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Development of Student Worksheet Based on Contextual Problems to Facilitate Students' Mathematical Problem-Solving Skills in Flat-Sided Space VIII SMP/MTs

Aci Ayu Pratiwi, Yenita Roza*, Atma Murni
Faculty of Education and Teacher Training, Universitas Riau, Pekanbaru, 28293, Indonesia

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* *Corresponding author:*

E-mail: yenita.roza@lecturer.unri.ac.id

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A B S T R A C T

This study aims to overcome the problem of minimal use of Student Worksheets (LKPD) based on contextual problems in mathematics learning. Through the 4D development model, the LKPD developed is proven to be valid and practical in facilitating the problem-solving abilities of grade VIII junior high school students on the material of flat-sided solid shapes. The results of the small group LKPD trial obtained a score of 85.11% with a very practical category and the results of the large group LKPD trial obtained a score of 85.70% with a very practical criterion. Thus, overall it is concluded that the LKPD developed based on contextual problems to facilitate students' mathematical problem-solving abilities on the material of flat-sided solid shapes of grade VIII junior high school/MTs has met the valid and practical criteria. Thus, this LKPD has the potential to be an effective alternative in mathematics learning, especially in improving students' critical thinking and problem-solving abilities.

1. Introduction

Mathematical problem-solving ability is one of the essential aspects of mathematics learning that students must possess. The National Council of Teachers of Mathematics (NCTM, 1998) emphasizes the importance of five key competencies in mathematics learning: connections, reasoning, communication, problem-solving, and representation. Among these, problem-solving is the core of mathematics learning, as it not only serves as a learning objective but also as a means to help students understand more complex mathematical concepts.

However, real-world observations indicate that students' mathematical problem-solving skills remain relatively low. According to a report from the Education Assessment Center of the Ministry of Education and Culture, the national exam

results for flat-sided solid geometry from 2015 to 2019 showed a low average score of only 46.30%. Several factors contribute to this low performance, including difficulties in understanding problems, challenges in constructing mathematical models, and an inability to solve non-routine or contextual problems. Observations at a public school in Bengkalis also revealed that students generally could only solve problems that had been demonstrated by the teacher or those found in their textbooks.

One effort to address this issue is by providing supportive learning materials, such as Student Worksheets (LKPD), designed to facilitate mathematical problem-solving skills. This aligns with Gazali (2016), who stated that optimizing students' mathematical problem-solving abilities requires improvements in both the learning process and the availability of teaching materials like LKPD. According to Sholehah (2021), LKPD is an instructional material that contains a summary of the lessons taught along with the steps students need to follow.

To support the development of mathematical problem-solving skills, an appropriate learning approach is necessary. One effective approach is the scientific approach. LKPD based on the scientific approach is considered effective in enhancing students' engagement in the learning process because it emphasizes activities such as observing, questioning, reasoning, experimenting, and networking. These activities allow students to actively participate in exploring and analyzing problems.

The use of real-world contexts in scientific-based LKPD further strengthens the learning process, particularly in understanding abstract mathematical concepts, making it easier for students to solve contextual problems. Solving contextual problems requires the ability to connect mathematical concepts with real-life issues, often identified as the modeling process. The scientific approach encourages students to think critically and systematically, providing an ideal framework for solving contextual problems and enhancing overall mathematical problem-solving skills. When students engage with contextual problems, they relate problem situations to their personal experiences. Therefore, integrating contextual problems into mathematics learning is considered to have the potential to increase student engagement while motivating them in the learning process (Widjaja, 2013).

Previous studies have examined the importance of contextual-based teaching materials in improving mathematical problem-solving skills. However, this study offers a new contribution by developing a contextual problem-based LKPD on flat-sided solid geometry for eighth-grade junior high school students. In its development, this study follows three aspects of instructional material feasibility: validity, practicality, and effectiveness (Nieveen in Prabowo, 2016). However, this study focuses only on validity and practicality.

The objective of this research is to develop a contextual problem-based LKPD on flat-sided solid geometry that is valid, practical, and effective in facilitating the mathematical problem-solving skills of eighth-grade junior high school students.

The findings of this study are expected to serve as an alternative solution to improve the quality of mathematics learning while also positively impacting students' mathematical problem-solving abilities.

2. Methodology

The type of research conducted by the researcher is research and development (R&D). This study follows the 4-D development model, which consists of four stages: (1) Define, (2) Design, (3) Develop, and (4) Disseminate. The Define stage involves identifying the fundamental problem, requiring a solution through activities such as preliminary-final analysis, student analysis, concept analysis, task analysis, and formulation of learning objectives. The Design stage involves creating an initial product prototype using an approach that includes test standard development, format selection, media selection, and product design. This stage results in the development of a learning tool in the form of a Student Worksheet (LKPD) on the topic of flat-sided solid geometry. The Develop stage includes product validation by experts and development testing with students to produce an effective LKPD. The Disseminate stage involves distributing the developed product to schools or teachers.

The research trial process was carried out in stages to ensure the quality of the contextual problem-based LKPD. The first stage, the one-to-one trial, was conducted to evaluate the readability of the LKPD, involving three ninth-grade students. The next stage, the small group trial, aimed to identify weaknesses in the LKPD through feedback from six students in class IX.1 of SMPN 12 Pekanbaru. After revisions based on the previous two stages, a large group trial was conducted to test the practicality of using the LKPD with 29 students in class IX.2 of SMPN 12 Pekanbaru.

The research utilized both qualitative and quantitative data. Qualitative data were collected from observations and interviews at schools, as well as feedback from expert validation. Meanwhile, quantitative data were obtained from validation score sheets and student response questionnaires. Data analysis for validation sheets and student response questionnaires used a Likert Scale assessment, consisting of four response alternatives: 1, 2, 3, and 4. The criteria for the validity and practicality of the LKPD are presented in Table 1 below.

Table 1. Criteria for Validity and Practicality of the LKPD

Interval	Validity Category	Practicality Category
85,01% ≤ V/P < 100,01%	Very Valid	Very Practical
70,01% ≤ V/P < 85,01%	Valid	Practical
50,01% ≤ V/P < 70,01%	Less Valid	Less Practical
00,00% ≤ V/P < 50,01%	Not Valid	Not Practical

References : Akbar (2013)

3. Result and Discussion

This research was conducted following the stages of the 4-D development model by Thiagarajan (1974). In the Define stage, the researcher conducted an initial-final analysis, student analysis, concept analysis, task analysis, and formulation of learning objectives.

In the initial-final analysis, the researcher interviewed mathematics teachers from several schools regarding classroom learning conditions and the learning resources used. The interviews revealed that students had never used Student Worksheets (LKPD) during lessons, even though LKPD is a valuable instructional material for practicing exercises and understanding mathematical concepts.

During lessons, teachers provided routine exercises that were not contextually related, making the learning process ineffective in facilitating students' mathematical problem-solving skills. Additionally, students relied solely on the solution steps provided by the teacher, which limited their creativity and problem-solving skills, preventing them from solving problems independently using appropriate strategies.

In the student analysis, observations of students at SMPN 12 Pekanbaru indicated that they were not actively engaged in the mathematics learning process, which hindered the development of their mathematical problem-solving abilities. This was further supported by interviews with mathematics teachers at SMPN 12 Pekanbaru, who stated that students struggled to identify key information in given problems, making it difficult for them to determine the "known" and "asked" elements. Additionally, students often made mistakes in planning appropriate problem-solving steps.

In the concept analysis, the researcher systematically identified and organized the key components of the flat-sided solid geometry material to be included in the LKPD. The main topics covered are:

1. Surface Area of Cubes and Rectangular Prisms
2. Volume of Cubes and Rectangular Prisms
3. Surface Area of Prisms
4. Volume of Prisms
5. Surface Area of Pyramids
6. Volume of Pyramids

In the task analysis and learning objectives formulation, the researcher identified the essential skills students must master to meet the minimum competency standards. The task analysis was conducted as part of the implementation to achieve the Competency Achievement Indicators (IPK), which were derived from the selected Basic Competencies (KD). The IPK were then used to formulate learning objectives, resulting in 15 objectives across all learning sessions.

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In the Design stage, the researcher developed the initial prototype of the LKPD using the scientific approach to enhance students' mathematical problem-solving skills.

- Test Standard Development: The researcher prepared validation sheets and student response questionnaires.
- Format Selection: The LKPD format was designed, incorporating color, images, page layout, and organization.
- Media Selection: Microsoft Word and Canva were chosen as supporting tools for designing the LKPD.
- Initial Product Drafting: A systematic storyboard of the LKPD was created, aligning with the scientific approach and indicators of mathematical problem-solving skills.

Once the initial LKPD design was completed, the next step was to develop the LKPD for six learning sessions covering cubes, rectangular prisms, prisms, and pyramids. The LKPD was structured into three main sections:

1. Cover: Contains the lesson title, class information, and group member names.
2. Introduction: Includes the Basic Competencies, learning objectives, and instructions for using the LKPD.
3. Content: Follows the initial format and adheres to the steps of the scientific approach.

Additionally, at the end of the LKPD, there is an "Ayo Berlatih" (Let's Practice) section, which provides two types of exercises to encourage students to engage with the material. Examples of LKPD-1 and LKPD-2:

1. LKPD-1: Covers the surface area of cubes and rectangular prisms using contextual problems and manipulatives. Students cut out a box to form the net of a cube or rectangular prism, allowing them to discover the formulas for surface area.
2. LKPD-2: Focuses on the volume of cubes and rectangular prisms using a contextual problem-solving approach. Students calculate the number of smaller cubes that fit inside a larger cube, helping them grasp the concept of volume more concretely.

Through these activities, students are expected to develop a deeper understanding of surface area and volume in a practical and engaging way**.**

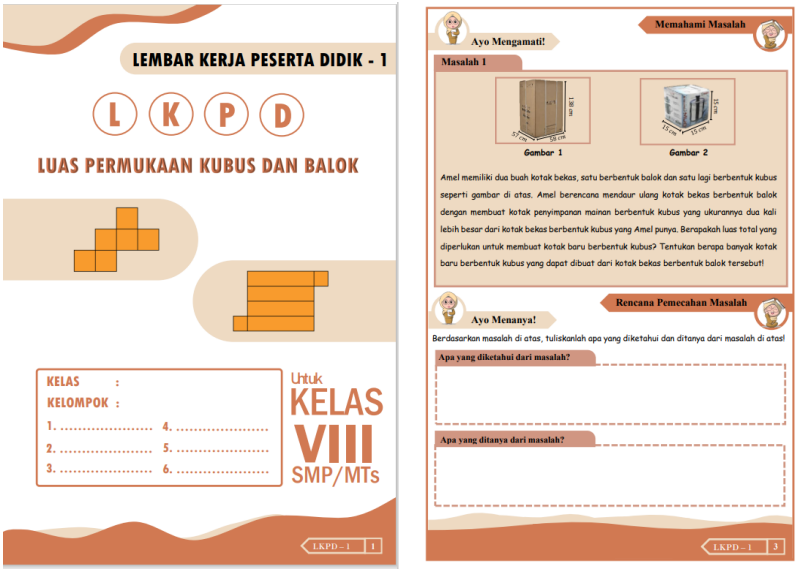

Figure 1. LKPD-1 Surface Area of Cubes and Rectangular Prisms

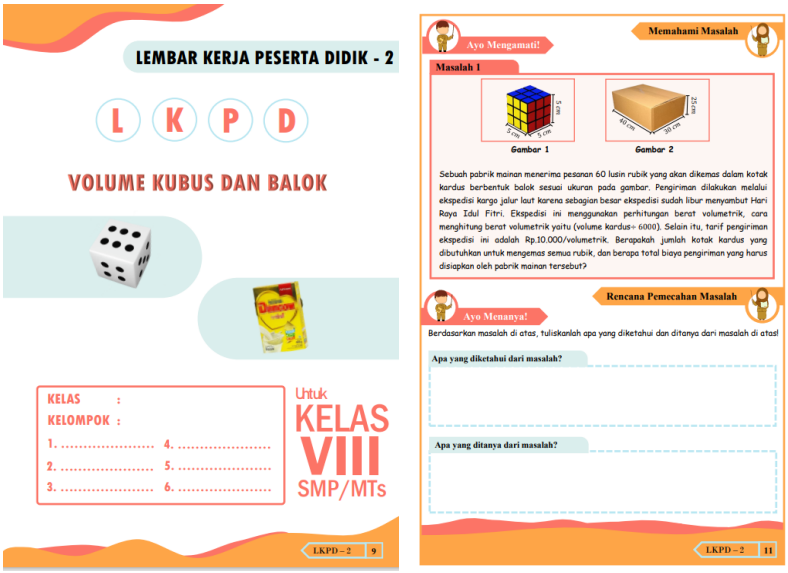

Figure 2. LKPD-2 Volume of Cubes and Rectangular Prisms

At the Develop stage, the researcher modified the LKPD based on formative evaluation by adopting Tessmer's model (as cited in Efendi, 2024). The formative evaluation consisted of expert validation and a one-to-one trial. The validation was conducted by three validators, including two mathematics education lecturers and one mathematics teacher. Meanwhile, the one-to-one trial involved ninth-grade SMP students living around the researcher's area. The following are the validation results of the LKPD from the three validators.

Table 2. Result of Validity of the LKPD

Assessed Aspects	Average LKPD Assessment by Validators −(%)						Average (%)	Category
	1	2	3	4	5	6		
LKPD Cover Appearance	100	100	100	100	100	100	100	Very Valid
LKPD content	96,30	94,44	97,22	94,44	96,30	97,22	95,99	Very Valid
LKPD Alignment with KPMM Indicators	93,75	100	95,83	89,58	87,50	100	94,44	Very Valid
Compliance with Didactic Requirements	88,33	91,67	86,67	90	88,33	90	89,16	Very Valid
Compliance with Construction Requirements	87,50	88,89	84,72	86,11	84,72	86,11	86,34	Very Valid
Compliance with Technical Requirements	91,67	89,58	89,58	86,46	84,38	88,54	88,37	Very Valid
Average	93,93	94,10	92,34	91,10	90,21	93,64	92,55	Very Valid

Based on Table 2, the average total score from the three validators for the six developed LKPDs was 92.55%, categorized as highly valid. This indicates that the LKPDs can be tested after incorporating the suggestions provided by the validators. The validators' suggestions are as follows:

1. In Activity 4 of LKPD-1, the validator suggested removing the word "ini" as it was considered ambiguous.
2. In the "Let's Gather Information" step of LKPD-3, the validator noted that the provided column was too small and needed to be enlarged to facilitate students in drawing.
3. In Problem 1 of LKPD-4, the validator pointed out that the image presented did not match the shape described in the problem.
4. In Problem 1 of LKPD-5, the validator commented that the problem presented was not directly related to the daily lives of SMP/MTs students.

After validation and revisions based on the validators' suggestions, the next stage was product testing. The small-group trial was conducted on July 16 and 18, 2024, involving six ninth-grade students from class IX.1 at SMP Negeri 12 Pekanbaru. The large-group trial was carried out with 29 ninth-grade students from class IX.2 using student response questionnaires in the same location.

During the trial, the researcher distributed the LKPDs to each student. At the beginning of the activity, the researcher provided information about the LKPD usage guidelines to ensure students understood what they needed to do. Once each LKPD was completed, the researcher distributed student response questionnaires to gather feedback on the LKPDs they used. Clear instructions were also given on how to fill out the questionnaire. After the students finished working on all LKPDs and filling out the response questionnaire, the researcher conducted a brief

discussion with them to obtain additional feedback, which was then used for further revisions.

Table 3. Small Group Trial Result

Practical Aspect	Student Response Questionnaire Result on LKPD – (%)						Average (%)	Category
	1	2	3	4	5	6		
Ease of Use	88,54	86,46	87,50	82,29	82,29	83,33	84,74	Practical
Attractiveness	86,11	86,11	86,11	84,72	84,72	84,72	85,42	Very Practical
Efficiency	86,11	87,50	84,72	86,11	81,94	84,72	85,18	Very Practical
Average (%)	86,92	86,69	86,11	84,37	82,98	84,26	85,11	Very Practical

The results of the student response questionnaire for the small-group trial are presented in Table 3. The findings show that the average score for LKPD-1 to LKPD-6 was 85.11%. Based on this average, it was concluded that the LKPDs developed by the researcher fall into the "highly practical" category for use. The lowest average score was 82.98% for LKPD-5, while the highest was 86.92% for LKPD-1. After the small-group trial, the product was revised based on student feedback and then tested in the large-group trial.

The large-group trial followed a similar procedure to the small-group trial, where students completed the LKPDs and then filled out the response questionnaire. The results of the student response questionnaire for the large-group trial indicate that the developed LKPDs effectively facilitate students' mathematical problem-solving skills in SMP/MTs. The results of the student response questionnaire for the large-group trial are shown in Table 4 below.

Table 4. Large Group Trial Result

Practical Aspect	Student Response Questionnaire Results on LKPD – (%)						Average (%)	Category
	1	2	3	4	5	6		
Ease of Use	84,72	84,05	85,13	83,41	85,56	85,13	84,60	Practical
Attractiveness	85,06	87,36	89,94	86,78	87,36	86,50	87,16	Very Practical
Efficiency	84,20	85,06	83,05	85,34	87,07	87,36	85,35	Very Practical
Average (%)	84,45	85,49	86,04	85,18	86,67	86,33	85,70	Very Practical

Based on the results from the large-group trial presented in the table above, the average score obtained was 85.70%, categorizing the LKPD as highly practical. The lowest average score was 84.45% for LKPD-1, while the highest was 86.67% for LKPD-5. No further revisions were made during this large-group trial. The final stage of the 4-D model, Disseminate, involved distributing the LKPD by compiling it into a book and disseminating it to SMP Negeri 12 Pekanbaru.

This development research aimed to produce a practical and effective teaching material. The developed product is a context-based problem-solving LKPD designed to facilitate students' mathematical problem-solving abilities in the topic

of three-dimensional geometric shapes with flat surfaces. The LKPD was designed to be more engaging by incorporating images and colors to enhance students' focus and enthusiasm during the learning process. With this approach, the LKPD is expected to support mathematical problem-solving skills and positively impact learning outcomes. The trial results showed that students enjoyed using this LKPD. Based on the feedback and comments received, they appreciated the design, which included well-structured worksheets and attractive colors.

Based on the validation process, one-to-one trials, small-group trials, and large-group trials, the context-based problem-solving LKPD developed for eighth-grade SMP/MTs students met the criteria for validity and practicality. The developed student worksheets were then compiled and presented in the form of a teaching material book.

4. Conclusion

This development research resulted in a Student Worksheet (LKPD) that aligns with the 2013 curriculum, specifically for the topic of three-dimensional geometric shapes with flat surfaces, by incorporating contextual problems to facilitate the mathematical problem-solving abilities of eighth-grade SMP/MTs students. The LKPD was validated by three experts and tested on ninth-grade SMP/MTs students, ensuring its validity and practicality.

This study successfully designed an effective and beneficial context-based problem-solving LKPD for three-dimensional geometric shapes. Educators can utilize this LKPD as a guide to enhance the quality of mathematics instruction. Additionally, this LKPD has great potential for further development, both for other mathematical topics and different educational levels. Its alignment with the 2013 Curriculum and the Independent Curriculum demonstrates that this LKPD can adapt to future learning needs.

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