem solving, and limited time can reduce the effectiveness of this method.

Interaction with teachers in support and guidance is very important in helping students overcome difficulties and develop problem-solving abilities. Cooperation with peers can also encourage cooperation and collaboration between students, because it can help them learn from each other and develop problem-solving skills. Group discussions encourage students to open new insights and provide more creative solutions than if they worked alone.

The learning tools that have been validated are then tested for readability by the partner teacher and three students. Researchers carried out trials of learning tools in class IX D of SMP Negeri 1 Bungku, totaling 22 students, involving a partner teacher and two observers: one observer of the teacher's ability to manage learning and one observer of student activities.

Implementation of trial activities includes collecting data regarding teachers' abilities in managing learning, student activities, student responses to learning, as well as pretest and posttest results. Learning activities were carried out using guided inquiry-based LKPD for cross-sectional material, over three meetings.

The trial results show that the validation results of the learning tools developed fall within the valid criteria with a score of 3 or 4 for each aspect of the assessment and can be used with revisions according to the validator's suggestions.

The teacher's ability to manage learning meets the minimum criteria of good. Student activities during the learning process using guided inquiry-based LKPD also meet the minimum good criteria.

The results of the questionnaire analysis of student responses to learning tools and activities show that more than 80% of students agree with each statement on the questionnaire sheet.

In the development stage, good quality learning tools are produced consisting of Learning Implementation Plans (RPP), Student Worksheets (LKPD), and Learning Outcome Tests (THB) which meet the criteria for valid, practical, and valid learning tools. effective.

Learning Effectiveness

The results of research at the dissemination stage in implementation classes show that science learning using

guided inquiry LKPD for crossover material in class IX is effective. The effectiveness indicators are as follows:

1) Teacher's Ability to Manage Learning: The teacher is able to carry out each aspect of observation well or very well, showing the implementation of learning in accordance with the guided inquiry steps in the RPP.
2) Student Activities: Student activities in learning activities at meetings 1, 2, and 3 meet the minimum good criteria.
3) Student Response: The results of data analysis of student responses to learning devices and activities showed a positive response, with more than 80% of students agreeing with the statements on the questionnaire sheet.

Based on research results, the use of inquiry-based Student Worksheets (LKPD) has proven to be effective in improving critical thinking skills and problem solving abilities. Previous research by Bharata et al. (2019) shows that guided inquiry-based LKPD is valid, practical and effective for improving critical thinking skills with an average gain of 0.55 and a strong effect size of 2.69.

Factors that influence the effectiveness of student response questionnaires include questionnaire design, question structure and layout, data collection process, respondent characteristics, data analysis and interpretation, and understanding of questionnaire results (Susilowati & Sumaji, 2021).

Critical Thinking Skills

Factors that influence critical thinking skills include learning methods, challenging learning materials, a conducive learning environment, and students' active role in learning.

Evaluation of learning methods in improving students' critical thinking skills can be done by:

1) Pre-test and post-test to measure changes in critical thinking skills.
2) Observation and assessment of the learning process.
3) Analysis of student work results.
4) Collaborate with colleagues to discuss the effectiveness of learning methods.

Use of Inquiry-Based LKPD

Several studies show that the use of inquiry-based LKPD can improve problem-solving abilities. Research by Septiani et al. (2022) shows that students' mathematical problem solving abilities increase after using LKPD developed using various approaches. Research by Indayani et al. (2018) shows that LKPD with guided inquiry is valid according to material experts and media experts, and its implementation is quite effective. Research by Bharata et al. (2019) shows that guided inquiry-based LKPD is valid, practical, and effective for improving students' critical thinking skills. Research by Firdaus & Wilujeng (2018) shows an increase in students' critical thinking skills with a total average gain score of 0.43 and an increase in learning outcomes with a total average gain score of 0.34.

Conclusions

Based on the results of data analysis and research discussion, it was concluded that the development of guided inquiry-based Student Worksheets (LKPD) was effective in improving critical thinking skills and problem solving abilities of class IX students on cross-sectional material at SMPN 1 Bungku. This LKPD has been proven to be able to significantly improve critical thinking skills and problem solving abilities.

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Conflict of interest

The authors declares that there is no conflict of interest in this research. All parties involved have given their consent and contributed without any bias or influence that could affect the research results.

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