

IMPROVING STUDENTS' MATHEMATICAL REASONING ABILITY THROUGH LKPD (STUDENT WORK SHEETS) IN FLAT SIDED SPACES MATERIALS

Dicky Wachyudi^{1*}, Dian Nataria Oktaviani², Ahmadi³

^{1,2,3} Departments of Mathematics Education, Pancasakti Tegal University, Tegal, Indonesia

*Corresponding author: dickywachyudi.contact@gmail.com

Abstract

The purpose of this development research was to find out the form of a valid LKPD and find out the results of the development of student worksheets on flat-sided geometrical material in improving the mathematical reasoning abilities of class VIII students who met valid criteria. The development model used in this study is ADDIE which includes the stages of analyze, design, development, implementation, and evaluation. However, this research is only limited to the development stage. The instrument used to measure the validity of the developed LKPD is a validity questionnaire by expert lecturers and mathematics teachers. The validity of LKPD is assessed from the assessment of experts with a maximum score of 4 for each statement. The results of the LKPD assessment of four lecturers and two teachers are 3.85 so that it can be interpreted that the LKPD developed has a very valid category.

Keywords: Development of LKPD, Flat Sided Spaces Geometric, Mathematical Reasoning Ability

1 INTRODUCTION

Mathematics is a very important and useful learning for humans because it is directly applied in everyday life. In essence, learning mathematics aims to train the brain so that it can have the ability to reason, think logically, regularly, continuously, and state strong evidence in every statement made [1]. One of the goals to be achieved in learning mathematics is mathematical reasoning ability. This is in line with the National Council of Teachers of Mathematics (NCTM) which states that there are six learning objectives namely (1) mathematical understanding, (2) mathematical reasoning, (3) mathematical communication, (4) mathematical connection, (5) mathematical representation), (6) mathematical problem solving [2].

Mathematical Reasoning and Mathematical Learning themselves are two related things that cannot be separated, because mathematical material itself can be understood through reasoning and reasoning can also be trained and understood through learning mathematics [3]. Therefore, through learning mathematics, students' mathematical reasoning abilities can be trained.

Based on the results of initial observations made on January 2, 2023 at Tegal 10 Public Middle School, it shows that the learning carried out pays little attention to students' mathematical reasoning abilities. This can be seen from the learning that is still focused on the teacher. The teacher who is more dominant explains at the time of learning. During this learning process, students only pay attention to the teacher's explanation in front of the class and then immediately record what the teacher has written. When students are given questions, they find it difficult to propose the right solution steps, then when given questions of a different type, these students find it difficult to find the flow of solving the problem. This shows that students' mathematical reasoning abilities are still low.

The low mathematical reasoning abilities of these students can be seen from the results of the Mathematics Daily Test scores for the 2021/2022 Academic Year on the material aspects of Building Flat Sided Spaces. The average value shows an overview of the ability of students in mastering the Flat Sided Building material, where the overall average score is still below the KKM, namely 70. The low ability of these students can also be seen from student data based on their grades, where 63.93% of students still have a value below the KKM, this can be seen in table 1

Tabel 1. The average value of students' daily tests in 2022 at SMP Negeri 10 Tegal

Mathematics Test	Grade Point Average							Overall Average Score
	VIIIA	VIIIB	VIIIC	VIIID	VIIIE	VIIIF	VIIIG	
2022	68.33	56.72	57.50	39.22	48.13	43.23	78.83	55.99

Factors causing the low ability of students' mathematical reasoning, one of which is because the teaching materials used in the learning process pay less attention to aspects of the students' own reasoning. Stacey & Vincent (2009) stated that most teaching materials only present practice questions for tests rather than material explanations that train students' reasoning to think. Teachers in the learning process need to provide practice questions to train students and direct them to mathematical reasoning abilities so that students become more accustomed to reasoning to solve a problem [5].

Based on the initial interview conducted on December 30 2022 to the class VIII teacher at SMP Negeri 10 Tegal, it was found that the learning media used for the material on flat sides in class VIII SMP Negeri 10 Tegal are visual aids, as well as teaching materials on flat sides. that is used is the teaching module of the Subject Teacher Consultation (MGMP). However, there are deficiencies in the teaching module, namely the flat sided geometric material that is conveyed, namely the lack of pictures or illustrations regarding flat sided geometric material, and only showing a quick formula for calculating without accompanying the steps to find the formula. This makes the existing teaching materials not focus on the process of developing students' mathematical reasoning abilities. The low ability of mathematical reasoning can also be seen from the results of the interviews, when students get questions, students can write down the known and asked components of the problem, but only some students can find existing patterns regarding these components, as a result only some participants only students who can arrange answers and then conclude the solution of the problem. Of course, to overcome this so that teaching materials can facilitate students' mathematical reasoning abilities, appropriate teaching materials are also needed.

The use of teaching materials at SMP Negeri 10 Tegal is not optimal because it has not utilized other alternative teaching materials such as PowerPoint, learning videos or student worksheets (LKPD). LKPD is a printed teaching material in the form of sheets containing material, summaries, exercises, and instructions that students must work on [6, p. 204]. This student worksheet was chosen to be used because it has advantages, namely: 1) student worksheets make students actively carry out learning activities by carrying out an activity, 2) student worksheets are practical teaching materials because they can be used outside or outside in class, 3) student worksheets are teaching materials that focus on students, 4) student worksheets can help teachers to determine the level of student learning achievement based on what the students have done. Student worksheets are expected to be a way out to facilitate students' mathematical reasoning abilities because these teaching materials can be designed in a structured manner so that students can draw conclusions well and logically on the issues presented. Therefore it is necessary to develop student worksheets that contain clear explanations of the material, presentation of the application of the material, as well as real problems related to the material that are able to develop students' mathematical reasoning abilities so that students can be involved in solving problems with the knowledge they already know. previously.

Based on the results of the analysis, it can be seen that learning pays little attention to students' mathematical reasoning abilities, the result of this is that students' mathematical reasoning abilities are low and students have difficulty understanding the material on flat sided spaces. Because students' mathematical reasoning abilities are low and students have difficulty understanding the material for flat-sided shapes, students experience problems in the process of calculating the area of flat-sided shapes. So that the solution is obtained, namely the development of interesting flat-sided building material teaching materials and training students' mathematical reasoning abilities, namely LKPD Flat-sided Building Material Material. The end result of this solution is the LKPD Material for Building Flat Sided Spaces.

Based on the background above, several problem formulations are described as follows: How do the results of developing student worksheets on flat-sided geometrical material in improving the mathematical reasoning abilities of class VIII students meet the valid criteria achieving an average validation value of at least 2.50? And the purpose of this study: To find out the results of the development of student worksheets on flat-sided geometrical material in improving the mathematical

reasoning abilities of class VIII students who meet valid criteria achieving an average validation value of at least 2.50.

2 METHODOLOGY

The research carried out was the development of student worksheets on flat-sided geometrical material, thus the method used in the research was the research and development method (Research and Development/R&D). According to Sugiyono [7, p. 297], research and development methods (Research and Development/R&D) are research methods used to produce a particular product and test the effectiveness of that product. In this study, the product developed was worksheets for students on flat-sided shapes for class VIII students in the even semester.

The location for conducting this research is SMP Negeri 10 Tegal which is located at Jalan Kartini No. 58, Kec. East Tegal, Tegal City. This research plan is carried out in the even semester of the 2022/2023 school year by adjusting the hours of mathematics lessons in class VIII itself. The subjects of this study were class VIII students at SMP Negeri 10 Tegal. Self-developed research on students' mathematical reasoning abilities. The researcher took the object of research in the form of learning tools, namely lesson plans and worksheets on flat sided building material.

The procedure for developing LKPD on flat-sided geometric material for class VIII SMP Negeri 10 Tegal uses the ADDIE development model which includes Analyze, Design, Development, Implementation, and Evaluation proposed by Sugiyono (2015:38). In this research the development stage is limited to the development stage, this is because the implementation of learning teaching materials is still a trial activity, namely development is structured to obtain valid LKPD as needed. The stages that will be carried out in this research are.

Stage 1. Analyze (Analysis)

The analysis stage is a stage that is carried out by analyzing needs and problems in the form of relevant materials, teaching materials, and learning conditions (Sugiyono 2015:38). The information needed in this analysis stage is in the form of an analysis of students' needs, an analysis of students' mathematical reasoning abilities, and an analysis of material concepts.

Stage 2. Design (Design)

After doing the analysis, the next stage is the Design stage. the Design (Design) stage of LKPD products, namely formulating the elements needed in LKPD such as indicators and learning objectives as well as drafting LKPD material for flat sided spaces. Preparing references for products and compiling product designs is what is done at this stage.

Stage 3. Development (Development)

The development stage is a stage that aims to realize the product that was designed at the design stage. The end result of the development stage is a product in the form of an LKPD which will be tested. Furthermore, validation will be carried out by experts in their fields, namely four lecturers and two junior high school teachers. This expert validation aims to assess whether the LKPD meets the valid criteria.

The source of the data in this study was data on daily test scores for the flat-sided geometric material obtained from Class VIII teachers at SMP Negeri 10 Tegal and the results of observations on the learning process in class and interviews conducted with Class VIII teachers at SMP Negeri 10 Tegal. The form of the data in this study is a description of the stages of development of the LKPD on the flat sided space material. The results of data collection are in the form of descriptions obtained from observations and interviews. The instruments used include observation sheets, interview sheets, and expert validation questionnaires.

In this study, after the observations were made and the two informants had been interviewed, the results were obtained from the observations and interviews, then the data was analyzed through the stages proposed by Moleong [8], these stages are:

1. Data reduction

Data reduction is the process of selecting and focusing the data obtained. The results of observation and interview data that have been obtained will then be identified and then linked to the research problem.

2. Categorization

Categorization is the process of sorting data into sections that have similarities to the research problem

3. Synthesis

Synthesis is the process of looking for links between existing categories and other categories

4. Conclusion Drawing

Drawing conclusions is an activity carried out based on the analysis of data that has been obtained. From these data, interpretation is then carried out to get a conclusion

The validity analysis technique used in this study to determine the validity of LKPD through an expert validation questionnaire is based on a 4-point likert scale, with the following validity analysis scoring:

Tabel 1. Penskoran Validasi

Pilihan Jawaban	Skor
Sangat Relevan	4
Relevan	3
Kurang Relevan	2
Tidak Relevan	1

Sumber: Widiyoko (2013)

Adapun hasil dari perhitungan tersebut dapat diinterpretasikan dengan menggunakan kategori sebagai berikut:

Tabel 2. Pengkategorian Validasi

Interval Skor	Kategori
$0 < \bar{x} \leq 1,75$	Tidak Valid
$1,75 < \bar{x} \leq 2,50$	Kurang Valid
$2,50 < \bar{x} \leq 3,25$	Valid
$3,25 < \bar{x} \leq 4,00$	Sangat Valid

Sumber: Widiyoko ((2013)

3 RESULTS

The results of the LKPD development research carried out with the ADDIE stage which is limited to the Development stage are as follows

Analyze

At the analysis stage, an analysis of the needs of students is carried out, an analysis of mathematical reasoning abilities, and an analysis of the concept of the material. Several things were obtained from the analysis stage as follows.

- Analysis of student needs aims to determine the basic problems encountered in student learning, this is used to analyze student needs regarding the media used in learning at SMP Negeri 10 Tegal. From the results of previous interviews, it was found that the learning media used for the flat sided geometric material in class VIII SMP Negeri 10 Tegal were teaching aids, as well as the teaching material for the flat sided geometric material used, namely the teaching module from the Subject Teacher Consultation (MGMP).
- Analysis of students' mathematical reasoning abilities is carried out to determine students' mathematical reasoning abilities, so that the preparation of LKPD will be adjusted to the abilities of students and will train students' mathematical reasoning abilities well. Based on the results of observations that have been made, it was found that when students were given questions, they found it difficult to propose the right steps for solving them, then when given questions of a different type, these students found it difficult to find a path from solving the problem. Meanwhile, based on the results of the interviews, it was found that when students got questions, students could write down the known and asked components of the questions, but only some students could find existing patterns regarding these components, as a result, only some students could Compile answers and then conclude the solution of the problem.
- Concept analysis of this material was carried out by identifying the main material, namely

cubes and blocks, as well as details of the material, namely cube nets, surface area of cubes, nets of blocks, and surface area of blocks, then rearranging the material systematically to find out what components are contained in this LKPD.

Design

At the design stage, it is carried out by formulating the elements needed in the LKPD such as indicators and learning objectives as well as drafting the LKPD for flat sided building materials to be presented and designing the LKPD framework to be made.

- a. The initial part consists of the front page (outer cover), preface, core competencies, basic competencies, competency achievement indicators, instructions, and introduction.
- b. This section consists of activities and material descriptions to train students' mathematical reasoning abilities.
- c. The closing section consists of reasoning exercises for students to do.

Development

The final stage is development, at this stage the design will be realized. The development steps undertaken are as follows:

a. LKPD form

The form of LKPD which is the final product of this research is student worksheets which contain material for building flat sides of cubes and blocks, as well as details of the material, namely nets and surface area of cubes and blocks. These student worksheets are adapted to indicators of mathematical reasoning according to Nurhayati and Rosyidi (2015: 4), namely taking into account the completion process, using patterns and interrelationships to examine mathematical problems, stating valid arguments using systematic methods, drawing logical conclusions.

The material developed in student worksheets is presented based on the components according to Daryanto and Dwicahyono (2014)[10], namely 1) Title, Subject, Semester, and Place, 2) Learning Instructions, 3) Competence to be achieved, 4) Indicators, 5) Supporting Information, 6) Exercises and work steps, 7) Assessment.

The results of the development and improvement on the suggestions for improving the validator are as follows.

1. LKPD cover

The cover page is designed to consist of a logo, title, image, name of the LKPD composer. The image on the cover is adapted to the flat sided space construction material and is designed to be as attractive as possible.

2. Author and Editor

Authors and Editors contain writers and editors who contributed to making LKPD.

3. Preface

The preface contains an explanation of the background, motivation, and importance of the topics discussed in the LKPD.

4. Table of Contents

The table of contents lists the titles of the sections or chapters in the LKPD.

5. Instructions for Using LKPD

Instructions for using LKPD are guides that provide information on how to use LKPD in the learning process.

6. Core Competencies, Basic Competencies, Competency Achievement Indicators, and Introduction

On this page, the goal is for students to know what to achieve after they have used and studied this LKPD and an introduction to the material to be studied.

7. Student Activities and Materials

The material in this LKPD is obtained from every activity in the LKPD. Students are expected to be able to understand the concept of the material presented through the design of the commands and questions that have been given.

8. Practice Questions

This exercise is a medium for practicing questions for students to measure students' mathematical reasoning abilities after studying the material, this section is made based on indicators of achievement of existing competencies and contains problems that must be solved.

b. Product Validation

Research on the development of LKPD on flat-sided geometrical material in improving the mathematical reasoning abilities of class VIII students uses the ADDIE development method, namely Analyze, Design, Development, Implementation, and Evaluation. However, in this study the research phase was limited to the development stage, so it was suggested to other researchers to test the practicality and effectiveness of this worksheet in improving student learning outcomes, because this research only reached the validity test stage.

In the analysis stage (analyze), the activities carried out include analysis of students' needs, analysis of mathematical reasoning abilities, and analysis of material concepts. The selection of suitable teaching materials by providing illustrations and showing steps to find a formula can provide students with an understanding of mathematical reasoning to students, especially in the material of geometric shapes, the sides of cubes and blocks are the results obtained from this stage. This condition is in accordance with research conducted by Anggraeni Dini [11] which states that the selection of teaching materials that provide illustrations can support the clarity of the presentation of learning material and stimulate students to understand according to mathematical reasoning indicators. So based on this, the analysis stage in this study was carried out to support the clarity of the presentation of the material for the flat sides of cubes and blocks based on indicators of mathematical reasoning.

At the design stage, the activities carried out include identifying the material, compiling the design, and determining the format of the LKPD. The conclusion that can be drawn at this stage is what steps have been taken so that the design of the LKPD that will be developed later is in accordance with the 2013 curriculum, especially the material for building flat sided rooms for class VIII. This condition is in accordance with research conducted by Handayani and Mandasari (2018) which states that the steps for identifying materials, preparing designs, and determining the format of LKPD are important stages in preparing products. So based on this, the design stage in this study was carried out to identify the material, arrange the design, and determine the format of the LKPD.

The final stage is development, the activities carried out are the preparation of LKPD, validation and revision. The LKPD that has been developed is then validated by experts to see its validity and the deficiencies in the LKPD that have been developed. LKPD which has invalid criteria will be corrected according to the suggestions given to produce more valid product criteria. If the LKPD has been declared valid, it can be interpreted that the LKPD has been developed so as to produce the final product, namely LKPD on flat sided geometrical material in improving students' mathematical reasoning.

LKPD validation was carried out by four expert lecturers from Mathematics Education at Pancasakti University of Tegal and two mathematics teachers at SMP Negeri 10 Tegal. Each validator has provided suggestions for improvements to the LKPD that has been developed to get a better final product. The average LKPD validation results from the six validators is 3.85 by producing a category that is very valid so that the LKPD on flat-sided geometric material can be used in the learning process in junior high schools to improve student learning on flat-sided geometric material.

Based on the description above, it can be concluded that the LKPD material on flat sided shapes in improving students' mathematical reasoning has been developed and meets very valid criteria.

4 CONCLUSIONS

Based on the results of research and discussion, the conclusions obtained are:

1. The development of LKPD on flat sided geometric material uses the ADDIE development model which starts from the Analyze, Design and Development stages. This LKPD is in the very valid category based on the average final score obtained from the LKPD validation results by each

expert. The average LKPD validation results from the six validators is 3.85 by producing a category that is very valid.

2. The form of LKPD, which is the final product of this research, is a student worksheet which contains material on flat side shapes, namely cubes and blocks adjusted to indicators of mathematical reasoning.

REFERENCES

- [1] F. Fanany, I. Isnani, and A. Ahmadi, 'Keefektifan Pembelajaran Kontekstual Terhadap Kesulitan Belajar Matematika Dan Kemampuan Penalaran Matematis Siswa', *Indiktika J. Inov. Pendidik. Mat.*, vol. 1, no. 2, pp. 144–153, 2019, doi: 10.31851/indiktika.v1i2.3035.
- [2] E. Suherman, *Strategi pembelajaran matematika kontemporer*. Bandung: Jica, 2003.
- [3] O. Romsih, Y. Yuhana, and H. Nindiasari, 'Peningkatan Kemampuan Penalaran Matematis Siswa Melalui Problem Posing Ditinjau Dari Tahap Perkembangan Kognitif Siswa', *SJME (Supremum J. Math. Educ.)*, vol. 3, no. 1, 2019.
- [4] K. Stacey and J. Vincent, 'Modes of reasoning in explanations in Australian eighth-grade mathematics textbooks', *Educ. Stud. Math.*, vol. 72, no. 3, 2009.
- [5] Nursalam, A. D. Angriani, and H. Usman, 'PENGEMBANGAN TES KEMAMPUAN PENALARAN MATEMATIS PESERTA DIDIK MADRASAH TSANAWIYAH DI MAKASSAR', *J. Pendidik. Mat.*, no. 36, 2017.
- [6] A. Prastowo, *Panduan Kreatif Membuat Bahan Ajar Inovatif*. Jogjakarta: DIVA Press, 2012.
- [7] Sugiyono, *Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif, dan R&D)*. Bandung: Alfabeta, 2015.
- [8] L. J. Moleong, 'Metode penelitian kualitatif edisi revisi', *Bandung PT Remaja Rosdakarya*, 2014.
- [9] E. P. Widiyoko, *Evaluasi program pembelajaran: Panduan praktis bagi pendidik dan calon pendidik*. Yogyakarta: Pustaka Pelajar, 2013.
- [10] Daryanto and A. Dwicahyono, *Pengembangan Perangkat Pembelajaran (Silabus, RPP, PHB, Bahan Ajar)*. Yogyakarta: Gava Media, 2014.
- [11] Anggraeni Dini, 'Pengembangan LKPD Berbasis Etnomatematika Pada Materi Bangun Ruang Sisi Datar Dismp Negeri 2 Satap Sabbang Kabupaten Luwu Utara', p. 159, 2020.