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DEVELOPMENT OF HOTS LKPD USING PROBLEM-BASED LEARNING MODELS TO IMPROVE STUDENTS' CRITICAL THINKING ABILITIES AND SCIENCE PROCESSING SKILLS IN JUNIOR HIGH SCHOOL

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Abstract

This study aims to describe the validity, practicality, and effectiveness of Student Worksheets (LKPD) based on Higher Order Thinking Skills (HOTS) on pressure material using a problem-based learning model at SMP Negeri 1 Menui. The research method is a type of development research following the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The subjects of the study were class VIII A students, consisting of 12 boys and 13 girls with the average age was 15 years old. Data collection involved validation sheets, questionnaires, and written tests. Validation sheets were used to assess the validity of the developed learning tools. Questionnaires evaluated the practicality of the learning tools, while written tests measured students' scientific process skills before and after the implementation of HOTS learning tools. The results showed that the developed LKPD is categorized as good, with an average validation percentage of 78.93%, classified as valid. The teacher response score of *M=3.78* classified it as practical. Field testing indicated that the LKPD effectively improved students' critical thinking and scientific process skills. This was evidenced by scientific process skills score of *M= 77.46*, categorized as effective. Additionally, the pre-test and post-test results showed an increase score from *M=64* to *M=73*, with an Cohen's (*d= 0.98*) categorized as huge effect.

Keywords: Student worksheets, HOTS, problem-based learning, ADDIE model, science process skills

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Introduction

Science education has a significant potential in the effort to build a nation. However, it has long been perceived as a burdensome subject that is not well-liked by students. Only a few students are interested in studying science, which results in the low quality of science education. This low quality has compelled the government to reform the education system, including the introduction of the 2013 curriculum as a foundation for implementing the educational process in Indonesia (Supriyantoro et al., 2019). The success of implementing the 2013 curriculum requires teachers to be creative in planning the learning process. The learning process should no longer be teacher-centered, but rather allow students to play an active role in constructing the knowledge they acquire. One of the learning methods that can be applied to engage students actively is problem-based learning.

Problem-Based Learning (PBL) involves using real-world, open-ended problems that students must solve, thereby developing their thinking skills, problem-solving skills, social skills, independent learning skills, and ability to build or acquire new knowledge. The selection of real-world problems is based on their relevance to achieving basic competencies (Sakti, 2019). The success of implementing PBL requires well-prepared and appropriate learning tools.

Learning tools are a set of media or resources used by teachers and students in the classroom, including a series of tools that teachers must prepare for classroom learning (Sari et al., 2020). These tools include the lesson plan (RPP), student worksheets (LKPD), learning media, and evaluation instruments. Learning tools encompass the stages of planning, implementing, and evaluating the learning process (Nursari et al., 2021).

The planning stage involves outlining the steps to be taken, considering the learning objectives, student needs, and the appropriate timing for implementation. The implementation stage includes the introduction, core, and closing phases, from the beginning of the lesson until its conclusion. During this stage, students need to be trained to engage in higher-order thinking. The evaluation of learning in the 2013 curriculum generally assesses three domains: cognitive, affective, and psychomotor (Nursari et al., 2021). Teachers must master the skills of constructing assessment instruments, ranging from lower-order to higher-order thinking skills.

Higher Order Thinking Skills (HOTS) refer to a process of thinking at a higher cognitive level, developed from various cognitive concepts and learning taxonomies such as problem-solving methods, Bloom's taxonomy, and the taxonomy of learning, teaching, and assessment. The main goal of HOTS is to enhance students' ability to think critically when receiving different types of information, think creatively in solving problems using their knowledge, and make decisions in complex situations (Ismafitri et al., 2022; Beddu, 2019). In developing problem-solving skills, higher-order thinking must be supported by scientific process skills to deepen students' understanding of the material presented.

Science as a process involves the attitudes and skills of scientists to achieve scientific products. Scientific process skills are used to investigate natural phenomena around us and aim to build scientific concepts. Essentially, science is a body of knowledge verified through facts, principles, concepts, and laws obtained through a series of investigative processes (Hartini et al., 2018).

Based on the researcher's experience in teaching, the learning tools used have not supported the development of students' problem-solving abilities. The tools are very basic and not aligned with the learning models applied, especially those that give students the freedom to play an active role and construct concepts independently.

To address this issue, the researcher intends to develop learning tools oriented towards enhancing students' higher-order thinking skills (HOTS) through the application of problem-based learning models. This will be done following the ADDIE model of instructional design, starting with analysing existing products, followed by designing and developing new products, and concluding with implementing and evaluating the new products (Makuasa et al., 2024). The ADDIE model is more systematic and structured, involving several evaluation stages in each development phase before producing a usable product. Based on the explanation above, this paper aims to describe the validity, practicality and effectiveness of Student Worksheets (LKPD) based on Higher Order Thinking Skills (HOTS) on pressure material using a problem-based learning model at SMP Negeri 1 Menui.

Methods

This research is a type of development research (Development Research) limited to product development, product validation, practicality testing, and effectiveness testing of product use. The object of this research is the development of learning tools on the concept of pressure based on Higher Order Thinking Skills (HOTS) using problem-based learning. This research was conducted at SMP Negeri 1 Menui, The subjects were students in class VIII A consisting of 12 boys and 13 girls with the average age was 15 years old.

The research consisted of 3 meetings with material on pressure in solids, pressure in liquids and Archimedes' law. This research involves various parties as test subjects, namely subject matter experts, media experts, teachers, and eighth-grade students at SMP Negeri 1 Menui. This development research is adapted from Branch (2009) follows the steps of the ADDIE model (Analysis, Design, Development, Implementation, Evaluation).

Analysis

The analysis stage was initiated by conducting observations and interviews. Observations were carried out during the science learning process in the classroom. The purpose of the observations was to gather information about the learning model, teaching materials, and students' responses to the science learning process. Interviews were conducted with the school principal and teachers. The interview with the school principal aimed to obtain information about the learning tools used and students' responses to the learning process. The interview with the teachers aimed to gather information about the learning tools used, difficulties in learning, and students' responses to the learning process.

Design

The next stage was the design phase, where the product was designed according to the needs, characteristics of the students, and learning materials. The designed product included learning tools consisting of a lesson plan (RPP), student worksheets (LKPD), critical thinking ability tests, and science process skills observation sheets.

Development

The third stage is the development phase. Product development is based on the design previously created. During this stage, the researcher prepares the learning tools according to the pre-designed plan. The learning tools are then validated by validators. Validation is conducted by experts, including subject matter experts and media experts, through the completion of validation sheets. The purpose is to measure the validity of the developed learning tools. Additionally, small group trials are conducted by providing product evaluation sheets to students and teachers.

Implementation

The fourth stage is the implementation of the developed product design. During this phase, field trials involving eighth-grade students (Class VIII A) are conducted to assess the practicality and effectiveness of the product. Effectiveness is measured by administering pre-tests and post-tests. The pre-test evaluates the students' critical thinking skills before using the product in the learning process, while the post-test assesses their critical thinking skills after using the developed product. Practicality is measured using questionnaires given to students and teachers after the learning process.

Evaluation

This stage aimed to assess the feasibility of the developed product. Feedback questionnaires were provided to students and teachers regarding the learning process. The feasibility of the developed product was determined based on the feedback from students and teachers.

Data Collection

Data collection was conducted using validation sheets, questionnaires, observation sheets, and written tests. Validation sheets were utilized to gather information regarding the validity of the developed learning tools. These sheets contained questions designed to measure whether the tools met the desired variables and were used by validators to assess the validity of the learning tools. Questionnaires were employed to evaluate the practicality of the developed learning tools. The questionnaires included questions given to teachers and students to obtain information on the practicality of the tools. Science process skills were measured through observation questionnaires, consisting of 9 statement items. The critical thinking test instrument comprised 5 essay questions. The essay tests were used to measure students' scientific process skills before (pre-test) and after (post-test) the implementation of the HOTS learning tools. The number of test questions corresponded to the number of competency indicators of the taught material.

Data analysis

The data obtained in this research will be analyzed based on the validity, practicality, and effectiveness of the learning tools, as described below:

1. Analysis of the Validity of HOTS Learning Tools.

The validity data of the HOTS learning tools will be obtained from the validation results by validators using a validation instrument. The validation data can be analyzed using the following formula:

$$Vah = \frac{Tse}{Tsh} x\ 100\% \quad (1)$$

Explanation:

Vah = Expert validation
Tse = Total empirical score achieved
Tsh = Total expected score

2. Analysis of the Practicality of HOTS Learning Tools

The practicality analysis will be conducted using data sourced from student response questionnaires and teacher response questionnaires. The following formula will be used:

$$P = \frac{Tse}{Tsh} x\ 100\% \quad (2)$$

Explanation:

P = Practicality percentage
Tse = Total empirical score achieved
Tsh = Total expected score

3. Analysis of science process skills observation results

The analysis of the science process skills observation results was derived from the observation sheets that were used to assess these skills during each learning session with the HOTS LKPD.

4. Analysis of the effectiveness of LKPD on critical thinking skills

The effectiveness of the HOTS LKPD on critical thinking skills was analyzed using a difference test and effect size. The difference test was employed to compare the pre-treatment and post-treatment results, while the effect size was used to provide an overall picture of the score improvements between the pretest and posttest.

Results and Discussion

Research was conducted to develop Higher Order Thinking Skills (HOTS)-based Student Worksheets (LKPD) using a problem-based learning model. The result of this research is the HOTS-based LKPD product on the topic of substance pressure and its application in everyday life. This worksheet is a practical LKPD, developed as an alternative to assist students in learning about pressure. Additionally, this LKPD is designed to train 21st-century skills, encompassing the 4Cs: Critical Thinking, Creativity, Communication Skills, and Collaboration.

The development process followed the ADDIE model, which includes the stages of 1) Analysis, 2) Design, 3) Development, 4) Implementation, and 5) Evaluation. The research and development outcomes from each stage are as follows:

Analysis

Based on the observations and interviews conducted with the teachers and the principal, the following information was obtained:

1) The direct teaching model was used in the science classes of grade VIII at SMPN 1 Menui.
2) The teaching materials were primarily sourced from textbooks.
3) Difficulties were encountered in teaching science topics that involved extensive calculations.
4) Students were not actively participating in the learning process.

Using this information, an analysis was conducted to find solutions to the issues in the science learning process at grade VIII of SMPN 1 Menui. The results of the analysis to address these issues were:

1) The use of video media to capture students' attention during the learning process.
2) The implementation of a problem-based learning model to assist students in constructing knowledge through problem-oriented learning activities and group discussions.
3) The use of HOTS-based LKPD with practical activities to help students improve their critical thinking skills and science process skills.

An accurate and thorough analysis ensures that the resulting learning design will be effective, relevant, and aligned with the students' needs. A comprehensive analysis determines that the developed learning design can be more effective and suitable for students' needs, addressing the existing issues in the science learning process for grade VIII at SMPN 1 Menui.

Design

(1) ***Formulation of learning objectives***

The design phase begins with formulating learning objectives and competency achievement indicators (IPK) based on the previous material analysis. This activity aims to establish the direction of learning to be achieved. The development of learning objectives and IPK indicators is guided by the basic competencies assigned to the material according to Permendikbud 37/2018. Learning objectives are formulated based on competency achievement indicators. Below are the details of IPK and learning objectives: (1) Through video presentations, students can explain the pressure of solid substances; (2) Through simple experiments, students can investigate the factors that influence the pressure of solid substances; (3) Through simple experiments students can analysed the relationship between the outer surface, the magnitude of the force and the magnitude of the pressure of solid substances; (4) Through video presentations, students can explain the concept of liquid pressure; (5) Through simple experiments, students can investigate the factors that influence the pressure of liquids; (6) Through simple experiments, students can analysed the relationship between factors that influence the amount of liquid pressure; (7) Through video presentations, students can explain Archimedes' law; (8) Through simple experiments students can investigate the factors that influence buoyancy; (9) Through simple experiments students can analysed the factors that influence buoyancy.

This stage includes determining competency achievement indicators (IPK), formulating learning objectives, planning teaching materials, and planning worksheets (LKPD). Determination of competency achievement indicators and formulation of learning objectives refer to the Basic Competencies assigned to the Pressure topic, namely KD 3.8 which involves analyzing the concept of pressure and its application in daily life, and KD 4.8 which involves presenting experimental data to investigate pressure. The competency achievement indicators (IPK) determined consist of 6 knowledge IPKs and 6 skill IPKs. Meanwhile, the formulation of learning objectives is aimed at the overall implementation of LKPD. Three meetings are required to achieve the learning objectives, hence 3 LKPDs are developed packaged into one cohesive unit.

(2) ***Designing LKPD***

In designing the HOTS-based LKPD, the researcher begins by creating an initial draft using a problem-based learning model. The LKPD is structured into three main sections: introduction, content, and conclusion.

a. Introduction:
The introduction section of the LKPD includes a cover page, foreword, table of contents, concept map, syllabus, core competencies, basic competencies, competency achievement indicators, learning objectives, and usage instructions.

b. Content Section:
The content section of the LKPD comprises three sub-topics: solid substance pressure, liquid substance pressure, and Archimedes' principle. The LKPD is designed for three sessions with a time allocation of 7 teaching hours.

c. Conclusion:
The conclusion section includes exercise questions and a bibliography.

The next stage is the designing of LKPD. LKPD is designed based on HOTS using problem-based learning. The initial design of LKPD is structured into three main parts: the introductory section, the core section, and the concluding section. The introductory section includes a cover page, preface, table of contents, concept map, basic competencies, competency achievement indicators, and usage instructions. The core section contains the steps of LKPD tailored to the steps of problem-based learning models. LKPD covers three topics: solid pressure, liquid pressure, and Archimedes' principle. The concluding section includes exercises and a bibliography.

HOTS are applied in this LKPD not only through problem-based learning approaches but also through questions designed based on HOTS principles. In each subtopic, namely the pressure of solids, the pressure of liquids, and Archimedes' principle, students are guided to analysed the situations and conditions they face, evaluate the various factors affecting these phenomena, and create innovative solutions relevant to the context of the problems presented. Activities include problem identification, data and information collection, data analysis and interpretation, as well as problem-solving and discussion. Additionally, the questions provided encourage students to apply the concepts learned to new and challenging situations, thus strengthening their critical and creative thinking skills.

The HOTS-based approach in this LKPD aligns with previous research showing that learning emphasizing higher-order thinking skills can enhance students' conceptual understanding and problem-solving abilities (Nadifatinisa & Sari, 2021). Studies have shown that students who learn using this method tend to have a deeper understanding and can apply their knowledge more effectively compared to conventional learning methods. Therefore, this HOTS-based LKPD is not only aimed at achieving basic competencies but also at developing higher-order thinking skills, which are crucial in 21st-century education (Siregar & Aghni, 2021).

Development

This stage is an advanced phase following the design phase to produce HOTS-based LKPD using a problem-based learning model. The completed LKPD product then undergoes expert validation, individual testing, and small group testing.

(1) ***Expert validation***

The LKPD is validated by expert validators. The purpose of this validation is to measure and evaluate the validity of the developed product. In addition to the LKPD, other instructional tools such as lesson plans (RPP), critical thinking skill assessment test, and science process skill observation instruments are also validated. The validation results are assessed using a Likert scale. The result of validation can be seen in Table 1. And The recommendations and improvements for all aspect can be seen in Table 2.

Table 1. Result of Validation

Aspect	Description	Validator 1	Validator 2	Average
RPP Validation	Total Score	68	76	72
	Mean	4.00	4.47	4.23
	Percentage (%)	80.00	89.41	85
		Interpretation		**Very valid**
LKPD Validation	Total Score	103	118	110,5
	Mean	3.68	4.21	3.94
	Percentage (%)	73.57	84.29	79
		Interpretation		**Valid**
Critical Thinking Skills Test Validation	Total Score	51	55	53
	Mean	3.64	3.93	3.78
	Percentage (%)	72.86	78.57	76
		Interpretation		**Valid**
Science Process Skills Instrument Validation	Total Score	51	55	39,5
	Mean	3.64	3.93	3.95

Percentage (%)	72.86	78.57	79
Interpretation			**Valid**

Table 2. Recommendations and improvements

Aspect	Improvement Suggestions	Improvement Results
RPP	• Adapted to PBL syntax and oriented towards improving critical thinking skills • Drawing conclusions involves students • The language used is simpler, adjusted to the level of students	• It has been adapted to the PBL model in designing lesson plans and is oriented towards critical thinking skills • It has been revised in the Conclusion drawing section • It has been revised to use language appropriate to the level of students.
LKPD	• Questions in analysis and evaluation direct students to find answers by thinking critically • Problem orientation is adapted to circumstances in everyday life • Sequence of LKPD • Manuscript layout and images	• Has been adjusted to indicators of critical thinking ability • It has been adapted to the circumstances of everyday life • Has been adjusted to the correct LKPD sequence • Images and script have been adjusted
Critical Thinking Skills Test	• Adjust to indicators of critical thinking skills • Adjust HOTS cognitive level	• Has been adapted to critical thinking indicators • Has been adjusted to HOTS cognitive level
Science Process Skills Instrument	• Adjust to science process skill indicators	• It has been adjusted to indicators of science process skills

The validation results of the RPP analysis are presented in Table 3. Validator 1's results showed an average score of 4.00 (80.00%), categorized as valid, while validator 2's results showed an average score of 4.47 (89.41%), categorized as highly valid. The LKPD validation results indicated that validator 1's average score was 3.68 (73.57%), categorized as valid, and validator 2's average score was 4.21 (84.29%), categorized as highly valid. Despite this, improvements are necessary based on the validators' feedback. The critical thinking skills test validation showed validator 1's average score was 3.64 (72.86%), categorized as valid, and validator 2's average score was 3.93 (78.57%), also categorized as valid. For the science process skills instrument, validator 1's average score was 3.90 (78%), categorized as valid, and validator 2's average score was 4.00 (80%), also categorized as valid.

(2) ***Individual trials***

Individual testing was conducted with 5 students, consisting of 2 high-ability students, 1 moderate-ability student, and 2 low-ability students. The results of the individual testing analysis can be seen in Table 3.

(3) ***Small group trials***

Individual testing was conducted on 10 students. The results of the individual testing analysis can be seen in Table 3.

Table 3. Individual & small group test analysis results

Test	Description	Result
Individual	Total Score	133
	Mean	2.96
	Percentage (%)	73.89
	Interpretation	**suitable for use**
Small Group	Total Score	315
	Mean	3.50
	Percentage (%)	87.50
	Interpretation	**suitable for use**

Next is the individual testing stage. Individual testing conducted with 5 students from class VIII B at SMPN 1 Menui. The average score from individual testing was 2.96, 73.89% suitable category. Following that is the small group testing stage. Small group testing involved 10 students from class VIII B at SMPN 1 Menui. The average score from small group testing was 3.50, 87.50% suitable category.

(4) ***Teacher Assessment***

The next procedure involves LKPD being assessed by three science teachers. The objective of this teacher assessment is to determine the suitability of LKPD for learning purposes. The results of the teacher assessment analysis can be seen in Table 4.

In the teacher assessment stage, LKPD is evaluated by three science teachers from SMPN 1 Menui. The goal of teacher assessment is to determine the suitability of LKPD before field testing. From the assessment, Teacher 1 scored an average of 3.60, 90% suitable category, Teacher 2 scored an average of 3.70, 92.5% suitable category, and Teacher 3 scored an average of 3.50, 87.5% suitable category.

Table 4. Teacher Assessment Analysis Result

Description	Evaluator 1	Evaluator 2	Evaluator 3
Total Score	36	37	35
Mean	3.60	3.70	3.50
Percentage (%)	90.00	92.50	87.50
Interpretation	**suitable for use**	**suitable for use**	**suitable for use**

Implementation

The fourth stage is the implementation stage. Implementation involves field testing the produced LKPD. The LKPD used in implementation is HOTS-based, utilizing a problem-based learning model. This LKPD is tested over three sessions with different sub-topics. During the field testing, the process begins with administering a pre-test to students before the lesson begins and concludes with a post-test at the end of the third meeting.

The development product of HOTS LKPD using a problem-based learning model on the topic of fluid pressure to improve critical thinking skills and science process skills was validated by experts. Subsequently, the next stage involved the implementation of the LKPD product, which was tested on a group of students. This trial was conducted in class VIIIA. Students engaged in learning activities using the developed product and then underwent a series of tests to assess the product's effectiveness. Teachers evaluated the practicality of the developed product using a teacher response questionnaire.

Table 5. The practicality of LKPD result.

Criteria	Score	Category
Knowledge construction	3.58	Practical
Design	3.85	Practical
Language	3.83	Practical
Problem-based learning activities	3.87	Practical
Conclusion	**3.78**	**Practical**

(1) The practicality of LKPD

The practicality of the LKPD was assessed through teacher responses during the learning process conducted in the school classroom. The results of the LKPD's practicality are presented in Table 5. Based on Table 5, it is shown that the score falls within the practical category, which is 3.78. This indicates that the LKPD is practical.

(2) The Effectiveness of LKPD

The effectiveness of LKPD was measured through the results of the science process skills observation sheets as well as pretest and posttest scores of students' critical thinking skills.

(a) *Science process skills*

Students' science process skills were measured using an observation sheet with nine assessment aspects. The observation sheet used was validated by expert validators. The results of the science process skills data can be seen in Table 6.

Table 6. Description of students' science process skills scores.

Science Process Skills Indicator	Meeting		
	1 (%)	2 (%)	3 (%)
Observation	66	74	75
Classification	66	68	72
Interpretation	66	72	76
Using Tools	70	73	83
Communicate	67	70	75
Asking Question	64	76	78
Mean	67	72	77
Category	**Good**	**Good**	**Good**

Based on Table 6, it can be observed that the science process skills of students in the class showed improvement from the first meeting to the third meeting. Improvement occurred in all aspects of science process skills. The percentage for the first meeting reached 67% in the category, the second meeting reached 72% in the good category, and the third meeting reached 77% in the good category. The average percentage increase per meeting was around 5%. These results indicate an enhancement in science process skills through the use of HOTS-based LKPD.

The analysis of science process skills shows that the use of HOTS-based LKPD, utilizing a problem-based learning model on the topic of pressure of substances, is effective in improving students' science process skills. This is consistent with research conducted by Berlian et al. (2023) titled "Development of Science Worksheets to Improve Process Skills." Their study demonstrates that PBL-based LKPD can enhance students' science process skills. Safitri et al. (2022), in their research titled "Development of Problem-Based Learning-Based E-LKPD to Improve Science Process Skills," also found that using problem-based learning-based E-LKPD can effectively enhance students' science process skills.

Improvements in students' science process skills can be seen in their ability to create concepts, theories, principles, laws, facts, and demonstrate something. Science process skills are typically applied from secondary school to higher levels, considering students' stages of cognitive development. Training students in science process skills requires appropriate methods, such as through laboratory experiments or practical activities (Ernawati & Sujatmika, 2018).

(b) *Critical thinking skills*

Students' critical thinking skills were measured from the pre-test and post-test results. The test consisted of five essay questions. The effectiveness test results of HOTS-based LKPD with a problem-based learning model on the subject of matter pressure can be seen in Table 7

Table 7. Critical thinking skills test results

Description	Score	
	Pre-test	Post-test
Total Score	654	656
Mean	64	73
Tsig Test (2-Tailed)	0.001	
Cohen's D	0.98	
Interpretation	**The Effect is Large**	

Based on Table 7, it can be seen that the sig (2-tailed) value is $0.001 < 0.05$ based on the pretest and posttest results. This indicates that there is a significant difference between the pretest and posttest results, as shown by the average pretest score of 64 and the posttest score of 73. The data above also shows that the Cohen's D value is 0.98, with a high effect category. This indicates that the use of HOTS with a problem-based learning model on the topic of fluid pressure is effective for use.

The pre-test and post-test results were used to assess the effectiveness of HOTS-based LKPD in improving students' critical thinking skills. From the pre-test and post-test results, an average pre-test score of 40 and an average post-test score of 74 were obtained. Upon calculation, an effect size score of 0.98 was derived, indicating a high effect size. This is consistent with research by Simbolon et al. (2022), who found that HOTS-based learning tools using the CTL learning model can enhance students' critical thinking skills and confidence. HOTS-based LKPD is highly suitable for science education. Its use encourages students to engage in higher-order thinking, including critical and creative thinking, enabling them to critically analyze problems and creatively solve them.

Khotimah and Sari (2020) also conducted research titled "Development of Student Worksheets Based on higher order thinking skills (HOTS) using environmental context." Their findings indicate that HOTS-based LKPD using environmental contexts develops high-level thinking skills in students, including critical thinking. LKPD serves as a tool to facilitate learning activities, enhancing effective interaction between students and educators, thereby increasing student engagement in improving their thinking skills. Problem-solving skills embedded in LKPD influence students' HOTS. This is consistent with research by Astuti et al. (2018), stating that LKPD is designed to allow students to learn independently, encouraging them to actively solve problems through group discussions, practical activities, and real problem-solving. This approach challenges students in a more interactive learning process compared to one-way communication.

Problem-solving activities in LKPD contribute to enhancing students' thinking processes, including critical thinking, as evidenced by the analysis of pre-test and post-test questions and supported by previous research. LKPD serves various functions, including acting as a laboratory guide. The HOTS-based LKPD developed in this study serves as a practical guide tailored to real-world conditions. It also includes HOTS questions that help students improve their problem-solving abilities. Based on the analysis of science process skills observation sheets and previous research, it is evident that HOTS-based LKPD using a problem-based learning model is effective in enhancing students' science process skills (Nadifatinisa et al., 2021; Siregar & Aghni, 2021).

Evaluation

The final stage of developing this LKPD involves evaluating the suitability of HOTS-based LKPD using a problem-based learning model on the topic of pressure for students. The success criterion for this LKPD development is evaluated based on the feedback provided by students through a questionnaire they filled out. The analysis of student feedback can be seen in Table 8.

Table 8. Results of student response questionnaire analysis

Description	Result
Total Score	887
Mean	3.55
Percentage (%)	88.70

Based on Table 8, the average score of student responses obtained is 3.50, with a percentage of 88.70%, categorized as practical. This indicates that HOTS-based LKPD using a problem-based learning model on the topic of pressure is practical for use in learning.

The final step of this research is evaluation. This stage aims to assess the suitability of HOTS-based LKPD using a problem-based learning model on the topic of pressure. In this stage, a feedback questionnaire is given to students to gauge their response to the learning process using the HOTS-based LKPD product with a problem-based learning model. The success criterion for this LKPD development is evaluated based on student feedback through the questionnaire. From the results of the student feedback questionnaire, an average score of 3.70 with a percentage of 92.42% was obtained. This demonstrates that this LKPD is practical for use in learning.

Conclusions

Based on the research findings, it can be concluded that the Problem-Based Learning (PBL) based Higher Order Thinking Skills (HOTS) Student Worksheets (LKPD) in Grade VIII SMPN 1 Menui are validated with an average validation percentage of 78.92%. Furthermore, the PBL-based HOTS LKPD is practical for use in learning, with an average practicality percentage obtained from individual trials of 73.89% categorized as practical. This conclusion is supported by small group trial results, which achieved an average percentage of 87.50%, teacher assessments with an average percentage of 90%, and teacher response questionnaire results with an average percentage of 94%, categorized as highly practical.

The implementation results of the product demonstrate its effectiveness in enhancing critical thinking skills and science process skills. This is evidenced by a 5% increase in science process skills assessment scores at each meeting. Additionally, the pre-test and post-test results show an average pre-test score of 64 and an average post-test score of 73. Upon calculation, an effect size score of 0.98 was found, categorized as high effect size.

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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.

References

Astuti, S., Danial, M., & Anwar, M. (2018). Pengembangan LKPD berbasis PBL (problem based learning) untuk meningkatkan keterampilan berpikir kritis peserta didik pada materi kesetimbangan kimia. *Chemistry Education Review (CER)*, *1*(2), 90-114.

Beddu, S. (2019). Implementasi pembelajaran higher order thinking skills (HOTS) terhadap hasil belajar peserta didik. *Jurnal Pemikiran Dan Pengembangan Pembelajaran*, *1*(3), 71–84.

Berlian, M., Salsabilla, D., Junaidi, K., & Vebrianto, R. (2023). Pengembangan LKPD IPA Untuk Meningkatkan Keterampilan Proses Sains *: Systematic Literature Review Development of Science Worksheets to Improve Science Process Skills : Systematic Literature Review. XII*(2), 124–140.

Branch, R. M. (2009). Instructional Design : The ADDIE Approach. Springer.

Ernawati, T., & Sujatmika, S. (2018). Pengembangan LKS berbasis project based learning untuk meningkatkan keterampilan proses sains siswa SMP. *JIPVA (Jurnal Pendidikan IPA Veteran)*, *2*(2), 149-161.

Hartini, L., & Miriam, S. (2018). Pengembangan perangkat pembelajaran berorientasi keterampilan proses sains menggunakan model inquiry discovery learning terbimbing. *Berkala Ilmiah Pendidikan Fisika*, *6*(1), 69-82.

Hidayat, F., & Muhamad, N. (2021). Model addie (analysis, design, development, implementation and evaluation) dalam pembelajaran pendidikan agama islam ADDIE model in islamic education learning. *J. Inov. Pendidik. Agama Islam*, *1*(1), 28-37.

Ismafitri, R., Alfan, M., & Kusumaningrum, S. R. (2022). Karakteristik HOTS (high order thinking skills) dan kaitannya dengan kemampuan literasi numerasi di sekolah dasar. *Jurnal Riset Intervensi Pendidikan*, *4*(1), 49–55.

Khotimah, R. P., & Sari, M. C. P. (2020). Pengembangan lembar kerja peserta didik berbasis higher order thinking skills (HOTS) menggunakan konteks lingkungan. *Jurnal Aksioma*, *9*(3), 761-755.

Makuasa, D. A. A., Rahmawati, S., & Afadil, A. (2024). Development of a Chemistry Learning E-module Based on Project-based Learning with a STEM Approach to Improve Students Problem Solving and Communication Skills on Solubility and Solubility Product Material. *International Journal of Education, Humaniora, and Social Studies*. *1*(1). 22-27

Nadifatinisa, N., & Sari, P. M. (2021). Pengembangan lembar kerja peserta didik (LKPD) berbasis higher order thingking skill (HOTS) pada pembelajaran IPA materi ekosistem kelas V. *Jurnal Pedagogi Dan Pembelajaran*, *4*(2), 344-351.

Nursari, E. V., Setiawati, I., & Lismaya, L. (2021). Analisis Perangkat Pembelajaran Berbasis Higher Order Thinking Skill (HOTS) di Masa Pandemi Covid-19. *ALVEOLI: Jurnal Pendidikan Biologi*, *2*(2), 78-97.

Safitri, W., Budiarso, A. S., & Wahyuni, S. (2022). Pengembangan e-LKPD berbasis problem based learning untuk meningkatkan keterampilan proses sains siswa SMP. *Saintifika*, *24*(1), 30-41.

Sakti, I. (2019). Implementasi Model Perangkat Pembelajaran Berorientasi Hots (High Order Thinking Skills) Dan Pendidikan Karakter Melalui PBL (Problem Based Learning) Pada Mata Kuliah Fisika Dasar. In *Prosiding Seminar Nasional Fisika (E-Journal)* (Vol. 8, pp. SNF2019-PE).

Sari, N. M., Sabri, T., & Kresnadi, H. (2020). Analisis perangkat pembelajaran tematik dengan pendekatan saintifik dalam masa Covid-19 di kelas IV SD. *Jurnal Pendidikan dan Pembelajaran Khatulistiwa*, *9*(11), 1–8.

Simbolon, J., Nasution, H., & Simanjorang, M. (2022). Pengembangan perangkat pembelajaran berbasis HOTS menggunakan model pembelajaran contextual teaching learning untuk meningkatkan kemampuan critical thinking dan self-confidence. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *6*(3), 2498–2514.

Siregar, M. N. N., & Aghni, R. I. (2021). Pengembangan perangkat pembelajaran berbasis problem based learning (PBL) untuk meningkatkan higher order thinking skill (HOTS). *Jurnal Pendidikan Akuntansi (JPAK)*, *9*(2), 292-301.

Supriyantoro, D., Sumbawati, M. S., & Sitompul, N. C. (2019). Pengembangan Perangkat Pembelajaran IPA dengan model problem based learning Berbasis outdoor learning. *Jurnal Pijar Mipa*, *14*(2), 42-48.

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