

# Developing student worksheet (LKPD) as a problem solving to improve the critical thinking of elementary school students

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## ABSTRACT

Problem solving skills are useful for training students to deal with increasingly complex problems. Teaching materials that have not integrated these abilities need to be used. So, this study purpose to determine the process of developing problem-solving-based LKPD to improve students' critical thinking skills and determine the effectiveness of problem-solving-based LKPD. This research was Research and Development (R & D) with reference to the Borg and Gall development model. This research was conducted in class IV State Elementary School 2Sumberejo, Kemiling Bandar Lampung with a total of 124 students consisting of class IV A, IV B, IV C and IV D. By taking samples using simple random sampling. The results of the analysis showed that LKPD based on problem solving is feasible to use, this is evidenced by the results of the validation analysis of experts 0.97, media experts 0.95, and language experts 0.96 with the "very good" category. LKPD based on problem solving is also effective for use, this is evidenced by the significant t test results and scores of n-Gain in the experimental class 0.62 category "moderate" and the control class 0.17 category "low". It can be concluded that the problem-solving-based worksheets that have been developed at State Elementary School 2Sumberejo are valid and appropriate for use in the learning process, and problem-based worksheets are effectively used to improve students' critical thinking skills in class IV Mathematics at State Elementary School in Sumberejo, Kemiling, Bandar Lampung.

## KEYWORDS

Student Worksheet; Problem Solving; Critical Thinking Skill

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## Introduction

According to Law No. 20 of 2003, Article 3 concerning the National Education System, the current objective of Indonesian education is to develop the potential of students to become human beings who believe and fear God Almighty, have a noble character, is healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens (Depdiknas, 2003). Teaching and learning are two-way interactions between educators and pupils. If an educator performs his or her job appropriately, an effective teaching and learning process can be attained. One of a competent educator's responsibilities is to discover appropriate teaching materials and learning methodologies so that pupils are not passive and actively participate in teaching and study activities. Learning is an activity-based process, which means that pupils who learn actively participate in the learning process. The use of school supplies and the use of excellent learning strategies will also impact student learning outcomes to accomplish the intended learning objectives. According to the 2013 Curriculum's objectives for mathematics instruction, the goal of the subject is to help students solve issues in mathematics with a rational, critical, analytical, consistent, comprehensive, responsible, responsive, and persistent attitude. Students' critical thinking abilities are a crucial component to mastering mathematics learning objectives. Students' critical thinking abilities include the capacity to recognise, categorise, and logically and creatively address issues to reach just decisions.

Critical thinking skills for students are required for them to be prepared to solve problems and make informed judgements. Indeed, developing kids' critical thinking skills is difficult because each student has varied capacities, and pupils' interest in mathematics remains low. This is because most students believe mathematics is a tough and dull subject. One of the many factors influencing learning outcomes is the instructor component. In this situation, educators must be able to use and develop unique and creative media and learning practices to interest students in learning and increase student learning outcomes.

According to the findings of interviews with grade IV educators and the learning process at State Elementary School 2 Sumberejo, Kemiling Bandar Lampung, students lack high levels of learning enthusiasm. These appear to be relatively passive learners in learning. One of the issues is a lack of information among instructors about adequate

LKPD for mathematics subjects. Until now, instructors have relied solely on teaching resources provided in books. Even teachers rarely create their instructional materials. Only 25% of all mathematics learning educators use self-created worksheets in their classrooms. In the learning process, problem-solving questions are not overly elaborated. This is due to a lack of teacher proficiency with these queries. As a result, students do not have the opportunity to analyse a problem from their daily lives. In LKPD, learning activities are less diversified and more dominated by activities to do questions that are directed solely to logical-mathematical intelligence.

According to the findings of student interviews, most students rarely learn to use LKPD. As a result, kids are less engaged in learning in class. This means that kids are less challenged to independently examine knowledge or acquire critical thinking abilities. As a result, pupils will only work on the questions if the teacher has first introduced the content. Even if the learning process continues, educators play a significant part in problem-solving approaches since the process of growing students' abilities is only fixed by the educator's explanation. Based on the foregoing, this study will develop student worksheets (henceforth; LKPD) based on problem-solving to promote students' critical thinking in flat shape material. To promote students' critical thinking, students are expected to be able to determine the notion of the circumference of a flat shape through the problems given in the LKPD.

## Results and Discussion

### *Research and data collection*

During the research and data collection stage, the researcher first observed the conditions of the mathematics learning process and the needs needed to increase the critical thinking skills of primary school children at the school. Following observations and interviews with educators at public elementary school 2 Sumberejo (Figure 1.1), it was discovered that the teaching materials used by educators at these schools did not vary, causing students to struggle to understand learning and students' thinking skills to remain stagnant, despite the needs of the students. In every class, current skills in critical thinking must be developed. Based on the findings of this needs analysis, the researcher considers that the learning process in primary schools necessitates the use of problem-based worksheets, particularly in mathematics material, to strengthen students' critical thinking skill.

### *Planning*

The second stage is planning. The researcher began planning the development of problem-solving-based LKPD in mathematics material to boost fourth-grade students' critical thinking skills. The material chosen is the area and perimeter of flat shapes from grade IV primary school, as well as reference resources. There were numerous exercises to address difficulties on this theme, thus it is appropriate to be included in learning projects to improve students' critical thinking skills.

### *Developing initial products*

The next step is that the researcher develops the initial product. After determining the theme, the researcher must define competencies, indicators, objectives, and learning phases, and build a problem-solving-based model that is tailored to the syllabus. Because the Covid-19 epidemic was still in effect at the time of this research, the researchers devised a research product that might later be used for remote learning or online learning. The researcher then began to construct LKPD, which was, of course, tailored to the already-designed theme and lesson plan. The researcher designed the LKPD according to the level of fourth-grade elementary school students and the LKPD was designed to be attractive so that students would not get bored easily. Thus, researchers need the opinion of experts on the aspects of material, media, and language to assess the products that have been made by researchers.

### *Initial field trials*

Following the completion of the LKPD, a small-scale study was conducted. LKPD was first evaluated by material, media, and language experts. The following are the expert judgement results based on content validation analysis with expert judgement.

**Table 1.** Validation analysis with expert judgement

No.	Indicator	V	Description
1	LKPD contains the problem developed by the students	0.92	Strongly Valid
2	LKPD is carried out cooperatively	0.94	Strongly Valid
3	LKPD produces the product which can be presented	1.00	Strongly Valid
4	LKPD makes students more responsible	0.96	Strongly Valid
5	The activity in LKPD uses constructivism scientific procedure	0.95	Strongly Valid
6	The learning material in LKPD refers to Basic Competence	0.96	Strongly Valid

No.	Indicator	V	Description
7	LKPD presents teaching material or material that ease students to interact with the given material	0.98	Strongly Valid
8	The content of LKPD gives experience from learning activity	1.00	Strongly Valid
9	The type of activity in LKPD is hand on (directing students to be active)	1.00	Strongly Valid
10	The questions in LKPD is productive	1.00	Strongly Valid
<b>Average</b>		<b>0.97</b>	<b>Strongly Valid</b>

According to Table below, material experts agree that the LKPD is very valid. As a result, this problem-solving-based LKPD is thought to be feasible for application in the mathematics learning process for class IV Elementary Schools to strengthen students' critical thinking skills.

The following assessment comes from media experts, with the following analysis results:

**Table 2.** Validation analysis with media expert

No	Indicator	V	Description
1	Drafting of LKPD is universal	0.94	Strongly Valid
2	LKPD emphasizes on the process of finding concept	0.94	Strongly Valid
3	LKPD teaches students to be active in the learning process	0.94	Strongly Valid
4	LKPD develops the ability of communication, social, emotional, moral, and esthetics	0.94	Strongly Valid
5	Language Usage of LKPD	0.94	Strongly Valid
6	Sentence Usage of LKPD	1.00	Strongly Valid
7	Difficulty and clarity of LKPD	1.00	Strongly Valid
8	Writing	1.00	Strongly Valid
9	Picture	1.00	Strongly Valid
10	LKPD Display	1.00	Strongly Valid
<b>Average</b>		<b>0.95</b>	<b>Strongly Valid</b>

According to media experts, Table below reveals that the LKPD is extremely valid. As a result, media in the form of problem-based worksheets is deemed appropriate for use in the mathematics learning process for Grade IV Elementary Schools to strengthen students' critical thinking skills.

Other expert assessments are assessments by language experts with the following analysis:

**Table 3.** Validation analysis with language expert

No	Indicator	V	Description
1	Accuracy of sentence structure	1.00	Strongly Valid
2	Sentence effectiveness	1.00	Strongly Valid
3	Term ambiguity	1.00	Strongly Valid
4	Message readability	1.00	Strongly Valid
5	Accuracy of using language grammar	0.75	Strongly Valid
6	The ability to motivate message or information	0.88	Strongly Valid
7	The ability to encourage critical thinking	1.00	Strongly Valid
8	Suitability of students' intellectual development	1.00	Strongly Valid
9	Suitability with the level of students' emotional development	1.00	Strongly Valid
10	The coherence and cohesiveness among learning activities	1.00	Strongly Valid
11	The coherence and cohesiveness among paragraphs	1.00	Strongly Valid
12	The consistency of term usage	0.88	Strongly Valid
<b>Average</b>		<b>0.96</b>	<b>Strongly Valid</b>

According to Table below, LKPD is very valid in the opinion of language experts. As a result, the use of language in problem-solving worksheets has been deemed appropriate for the process of learning mathematics to strengthen the critical thinking skills of fourth-grade elementary school pupils. Following an evaluation by experts, the LKPD was tested on a small scale at first. The effectiveness of LKPD is assessed using the n-Gain formula in small-scale pre-test and post-test activities. Six students were subjected to small-scale tests, which are summarised in the table below:

**Table 4.** n-Gain for pre-test and post-test

No	Name	n-Gain	Description
1	AFL	0.50	Medium
2	AF	0.33	Medium
3	ASPA	0.50	Medium
4	DA	0.75	Medium
5	KK	0.40	Medium
6	SFH	0.33	Medium
<b>Average</b>		<b>0.47</b>	<b>Medium</b>

According to the findings of the analysis in Table below, students' learning outcomes improved when they used problem-solving-based worksheets in the moderate category. This indicates that LKPD must be revised following

expert recommendations to improve *student* learning results in the fourth-grade elementary school mathematics learning process.

### **Revision of initial field trial results**

At this stage, the researcher revised the experts based on the opinions received. According to the assessment of two material experts, the problem-solving-oriented LKPD in the material packaging part needs to be modified to make it more appealing so that students are interested in reading the LKPD and exercises to improve students' critical abilities need to be added. The validator gave comments based on the assessment of two media experts so that LKPD may further inspire students' activeness to ask questions, transmit ideas, and give more beautiful and colorful covers and backgrounds for students still in elementary school. The validator offered feedback to LKPD based on the judgement of two language experts, so that the use of language was more effective and inspiring, and the usage of punctuation in LKPD required attention.

Based on expert advice, the researchers concluded that the initial product of LKPD development still required revision of the content so that it was more appealing to elementary school students and fostered interest, and motivation to read it so that the study's goal of improving critical thinking skills could be achieved.

### **Main field trials**

Following the completion of the initial product revision, the primary field trials will be conducted by designing learning into two research groups, namely the experimental class group and the control class group. This class group was formed to measure the usefulness of problem-solving-based worksheets in the process of learning mathematics to promote critical thinking skills. In this main field trial, each class received a distinct treatment; specifically, the experimental class used problem-solving-based worksheets to increase critical thinking skills, while the control class employed traditional learning. The two courses were given a pretest before learning and a posttest after learning. The Independent Sample t-Test was used to analyse the usefulness of problem-solving-focused worksheets in the process of learning mathematics to increase students' critical thinking skills.

The results of the assumption test are shown in the table below:

**Table 5.** Assumption test result

No.	Class	Sig. Value	Requirement	Description
1	Experiment	0.060	Sig. Value	Normal
2	Control	0.064	> 0.05	Normal

According to Table below, students critical thinking skills in the experimental and control classes are regularly distributed. If the assumption of normalcy is met, the following analysis can proceed.

The following assumption test is the homogeneity test, which yields the following results:

**Table 6.** Homogeneity test result

Test	Sig. Value	Requirement	Description
Homogeneity	0.730	Sig. Value >0.05	Homogeneous

According to Table below, the homogeneity assumption has been met, or the variance in the experimental and control classes is homogeneous. If the two assumptions are met, the difference analysis or t-test can proceed with the following results:

**Table 7.** t-test result

Test	Sig. Value	Requirement	Description
T test	0.000	Sig. Value >0.05	Significant

According to Table 4.7, students' learning results have a significant value or there are changes in learning outcomes between the experimental and control classes. The size of the difference in learning outcomes between the experimental and control classes can be seen using the n-Gain analysis results. The n-Gain analysis yielded the following results:

**Table 8.** n-Gain analysis result

No	Class	Average <i>n-Gain</i>	Description
1	Experiment	0.62	Medium
2	Control	0.17	Low

There is a difference in the increase in learning outcomes between the experimental and control classes based on the results of the n-gain study. The experimental group increases in the intermediate category, while the control group increases in the low category. Thus, using problem-solving worksheets in the learning process is useful for increasing critical thinking skills and mathematical learning outcomes in fourth-grade elementary school pupils. If there are any abnormalities during the primary field trial implementation process, improvements will be addressed at this stage. The test results show that problem-solving-based worksheets on mathematics content are effective in improving the critical thinking skills of fourth-grade elementary school students. Thus, this research can be continued to grant research copyrights to LKPD so that LKPD can be utilized in the learning process in schools.

### ***Developing the LKPD based on problem-solving***

This research and development produced a product in the form of Student Worksheets (LKPD) based on problem-solving in mathematics content to improve critical thinking skills for class IV at State Elementary School 2 Sumberejo. Based on the results of observations that have been made by researchers, it is known that the potential abilities possessed by students can support the development of problem-solving-based worksheets Development of problem-solving-based worksheets that focus on mathematics, in grade IV elementary school.

The development of problem-solving-based LKPD adopts the development steps (Borg & Gall, 1983), as follows:

#### ***Search and data collection***

In this first phase, the researcher searches and collects initial data regarding the problems faced by the researcher. Researchers conducted a needs analysis by conducting interviews with educators and observing students. This is done to obtain information about deficiencies during the learning process in class. Based on the results of interviews at State Elementary School 2 Sumberejo Kemiling Bandar Lampung, it is known that learning activities still stick to using teaching materials found in books only and only 25% of all mathematics learning uses self-made LKPD teaching materials in learning mathematics. The LKPD given is still less varied, and more dominated by activities to do questions that are oriented to logical-mathematical intelligence only. Problem-solving questions are not too elaborated in the learning process.

As a result, students appear quite passive, and they do not have the opportunity to analyse an issue from their daily lives. After being explained the content, students will solely work on the questions. According to the findings of the needs analysis, 56% of students did not complete the daily test scores. This demonstrates that students' critical skills in learning mathematics are still relatively low, and pupils also struggle to build critical thinking skills. The researchers created problem-solving worksheets based on current challenges, one of which was to increase students' critical thinking skills at State Elementary School 2 Sumberejo.

#### ***Planning***

This second phase is the researcher's phase to start planning the preparation of problem-solving-based worksheet products by starting with determining the objectives of the research to be carried out, analysis of Core Competencies (KI, Basic competencies (KD), Indicators, Learning Objectives and scope of material, and compiling a grid of instrument grid In this phase the preparation of LKPD is intended to improve student's critical thinking skills in mathematics class IV State Elementary School 2 Sumberejo.

#### ***Developing initial product form***

The researcher developed the development into the initial version of the LKPD product after preparing the plan. During the initial development phase, the researcher established a development plan that included learning steps, competencies, indicators, and objectives that would be implemented in problem-solving-based worksheets, then validated, revised, and tested on a limited basis at State Elementary School 2 Sumberejo. Expert validation is a method that determines whether the creation of problem-solving-oriented worksheets can already be classified as an effective learning design for improving students' critical thinking skills. A team of experts comprised of material experts, design experts, and media experts provided initial product design validation. There are several suggestions given by the expert validator for the product being developed.

#### ***Initial field trials***

If the LKPD development plan has been finished, the LKPD has tested on small groups as well as a validation test. Six students participated in small group assessments, while experts, including material experts, media experts, and language experts, participated in validation tests. This is done to validate and test the product generated as a development stage need.

### *Revision of initial field trial findings*

The results of the initial field trial will be revised in the following phase. Following the completion of the initial study, the researcher receives feedback or ideas from specialists. The researcher then made changes based on the feedback from the experts.

### *Primary field trials*

The primary field testing is conducted after the researcher has completed the initial product revision. This trial was carried out by dividing mathematics learning into two study groups, namely the experimental class and the control class, where the two classes received different treatments, with the experimental class receiving treatment using problem-solving-based worksheets and the control class receiving treatment using traditional learning methods. Before beginning to study, the two courses were given a pre-test to determine the student's initial abilities, and after the two classes underwent treatment to improve the final product, they were given a post-test. In this phase, improvements will be made if there are irregularities during the main field trial implementation process. However, the trial results show that problem-solving-based LKPD on mathematics content is positive for improving critical thinking skills and can improve students' learning outcomes in mathematics. Thus the development of problem-solving-based LKPD was developed based on standard processes and syntax from Borg and Gall (1983) development research which is valid in meeting the material, media and language aspects.

### *LKPD effectiveness based on problem-solving*

Based on the effectiveness of the worksheets, this research generated worksheets based on problem-solving using flat shape materials to train critical thinking abilities. Worksheet learning based on problem-solving incorporates authentic problems, develops problem-solving abilities, and delivers work. The learning results of critical thinking abilities and students' reactions demonstrate the effectiveness of problem-solving-based worksheets on flat-form material in training students' critical thinking skills. The test of critical thinking skills learning outcomes is performed to measure the completeness of learning outcomes and achievement of critical thinking skills indicators. Tests are constructed based on learning indicators paired with indications of critical thinking skills, and then questions that are appropriate to accomplish these indicators are developed.

The purpose of the effectiveness test was to examine the efficacy and influence of problem-solving-based worksheets on learning outcomes connected to students' critical thinking skills. The efficacy test was conducted with 30 pupils from class IV State Elementary School 2 Sumberejo in the experimental class. The normality test, homogeneity test, t-test, and n-Gain test are used to assess the effectiveness of problem-solving-based LKPD. From this test, a significant value ( $> 0.05$ ) was obtained, namely 0.060 in the experimental class and 0.064 in the control class, meaning that the two classes indicated that students' critical thinking skills were normally distributed. The homogeneity test result ( $> 0.05$ ) for the two classes is 0.730, meaning that the homogeneity requirements for the two classes have been met. The results of the effects test as measured using the t-test obtained a significance value of 0.00 or less than 0.05. These results indicate that the learning outcomes of students have differences in learning outcomes between the control class and the experimental class. The extent of the difference in learning outcomes between the experimental and control classes can then be determined using the n-Gain analysis results. The n-Gain value in the experimental class is 0.62, while it is 0.17 in the control class. The experimental class's n-Gain value has increased to the moderate category, whereas the control class's growth remains in a low category. According to the findings of this study, the use of problem-solving-based worksheets in mathematics learning helps fourth-grade students at State Elementary School 2 Sumberejo develop their critical thinking skills. Student activity sheets based on PBL efficiently promote the implementation of student-centred learning. According to (Ananda & Tanjung, 2022; Saputra & Kuntjoro, 2019), one of the responsibilities of LKPD is as a teaching material that can strengthen the role of direct student interaction, so that students are active in learning. As a result, learning is student-centred, and the teacher serves only as a facilitator, assisting and guiding students to become self-sufficient and creating a learning environment in which students can get systematic instruction in conceptual, strategic, and reflective thinking in learning.

### *Advantages of LKPD based on problem-solving*

The advantages of problem-solving-based LKPD include the ability to improve students' learning motivation, inspire students to think at a higher level and make learning relevant to enable students to have strong self-confidence and the ability to learn independently. LKPD based on problem-solving also promotes increased student involvement in the learning process and improves learning attainment. In this circumstance, pupils must take an active role in developing their intelligence and talents.

There are various advantages to using Student Worksheets (LKPD) as a print-based learning medium, including the following:

- a. Students can learn and grow at their own pace and level of ability.
- b. In addition to being able to regurgitate material from printed media, pupils will be able to follow a logical chain of thinking.
- c. The use of text and images on printed pages is frequent; this can aid comprehension of information delivered in two formats, verbal and visual.
- d. Students will participate actively since they must answer the planned statements and exercises.

Problem-solving has several advantages including:

- a. Can strengthen skills in critical thinking so that students' initiative in work grows, an internal motivation to learn grows, and interpersonal relationships in group work can develop
- b. There will be meaningful learning in problem-solving. Learners learn to solve problems by using their existing knowledge or by attempting to discover the knowledge required to solve the challenge.
- c. Enabling pupils to become independent learners who are free to explore their knowledge.
- d. Problem-solving can help students create new information and take responsibility for their learning, as well as stimulate self-evaluation of both learning results and the learning process.

Thus, the advantages of developing problem-solving-based LKPD are as follows:

- a. A problem-solving-based LKPD is consistent with the revised 2013 curriculum. This is since students in the 2013 curriculum are expected to be able to identify, and give solutions to current problems, and have critical thinking skills.
- b. The creation of problem-solving-based worksheets based on the numerous problems that necessitate genuine investigation and completion of real problems. Problem-solving also enables students to engage between two directions of learning and the environment.
- c. According to the grade IV level of elementary school, the material produced for the development of problem-solving-based LKPD is made entertaining, original, and creative. This is designed to keep students from becoming bored, and it can also drive students to be excited about participating in learning.
- d. The development of problem-solving worksheets allows students to think critically.

### ***Limitations of problem-solving worksheet research and development***

The limitations of this study include:

- a. In this work, problem-solving-based LKPD development employs only seven phases of development. This is due to the current state of the Covid-19 epidemic, which means that time cannot be used optimally.
- b. The development of problem-solving-based worksheets was only adopted in one school.

### **Conclusion**

Based on the research and development results of problem-solving-based LKPD, it is possible to conclude that the problem-solving-based LKPD products created in this study are practicable. This is supported by validation analysis results from material experts, media experts, and language experts in the "very good" category, demonstrating that the problem-solving-based LKPD developed at State Elementary School 2Sumberejo is valid and feasible for use in the learning process, particularly in mathematics. The developed problem-solving-based LKPD products are effective. This is supported by the t-test findings, which show a significant difference between the experimental and control classes' learning outcomes, and the size of the learning outcomes gained in the experimental and control classes can be seen using the n-Gain value. Based on this analysis, the experimental class achieved values in the "moderate" category, whereas the control class earned values in the "low" category. Based on these findings, LKPD based on problem-solving is being applied effectively at SDN Sumberjo to strengthen students' critical thinking skills in class IV mathematics.

Based on the findings, the researcher suggests that for schools, the development of problem-based LKPD products can serve as a model for increasing educational quality. In terms of educators, the outcomes of this development can be used as a reference for teacher reference materials in the learning process to increase students' critical thinking skills in elementary schools. The final recommendation is for students to integrate the findings of this development research into their learning so that they are driven to learn, achieve, and have critical thinking skills. It is envisaged that future researchers will be able to employ questions with a higher level of difficulty in the medium and middle categories. Making questions must be tailored to the student's level of development and personality.

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