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# MODEL LEARNING TOOLS *DISCOVERY LEARNING* TO IMPROVE PROBLEM SOLVING SKILL CLASS VIII MATHEMATICS

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**ABSTRACT**

Mathematics is a science that plays a very important role. Mathematics sharpens many abilities, one of which is problem solving ability. However, students' mathematical problem solving abilities are still low, so it is necessary to develop learning tools that can improve students' mathematical problem solving abilities. The development of learning tools needs to be developed to support the quality of education . The aim of this research is to develop *discovery learning* model learning tools to improve students' mathematical problem solving abilities. This research uses the Plomp model with the aim of producing valid, practical and effective criteria.

**Keywords:** ***Mathematics, Problem Solving Ability, Learning Tools, Discovery Learning, Valid, Practical, Effective***

## 1. INTRODUCTION

Mathematics is a science that plays an important role in the success of educational programs, because mathematics is a basic academic science for other sciences. Mathematics subjects hone many abilities, including the ability to understand concepts, critical thinking, problem solving and so on. At this time, problem-solving skills are much needed in everyday life, because in principle life itself is a source of problems (Jana & Nisan, 2019). Apart from that, problem-solving abilities are also a competency that students must achieve both in elementary schools, middle schools and universities in Indonesia (Kemendikbud 2013). Therefore, problem solving becomes an important focus from elementary to middle school (Yulius, 2019).

The importance of problem solving skills is as a first step for students to develop ideas in building new knowledge and developing mathematical ideas. Problem solving as a method during learning that can be used to introduce concepts, through learning that involves exploration and discovery (Wilson 1993, et al). Problem solving ability is one of the goals of mathematics learning that students must master (Wilson 1993, et al).

Even though problem solving is very important in learning mathematics, mathematics is not a subject that students are interested in (Simamora et al, 2019). Students' mathematical problem solving abilities are low (Rahmiati et al, 2017). (Phonapichat et al, 2014) reported that the results of interviews with teachers about word problems in mathematics were very difficult for students. (Nasution & Yerizon, 2019) had the same low mathematical problem solving ability when conducting observations at SMA N 1 Payabungan. The results of interviews with teachers at the school showed that students' low ability to solve mathematical problems was due to the lack of learning resources obtained by students, practice questions that only came from textbooks, and many students who were still unfamiliar with the form of related questions.

Based on the results of the researcher's interview with one of the mathematics teachers at SMP Negeri 1 Bandar, students' mathematical problem solving abilities were still low. Researchers too _ found facts in the field that in learning mathematics, the teacher explained in front of the class and wrote on the blackboard and gave mathematics problems and then asked students to solve the problems. This causes students to participate less actively in learning, the only students who are active are those who have more abilities. Then, teachers also rarely use learning media that are able to visualize abstract mathematical concepts . The use of good learning media and learning models can make it easier for students to better understand concepts, principles and skills in the learning

process .

The low ability of students to solve mathematical problems was also seen when researchers conducted initial research and observations at SMP Negeri 1 Bandar. The teacher revealed that most students forgot the basic concepts of the material. When students are given a story problem related to this material, they are unable to solve it, so they ask the teacher which formula should be used in the problem. This shows that students do not master the concept.

Based on the questions given by researchers (Appendix 2), it can be concluded that students have difficulty solving problems related to mathematical problem solving abilities. This is a fact that proves that the mathematical problem solving abilities of students at SMP Negeri 1 Bandar are still relatively low.

Learning is something that takes place between teachers and students. Learning tools are tools to facilitate the learning process whose preparation is based on the teacher's own creativity. Learning tools are a goal of mathematics learning. The importance of learning tools is to support the implementation of effective and efficient learning so as to create an environment/atmosphere that allows students to learn, to improve student learning outcomes, student interest in learning, provide opportunities for students to practice, and to assist in solving problems experienced by students and Have an attitude of appreciating the usefulness of mathematics in life. Learning tools are considered problematic because they do not exist, or exist but do not meet learning needs, or exist but need to be repaired, and so on (Nasution et al, 2020).

Thus, before carrying out learning, teachers should have prepared learning tools. Learning tools are prepared based on the applicable curriculum, adapted to school conditions and student characteristics. However, the facts on the ground show that the learning tools implemented at SMP Negeri 1 Bandar are currently inadequate and teachers continue to use the same ready-to-use student books, RPPs and LKPD every year with the same learning model.

Teacher and student activities in the RPP are not clearly detailed (Appendix 2). No issues are raised before the material is explained. The problems listed in the RPP are also not explained clearly. The RPP used does not use a learning model or approach that is useful for making it easier for teachers to provide learning services and makes it easier for students to understand the material presented by the teacher in a more active and enjoyable atmosphere. The drafted RPP does not yet contain indicators of solving ability problem mathematical . Therefore, it is necessary to prepare a lesson plan using a *discovery learning learning model.*

Developing learning tools is something that teachers must do before the learning process (Yulius et al, 2017). The learning tools developed must be in accordance with the conditions, needs and characteristics of students and contain the components required by the domestic government. Learning tools designed by teachers and utilizing effective teaching materials including RPP and LKPD which can be used during learning. Objective compile device learning is to achieve learning mathematics . Objective learning mathematics according to Department Education National ( Ministry of National Education , 2006 ) is for solve problem , ability understand problems , designing mathematical models , solving problem models with the solution obtained . So with this research, researchers hope that there will be changes in developing learning tools .

Considering the different levels of student ability, learning tools need to be equipped with student activity sheets. The existence of this LKPD is intended to make it easier for teachers to accommodate different levels of student ability, but also to make it easier for teachers to manage learning with *discovery learning* . In accordance with the development of the 2013 Curriculum, the preparation of LKPD must also include *scientific* approach steps which aim to monitor students in solving the problems presented in the LKPD.

RPP and LKPD are designed using the *discovery learning model* . In *discovery learning* , students are not only required to master the learning material, but also how they can use their potential. Teachers have an active role in determining problems and the stages of solving them. The use of *the discovery learning* model is thought to be able to improve students' mathematical problem solving abilities (Yulius et al, 2017).

By using this *discovery learning model* , students learn to be more oriented towards guidance and instructions from the teacher so that students can understand lesson concepts (Rahmiati et al, 2017). The thing that underlies the choice of the *discovery learning model* as the development of learning tools is that, apart from the *discovery learning* model being a recommendation from the 2013 curriculum, students are required to organize their own way of learning in discovering a concept (Yulius et al, 2017).

*Discovery learning* is a learning process in which the learning concept is not directly presented, but students are asked to get the concept themselves so that students can discover new concepts or knowledge. *Discovery learning* is a learning process that prioritizes the discovery of previously unknown concepts or principles (Suparsih, 2018). With discovery learning, learning will be centered on students and teachers only as guides (Simamora et al, 2019).

In developing learning tools using *discovery learning* , the initial stage is to provide stimulus by providing concrete examples of mathematical concepts related to everyday life. According to Syah (Rahmiati, 2017) there are several procedures for applying *discovery learning* in learning, namely: (a) *Stimulation* , at this stage the teacher can start with PBM activities by asking questions, directing to read books, and other learning activities that refer to solving problem. (b) *Problem Statement* (problem identification), namely students identify as many problems as possible they face. This is useful for building students' thinking patterns so they are used to finding problems. (c) *Data Collection* (data collection), namely students learn actively to find something related to the problems they face, thereby accidentally connecting the problem with the knowledge they already have. (d) *Data Processing* (data processing) at this stage students process data and information that has been obtained either through interviews, observations, and so on. (e) *Verification* (proof) students carry out careful examination to prove whether or not the hypothesis determined is true with data that is matched by *processing* . (f) Generalization (conclusion), namely drawing conclusions.

Several efforts have been made to learn using the *discovery learning model* to improve student mathematics learning outcomes. Among them, Rahmiati et al (2017) developed a mathematics learning tool based on *discovery learning* to improve the problem solving abilities of class VII junior high school students. Yulius et al (2017), developed a mathematics learning tool based on a discovery learning model with open ended problems for students in class The results of this research show that the learning tools are valid, practical and effective. Jualini et al (2022) developed a *discovery learning* model learning tool to facilitate students' mathematical representation (KRM) abilities. The final results show that the learning tools using *discovery learning* to facilitate students' KRM in the material on linear equations and inequalities in one variable are valid and practical and can be used in schools. Yuwono et al (2021) developed pop up book learning media based on *discovery learning* to prove the area and circumference of a circle. This research produced a pop up book based on *discovery learning* on proving the area and circumference of a circle which is practical and effective. Simamora et al (2019) developed a *discovery learning tool* with the Toba Batak cultural context. This research resulted in increased mathematical problem solving and *self-efficacy* in students.

These studies have discussed several aspects, but research that develops learning tools with questions using the *discovery learning model* is still limited and inadequate. Therefore, researchers aim to develop valid, practical and effective mathematics learning tools with the hope that the learning tools developed can become teaching materials for teachers in the learning process in order to improve students' mathematical problem solving. Based on the description above, the problem formulation for this research is:

1. *discovery learning* model learning tools valid, practical and effective?
2. *discovery* learning model learning tools improve the mathematical problem solving abilities of class VIII students?

Based on the problem formulation above, the objectives of this research are: Developing *discovery learning model learning tools* .Developing learning tools on Building Flat Side Space material. to improve the mathematical problem solving abilities of class VIII students.

## 2.LITERATURE REVIEW

### *Discovery Learning* Learning Devices

There are three aspects that need to be carried out in assessing product quality, namely validity, practicality and effectiveness. The validity test is used to determine whether the learning tools developed by researchers are in accordance with the characteristics of the *discovery learning model* .

### *Validity of Learning Tools*

Validation of lesson plans, LKPD, learning media, and problem solving ability tests was carried out by four validators. The validation sheet is used to obtain data regarding the validator's opinion regarding the mathematics learning tools being developed. The following criteria are adapted to the validity of the learning tools that researchers have developed, namely:

1) At least three of the four validators stated that the *discovery learning model learning tool* to improve students' mathematical problem solving was based on strong theory.
2) At least three of the four validators stated that the components of the *discovery learning model learning tools* to improve students' mathematical problem solving were consistent and mutually supportive.
3) The trial results show that the components of the *discovery learning model learning tools* to improve students' mathematical problem solving are interrelated.

### *Practicality of Learning Tools*

The practicality of the learning tools developed on the flat-sided spatial structure material of *the discovery learning model* is measured by observer results on practicality tests which are in the practical or very practical category. Learning tools are said to be practical if they meet the following indicators:

1) Experts and practitioners stated that the tools developed were easy to apply in the classroom.
2) The observation results show that the level of learning implementation is in the appropriate or very appropriate category as in table 3.1 below.

Table 3.1 *Criteria for implementing learning*

| Percentage(%) | Criteria |
|---|---|
| - 100 | Very suitable |
| – 80 | In accordance |
| – 60 | Suitable enough |
| – 24 | not suitable |
| -20 | Very Inappropriate |

### *Effectiveness of Learning Tools*

*discovery learning* model learning tools on the flat-sided building material that was developed can be seen from the results of the student response questionnaire to the components of the *discovery learning learning tools* and the completeness of the learning outcomes. In this research, the planned target is to improve students' mathematical problem solving abilities. Therefore, data on the effectiveness of learning tools is obtained from responses and results of problem-solving ability tests. The learning tools developed are said to be effective if they meet the following indicators.

1) This student response questionnaire is processed descriptively with percentages. The percentage of each student's response to the learning tools developed can be calculated using the formula:

$$\frac{jumlah\ tiap\ respom\ positif\ peserta\ didik\ tiap\ aspek\ yang\ muncil}{jumlah\ seluruh\ peserta\ didik} \text{x } 100\%$$

Student responses are said to be positive if 80% or more of students respond in the positive category for each aspect responded to.

2) Problem solving ability test data is processed descriptively using the requirements for completeness of learning outcomes. Completeness of learning outcomes exceeds the criteria for completeness, namely a minimum of 80% of students achieving the specified score, namely 75.

## 3. METHODS

This research is development research . *Development research* is a research method used to produce certain products. The aim of this research is to produce *discovery learning* model learning tools by developing valid, practical and effective problem solving questions. The learning tools developed are RPP, LKPD, learning media, and a *discovery learning model problem solving ability test* . The learning device development model used is the development model according to Plomp . The reason for choosing the Plomp Development Model was because the procedure was clear and systematic and in accordance with the development process carried out by the researcher. The development steps according to Plomp are in Figure 3.1.

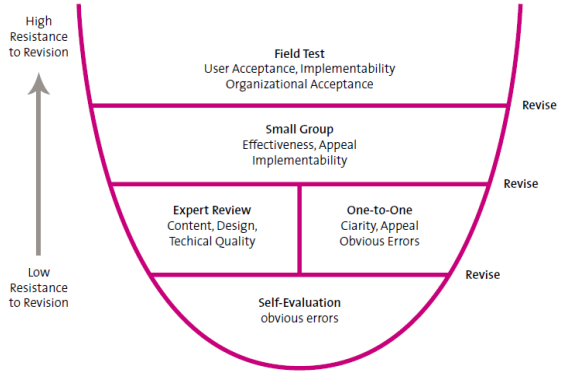


*Figure 6: Layers of formative evaluation (taken from Tessmer, 1993)*

This research was limited to class VIII junior high school students only. Three classes of subjects were selected, one as a readability trial class, one as a limited trial class, and one as a field trial class. The control class was used as a limited trial of five to ten people.

This research uses several instruments. At the *preliminary research* stage there are six instruments used, namely: 1) analysis sheet class VIII middle school curriculum; 2) concept analysis sheet in developing *discovery learning* learning tools to improve students' mathematical problem solving; 3) analysis sheet for existing learning tools; 4) task analysis sheet in the textbook; 5) situation and condition analysis sheet; and 6) needs analysis sheet. In the *prototyping phase* there are four validation instruments, namely: 1); RPP validation sheet; 2) LKPD validation sheet; 3) learning media validation sheet 4) problem solving ability test validation sheet. The final stage is *the assessment phase.* There are four instruments used, namely: 1) expert and teacher recommendation sheets; 2) observation sheet on the implementation of learning tools; 3) student response questionnaire; and 4) problem solving ability test. Thus, the total instruments used were 14.

**Data collection technique**

Data collection techniques are the methods used by researchers to collect data. Data collection used in this research was carried out in various ways. The method of data collection carried out by researchers is as follows:

1) *Preliminary Research*

The activities carried out at the *Preliminary Research stage* aim to collect information about the importance of learning *the discovery learning model* to improve students' mathematical problem solving. This can be collected if there is an instrument. The instruments used in this research were needs analysis sheets consisting of: a) analysis of the independent curriculum for class VIII SMP; b) concept analysis in developing *discovery learning* model learning tools to improve students' mathematical problem solving; c) analysis of existing devices; d) analysis of the tasks in the book; e) analysis of literature and learning resources f) analysis of school situations and conditions; and 7) user analysis.

2) *Prototyping Stage*

*discovery learning* model learning device on flat-sided geometric material. Apart from that, at this stage *a prototype I will also be produced* which is ready to be validated. After the validation process by experts is complete, readability tests are then carried out on several students who are not the subjects of field trials.

3) *Assessment Phase*

After carrying out a validity test at the *prototyping stage.* Then, a limited trial was carried out on several students, after which the learning tools were revised again. Next, draw conclusions whether the learning tools developed meet the specifications that have been determined or determined previously. In this phase, field trials are carried out with the aim of obtaining learning tools that are valid, practical and effective, and can improve students' mathematical problem solving.

## 4. RESULT

***Results of Curriculum Analysis for Class VIII Semester 2***

At this stage, an analysis of the curriculum that applies in one of these schools is carried out, namely the 2013 curriculum. Based on the curriculum that applies in that school, the development of learning tools refers to the 2013 curriculum. The demands of the 2013 curriculum require an educational process that provides opportunities for students to be able to develop everything. the potential it has.

In learning, students are subjects who have the ability to search, process, construct and use knowledge in their cognitive processes. Students need to be stimulated to learn to solve problems ( *problem solving* ), discover things ( *discovery learning* ), and realize the ideas they have so that they will truly understand and be able to apply their knowledge in life.

One material that is suitable for implementing the *discovery learning model* is building flat-sided spaces. Next, we analyzed KI (Core Competencies) and KD (Basic Competencies) in the flat-sided building material. KI and KD for flat-sided building material are available in the 2013 curriculum as shown in table 4.1

Table 4.1 *Syllabus for Building Flat Side Spaces*

| **Basic competencies** |
|---|
| .9 Distinguish and determine the surface area and volume of flat-sided figures (cube, cuboid, prism and pyramid). |
| ) Solve problems related to the surface area of flat-sided figures (cubes, blocks, prisms and pyramids) |

Based on the competencies described above, the indicators that must be achieved in learning are:

1. Find the surface area and volume of flat-sided figures (cube, cuboid, prism, and pyramid) .

2. Calculate the surface area and volume of flat-sided figures (cubes, cuboids, prisms and pyramids).

3. Solve contextual problems related to the surface area and volume of flat-sided figures (cubes, blocks, prisms and pyramids) .
4. Solving problems related to flat-sided shapes and their combinations (cubes, blocks, prisms and pyramids) in everyday life.

Researchers consider that the flat-sided building material is suitable for the use of *discovery learning models.*

***for Discovery Learning* Model Learning Devices**

Based on the results of the needs analysis that has been carried out, it was found that teachers agree that the *discovery learning model* is a learning model that is needed to improve students' mathematical problem solving abilities. Apart from that, it was also found that teachers had never created, received, or applied *discovery learning tools* consisting of RPP, LKPD, pocket books as learning media, and problem solving ability tests on flat-sided geometric material. However, if the learning tools are available, the teacher states that he is willing to try to understand them. If the teacher already understands the learning tools, then the teacher will apply them in class.

***Design Phase ( Design Phase )***

*discovery learning* tools consisting of lesson plans, worksheet, media, and problem solving ability tests. The following explains some of the designs carried out at this stage, including the following:

***Draft RPP***

The RPP design is designed based on the curriculum that applies in schools, namely the 2013 curriculum, referring to the *discovery learning model*. Then, after this stage was completed, the researcher asked for opinions, suggestions and input from several experts (lecturers and teachers) who were experienced in the field of mathematics education as a learning tool that was developed, namely *prototype I.*

***LKPD design***

LKPD 1 includes the delivery of material on building the flat side of a cube, solving problems, discussing and solving problems in everyday life. The contents of LKPD 2 include the delivery of material on building space with the flat side of blocks, solving problems, discussions and solving problems in everyday life. The contents of LKPD 3 include the delivery of material on the flat side of a prism, solving problems, discussions and solving problems in everyday life. LKPD 4 's contents include presenting material on building the flat side of a pyramid, solving problems, discussing and solving problems in everyday life . The contents of LKPD 5 include the delivery of material on combined flat-sided spatial structures, solving problems, discussions and solving problems in everyday life.

***Learning Media Design***

The result of the learning media design is a pocket book . The material is designed using the *discovery learning model* . Design lesson materials using a mathematics pocket book. Meanwhile, the teaching material prepared in this research learning tool contains an introduction and introduction to flat-sided spatial shapes. This is what differentiates the teaching materials in the textbooks that students use.

The teaching material used in this research presents an introduction and explanation of flat-sided geometric figures, then presents concept descriptions, pictures in everyday life related to the flat-sided geometric material.

***Problem Solving Ability Test Question Design***

The problem solving ability test is designed based on the objectives to be achieved in learning using the *discovery learning model* . The questions presented in the problem-solving ability test are varied in order to measure the ability to understand the flat-sided geometric material.

***Analysis of Validation Results***

**A. Results of Validation and Revision of RPP**

**1) RPP Validation Results**

**a. Material Aspects**

Based on the validation results, the 4 validators have generally provided an assessment. On the criteria for identity completeness, validator 2 said it was good, validators 1, 3 and 4 said it was very good. On the criteria for clarity in providing material, validator 2 said it was not good, validator 1, 3 and said it was good. Regarding the clarity criteria for the numbering system, validator 1 said very good, validators 2, 3 and 4 said good. On the criteria for clarity of layout settings, validator 2 said it was quite good, validators 1,3 and 4 said it was very good. Regarding the type and letter criteria, validator 2 said it was quite good, and validators 1, 3 and 4 said it was very good. On criteria

**b. Construction Aspects**

Regarding the criteria for suitability of the indicator formulation with basic competencies, validator 2 said very good, validators 1, 3, and 4 said good. Regarding the criteria for suitability of learning stages with initial activities) apperception, motivation, learning objectives, and linking lesson material with daily life) validator 3 said very good, validators 1, 2, and 4 said good. Regarding the criteria for suitability of stages with core activities, the four validators said they were good. Regarding the criteria for appropriateness of the learning stages in the final activity (summarizing learning, evaluation/assignment, or reflection) all four validators said it was very good. Regarding the criteria for suitability of learning stages with *discovery learning*, validator 1 said very good, validators 2, 3, and 4 said good. On the criteria for diversity of learning resources, validator 2 said it was quite good, validators 1, 3 and 4 said it was good. Regarding the criteria for suitability of the learning process with the time allocation used, validators 1 and 3 said very good, validators 2 and 4 said good. Regarding the eligibility criteria as a learning tool, validator 1 said it was very good, validator 2 said it was quite good, and validator 4 said it was good.

**c. Language Aspects**

On the grammatical correctness criteria, validators 1 and 3 say good, validators 2 and 4 say very good. On the criteria for simplicity of sentence structure, validator 2 said it was quite good, validators 1, 3 and 4 said it was good. On the criteria for clarity of instructions and directions, validator 3 said good, validators 1, 2 and 4 said very good. On the communicative criteria, the language used by validators 1 and 2 said it was very good, validators 3 and 4 said it was good.

Based on the overall validator, they gave a general assessment, namely that the device can be used with slight revisions with an average score of 4.25 .

**2) Revise the RPP based on validation results**

The revised results were carried out based on suggestions and input from the validator team. The following will describe the results of the RPP validation

Table 4.3 *Results of revised RPP*

| Preliminary Design | After Revision |
|---|---|
| Students or students' writing must be consistent | It has been changed to students as a whole |
| Group division in phase three was eliminated | has been eliminated, group division only exists in the second phase |
| There are several things in the closing activities | In the closing activity, reinforcement and rewards |

that need to be added. Such as teachers providing reinforcement, group rewards, etc.

have been added.

**B. Result of Validation and revision of LKPD**

**1) LKPD Validation Results**

Validation activities carried out on LKPD include three aspects, namely: format aspect, construction aspect, and language aspect.

**a. Format Aspects**

On the criteria for clarity of the numbering system, all four validators said it was very good. On the criteria for clarity of layout settings, only validator 2 said it was good, validators 1, 3 and 4 said it was very good. On the fourth type and letter criteria, the validator said it was very good. Regarding the suitability criteria between the physical worksheet and students, validator 1 said it was very good, validators 2, 3 and 4 said it was good. In terms of attractiveness criteria, validator 1 said very good, validators 2, 3 and 4 said good.

**b. Construction Aspects**

Regarding the criteria for suitability of content/material with learning objectives, validator 1 said very good, validators 2, 3, and 4 said good. Regarding the criteria which are essential material or tasks, validator 1 said very good, validators 2, 3 and 4 said good. The criteria are grouped into logical sections, validators 1 and 4 say very good, validators 2 and 3 say good. In terms of their role criteria for students in finding concepts/procedures, validators 1 and 4 said very good, validators 2 and 3 said good. Regarding the eligibility criteria as a learning tool, validator 1 said very good, validators 2, 3 and 4 said good.

**c. Language Aspects**

On the fourth grammatical correctness criterion, the validator said it was very good. On the criterion of simplicity of sentence structure, only validator 4 said it was good, validators 1, 2 and 3 said it was very good. On the criteria for clarity of instructions and directions, only validator 4 said it was good, validators 1, 2 and 3 said it was very good. On the communicative criteria, the language used by the four validators said it was very good. On the criteria for suitability of sentences with the level of thinking and abilities according to the student's age, validator 1 said very good, validators 2, 3, and 4 said good. On the criteria for motivating students to learn, validator 1 said very good, validators 2, 3, and 4 said good.

**2) LKPD revision results based on validation results**

The revised results were carried out based on the validator's suggestions. The following describes the results of the revised LKPD.

Table 4.6 *LKPD Revision Results*

| Preliminary Design | After Revision |
|---|---|
| Teacher's day story on LKPD 1 | It has been replaced with stories of winning in football matches |
| Lots of writing errors (typos) | Already repaired |
| There are several parts where the working instructions are not clear | Work instructions have been clarified |
| The objectives of the LKPD must be in accordance with the RPP | It is in accordance with the objectives in the RPP |
| The writing on the GPA is not neat | It's been tidied up |

Based on table 4.6, it can be concluded that there has been a slight revision of the LKPD. This can be used as a guide for researchers to improve LKPD.

**C. Results of media validation and revision**

**1) Media validation results**

The media validation results are as follows:

**a. Content Aspect**

Regarding the correctness criteria for the content of the material, validator 1 said it was very

good, validators 2, 3 and 4 said it was good. Regarding the criteria for conformity with basic competencies, validators 1 and 4 said very good, validators 2 and 3 said good.

The criteria are grouped into logical parts, validators 1 and 4 say very good, validators 2 and 3 say good. The criteria for student activities are clearly formulated, so that they are easy for teachers to implement in classroom learning, only validator 4 said good, validators 1, 2, and 3 said very good. Regarding the criteria for conformity with the *discovery learning model* , validators 1 and 4 said very good, validators 2 and 3 said good. Regarding the eligibility criteria as a learning tool, validator 1 said very good, validators 2, 3 and 4 said good.

**b. Format Aspects**

On the criteria for clarity of distribution of material, validator 1 said it was very good, validators 2, 3 and 4 said it was good. On the clear numbering system criteria, the four validators said it was very good. The four validators said that the four validators said it was very good regarding the criteria for clear governance arrangements. On the type and size of letters criteria, the four validators said they were very good.

**c. Language Aspects**

On the grammatical correctness criteria, validators 1 and 4 say very good, validators 2 and 3 say good. On the criteria for simplicity of sentence structure, validators 1 and 4 said very good, validators 2 and 3 said good. On the criteria for clarity of instructions and directions, validator 1 said very good, validators 2, 3 and 4 said good. On the communicative criteria, the language used by validators 1 and 4 said it was very good, validators 2 and 3 said it was good.

**2) Media revision based on validator results**

The revised results were carried out based on the validator's suggestions. The following describes the results of the media revision.

Table 4.6 *Media Revision Results*

| Preliminary Design | After Revision |
|---|---|
| Pocket books have not been printed like pocket book size | It has been printed like a pocket book |
| There are several writing errors | Already repaired |
| The concept map in the pocket book is not yet on the flat side of the spatial structure | It's like a concept map for what a flat-sided building should be |

**D. Results of Validation of Problem Solving Ability Test Questions**

**a. Results of Validation and Revision of Problem Solving Ability Test Questions**

The problem solving ability test assessment consists of three components, namely: a) assessment of the material; b) assessment of question construction; c) assessment of language. The following is data obtained from validation results by experts and teachers. It is tabulated in table form and then the average score of all validators is calculated. The results of the validation analysis of test questions are as follows:

Based on the validation results , the learning tools developed can be used with slight revisions with an average value of 4.25 . Furthermore, the revised learning device became the *prototype II learning device.*

**Assessment Stage n**

The assessment stage is carried out through testing the devices that have been developed in class. The results of the analysis at the assessment stage were obtained through observation sheets regarding learning implementation.

**Readability Test**

After obtaining *Prototype II* and before field trials were carried out, readability trials were first carried out. The readability test was carried out on several students who took part in the readability test. There are 6 students from SMP N 1 Bandar.

The purpose of the readability test is to find out the language and sentences in learning tools such as LKPD, learning media, and problem solving ability test questions that cannot be understood by students, and another purpose of the readability test is to find out typing errors, words missed, errors in the use of uppercase and lowercase letters that the researcher missed. During the readability test, the activities carried out included: students were asked to answer the questions on the LKPD, then the researcher asked about the difficulties on the sheet.

There are several errors obtained from the readability test results, namely as follows:

Table 4.10 *Readability Test Results*

| No | Components evaluated | Error | Revision |
|---|---|---|---|
| | Typing error | How many | How much |
| | tters that should be lowercase | - | - |
| | tters that should be uppercase | di | di |
| | age captions do not match | - | - |

**Practicality Trial**

Furthermore, learning devices that have gone through the readability testing stage are tested for learning implementation and small group testing. Activities carried out in small groups take the form of an assessment of the learning tools developed. The subjects of the small group trial were 20 students from SMP N 1 Bandar.

**Field Trials**

Field trials of learning tools were carried out at SMP N 1 Bandar. In this research the teacher acts as a model teacher. The trial was carried out at the school with a total of 32 students. The field trial involved 1 mathematics teacher and 1 teacher accompanying the students. The aim of the field trial is to determine the practicality of the learning tools that have been developed. The tools tested were RPP, LKPD, media, and problem solving ability test questions. The results of the analysis used in the field trial are as follows:

**Data from Observation of Learning Implementation**

This observation aims to find out how learning is implemented using *discovery learning model learning tools* on flat-sided geometric material to improve students' mathematical problem solving abilities. The results of the analysis of learning implementation reached an average percentage of 95% which shows very good criteria according to the specified criteria. The results of data analysis by looking for the average observer assessment of learning activities and atmosphere are presented in the table in the attachment.

**Value on LKPD**

The LKP D developed consists of LKPD 1, LKPD 2, LKPD 3, LKPD 4 and LKPD 5. The results of the analysis are as follows:

| No | Group | LKPD 1 | LKPD 2 | LKPD 3 | LKPD 4 | LKPD 5 | Average |
|---|---|---|---|---|---|---|---|
| 1 | I | 95 | 80 | 90 | 95 | 95 | 91 |
| 2 | II | 100 | 95 | 80 | 80 | 95 | 94 |
| 3 | III | 100 | 100 | 100 | 90 | 100 | 94 |
| 4 | IV | 95 | 100 | 80 | 95 | 85 | 93 |
| 5 | V | 75 | 80 | 90 | 75 | 90 | 79 |
| 6 | VI | 100 | 95 | 80 | 80 | 95 | 94 |
| Average | | | | | | | 92.2 |

**Problem Solving Ability Test Data**

Based on the results of the analysis of students' mathematical problem solving ability tests in field trials, it was found that the average problem solving ability reached 92.2 after learning was carried out using the learning tools that had been developed.

Table 4.11 *Students' Mathematical Problem Solving Ability Test Scores*

| No | Student's name | Total Score |
|---|---|---|
| 1 | S1 | 85 |
| 2 | S2 | 90 |
| 3 | S3 | 80 |
| 4 | S4 | 74 |
| 5 | S5 | 82 |
| 6 | S6 | 85 |
| 7 | S7 | 85 |
| 8 | S8 | 87 |
| 9 | S9 | 80 |
| 10 | S10 | 74 |
| 11 | S11 | 80 |
| 12 | S12 | 80 |
| 13 | S13 | 60 |
| 14 | S14 | 74 |
| 15 | S15 | 85 |
| 16 | S16 | 80 |
| 17 | S17 | 80 |
| 18 | S18 | 82 |
| 19 | S19 | 90 |
| 20 | S20 | 90 |
| 21 | S21 | 82 |
| 22 | S22 | 80 |
| 23 | S23 | 85 |
| 24 | S24 | 85 |
| 25 | S25 | 74 |
| 26 | S26 | 90 |
| 27 | S27 | 92 |
| 28 | S28 | 82 |
| 29 | S29 | 85 |
| 30 | S30 | 80 |
| 31 | S31 | 80 |
| 32 | S32 | 90 |
| Average | | 82,125 |

## 5. DISCUSSION

The ministry of education and Culture (2016) stated that changes in the 2013 curriculum include graduation competency standards, content standards, process standards and assessment standards. Problem solving ability is the ability required by students to solve mathematical problems using the thinking process in solving problems through collecting facts, analyzing information, compiling various alternative solutions, and choosing the most effective problem solution. This ability is very important for every student to have in the learning process, students are required to be able to provide and develop their mathematical ideas based on problem solving. *Discovery learning* is a learning model that involves active students through exchanging opinions, trying and finding solutions to problems. So, the *discovery learning model* is related to problem solving. In the preliminary investigation phase , the equipment needs analysis begins with student

analysis, curriculum analysis and existing equipment analysis.

After completing the first stage, we then enter the design *phase* . At the design stage, the activities carried out are designing teaching materials, RPP, LKPD, media, and problem solving ability tests. The design result of the learning device to be developed is called *prototype* I. Next, *prototype I* entered the expert and practitioner validation stage. Then the learning tools were revised according to suggestions and input from the validator team. Then the device was called *prototype II* . Next, *prototype II* entered the small group testing stage. The small group test activity carried out by 6 students, namely the readability test, is said to be a subject. The purpose of the readability test is to see small errors in the learning tools being developed. Furthermore, the learning device with a *discovery learning model* on flat-sided spatial material is referred to as *Prototype III* .

The next step is to carry out limited trials. The results obtained from the limited trial were in the form of observation test results on learning implementation. Based on the results carried out by observers, this device is said to be practical. The next step is field trials. The results of the field trial are the results of a problem solving ability test. Based on the student response questionnaire, the learning tools in this research were declared effective.

**Validity of Learning Tools**

The validity of the learning tools developed is reflected in the validator results, the average validation of lesson plans reached 4.25, validation of LKPD reached 4.51, validation of media reached 4.56, and validation of problem solving ability tests reached 4.25. The overall average based on the validation team shows that the average is within valid criteria according to the established criteria. This means that the learning tools are valid based on content, namely according to the mathematics syllabus on flat-sided geometric material, based on constructs, namely according to the characteristics or principles of learning according to the format and applicable language rules according to refined spelling.

**Practicality of Learning Tools**

The learning device in the form of *prototype II* was obtained, the next step was to test the readability first. This test is carried out to find out some small errors in the learning tools, for example errors in typing, the quality of clarity of images and tables. After carrying out a readability test, the next step for the device will be a small revision of the readability test results. After the results of these trials, the device will be developed in the next stage which is referred to as *prototype III.*

The learning device, hereinafter referred to as *prototype III* , was tested in the field. The learning tools can be said to be practical if there are 32 students, where all students can use the learning tools well which is shown at the first learning meeting the average student reached 91, at the second meeting the average student activity reached 94, at the third meeting the average Student activity reached 94, at the fourth meeting the average student activity reached 93, at the fourth meeting reached 79 and at the fifth meeting 94. Overall, the average student activity showed very good criteria.

**Effectiveness of Learning Tools**

Product quality is determined by students, where students appreciate the product and have a desire to use it (Nieveen, 1999). Based on the results of the problem solving ability test in the field trial, the average score reached 80 after learning using the learning tools that had been developed. It can be interpreted that the problem solving ability test score is above the minimum completeness score obtained in the field trial.

Analysis of the LKPD shows that the LKPD scores for all groups are in the very good

category. So, overall it shows that the average value of the LKPD is being able to complete and use the LKPD well. The results of student responses to learning tools are LKPD, student response

questionnaires, and problem solving ability test results. Students responded to the atmosphere during learning, with a percentage of 82% of students responding positively. Meanwhile, based on the results of the problem solving ability test, it was found that 82.12% of students achieved learning completeness, this means that their problem solving ability also increased.

## 6. CONCLUSION

This research has obtained a product in the form of a learning tool for flat-sided building material for junior high school students that is valid, practical and effective. The validity of the tool developed between all components that are interconnected with each other is valid based on an assessment by four validators with an average of 4.25. This learning device has practical criteria based on a limited trial assessment in class VIII where all students can use the device well, shown by the average student activity results reaching 90.2, indicating very good criteria. Furthermore, this device met the effective criteria where 32 students reached the KKM (75) for the problem solving ability test.

Based on the research results and conclusions above, researchers can provide suggestions that the materials developed in *discovery learning learning tools* are still limited to flat-sided spatial structures. The researcher hopes that future researchers can research other materials.

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