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# Development Mathematics Learning Device Based Curriculum 2013 on Subject Quadri Lateral Through Problem Based Learning

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## ABSTRACT

This research aimed to develop mathematics learning device that are Lesson Plan (LP) and Students Worksheet (SW) based curriculum 2013 on subject quadrilateral through problem based learning. This research use development model by Borg and Gall. Development is done through the following steps: (1) research and information collecting; (2) planning; (3) develop of product; (4) preliminary field testing; (5) revision; (6) main field testing; and (7) revision. Researcher conducted a needs analysis, then collect the necessary materials to design learning device. Learning device that had been developed then validated by three validators and revised based on the input from validators. The valid learning device then tested in two stages, the small group trial with subjects are eight students and large group trial with subjects are 29 students. Based on the data analysis obtained that the mathematics learning device are valid with average for LP 3,79 and 3,82 for SW and practical to use by learners.

**Keywords:** Research and Development, Mathematics Learning Device, Problem Based Learning, Quadrilateral

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## Introduction

Mathematics is a universal science that is useful for human life and also underlies development of modern technology, has an important role in various disciplines and advance the human mind. The purpose of mathematics learning that is listed in the Curriculum 2013 is so that learners can: (1) understand the concept of mathematics; (2) using the pattern as a conjecture in problem solving and able to make generalizations based on existing phenomena or data; (3) using reasoning in nature, performing mathematical manipulations both in simplification, as well as analyzing existing components in problem solving with mathematical contexts as well as outside

mathematics; (4) communicating ideas, reasoning, and being able to construct mathematical evidence using complete sentences, symbols, tables, diagrams, or other media to clarify circumstances or problems; (5) has an attitude of appreciating the usefulness of mathematics in life; (6) have attitudes and behaviors consistent with values in mathematics and learning; (7) engage in motor activities using mathematical knowledge; and (8) using simple props or technology results to perform mathematical activities (Permendikbud Nomor 58 Tahun 2014).

Based on the observations in SMP Negeri 3 Tambang, learning process is still teacher

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centered. The learning activities undertaken are to explain subject matter, give examples of problems, and then provide the exercise. Learners are still not active in learning activities because teacher gave many lectures about the material. Activities undertaken by learners only hear and record, learners rarely ask or express opinions so that interaction and communication between learners with teachers and with other students still not well established. Such learning will not be able to optimize purpose of mathematics learning.

Learning device arranged by teachers of SMP Negeri 3 Tambang still refer to Educational Unit Level Curriculum (EULC) in the form of Lesson Plan (LP) and Students Worksheet (SW). Learning devices used by teachers do not facilitate learners to learn actively. Learners need a source or media that can help to construct the concept of learning. Based on purpose of mathematics learning teacher must have creativity in preparing learning device. Learning device should be adjusted to the situation, conditions, and characteristics of learners. Thus the need for development of learning device based on curriculum 2013.

The learning device that guides a teacher in carrying out learning process is Lesson Plan (LP). LP is a guide for teachers in implementing mathematics learning in the classroom. To produce an active learning, easy to understand, and fun for learners required a learning model. One of learning model that can learners actively to construct knowledge is problem based learning. Problem based learning is a learning process that starting point of learning begins based on real problems (Suyatno in Permedikbud Nomor 58 Tahun 2014). Furthermore, learning device that guides learners in learning process is Student Worksheet (SW). SW is a guide used by learners to

conduct investigation or problem solving activities (Trianto, 2012).

According to Sugeng Mardiyono (in Lili Somantri, 2012), mathematics as the basic science has an abstract object. This abstract makes it difficult for students to understand the subject matter of mathematics. One of the abstract mathematics subject matter is geometry. Learners have difficulty in understanding the objects of geometry. Learners need a learning resource that can help them to construct an abstract object into a concrete. One of the geometry materials taught to class VII is a quadrilateral. Application of some form of quadrilateral is often found in real life so as to facilitate learners to understand geometry. Based on the description, researcher is encouraged to develop mathematics learning device in the form of Lesson Plan (LP) and Student Worksheet (SW) based curriculum 2013 on subject quadrilateral through problem based learning.

## **Methodology**

This research is classified as a Research and Development (R&D) that intends to produce mathematics learning device in the form of a Lesson Plan (LP) and Student Worksheet (SW) based curriculum 2013 on subject quadrilateral through problem based learning. This research development model by Borg and Gall modified by Sugiyono (2008) with the following steps: (1) research and information collecting; (2) planning; (3) develop of product; (4) preliminary field testing; (5) revision; (6) main field testing; and (7) revision.

Research subjects in small group trials were eight students with heterogeneous academic ability from class VII-4 SMP Negeri 3 Tambang. Subjects for large group trials were 29 students class VII-4 SMP Negeri 3

Tambang with heterogeneous academic ability. Instrument of data collecting in this research is validation sheet and questionnaire response of learners. The validation sheet uses a Likert scale consisting of four alternative answers, namely 1, 2, 3, and 4 which states are very unsuitable, inappropriate, appropriate, and very appropriate. Questionnaire response of learners using Guttman scale which consists of two alternative answers, namely Yes and No.

Data analysis techniques in this research consist of validation sheet analysis and questionnaire response of learners. Analysis of validation sheet of LP and SW using the following formula (Anas Sudijono, 2011).

$$\bar{M}_v = \frac{\sum_{i=1}^n \bar{V}_i}{n}$$

Information:

$\bar{M}_v$  : average validation

$\bar{V}_i$  : average validation of the i-th validator

$n$  : number of validators

Determination of range can be known through the highest score minus the lowest score divided by the highest score. Based on determination of the range is obtained range 0.75. Average analysis validation criteria used can be seen in Table 1.

Table 1. Category of Learning Device Validity

Interval	Category
$3,25 \leq \bar{x} < 4$	Very Valid
$2,50 \leq \bar{x} < 3,25$	Valid
$1,75 \leq \bar{x} < 2,50$	Less Valid
$1,00 \leq \bar{x} < 1,75$	Invalid

Source: Suharsimi Arikunto, 2004

Questionnaire response of learners were analyzed using Cochran Q Test with

statistical test procedure according to Iqbal Hasan (2010) as follows:

- Determine hypothesis formulation.  
 $H_0$ : learners provide the same or uniform assessment  
 $H_1$ : learners provide unequal or uniform assessments
- Determine real level ( $\alpha$ ) and value of  $\chi^2$  (khi squared) table.
  - The real level used is 5% (0.05)
  - The value of  $\chi^2$  has degrees of freedom ( $df$ ) =  $k - 1$
- Define test criteria.  
 $H_0$  received  $H_1$  rejected) if  $Q \leq \chi^2_{\alpha (db)}$   
 $H_1$  accepted  $(H_0$  rejected) if  $Q > \chi^2_{\alpha (db)}$
- Determine value of test statistic (Q value).

$$Q = \frac{k - 1 [k \sum G_j^2 - (\sum G_j)^2]}{k \sum L_i - \sum L_i^2}$$

Information:

$G$  : number of successes for column

$L$  : number of successes for row

$k$  : number of groups

- Make a conclusion.  
 Concluding  $H_0$  accepted or rejected

## Result and Discussion

### Product Design

Activities undertaken at this stage consist of needs analysis and design of learning device.

- Needs Analysis
  - Core Competence (CC) - Basic Competence (BC) Analysis

Based on study of syllabus, the scope of material, and learning theories,

researcher chose the problem based learning model. The BC related subject on quadrilateral is as follows.

3.6 Identify properties of two dimensional figure and use them to determine circumference and area.

4.7. Solve the problems related to application properties of rectangular, square, parallelogram, trapezoid, split, and kite.

b. Characteristic of Learners Analysis

Subjects in this study were students of class VII-4 SMP Negeri 3 Tambang which average age 12-13 years. According to Piaget, at this age the thinking ability of a child has entered an abstract operational stage. However, reality in the field shows that many students of class VII-4 SMP Negeri 3 Tambang whose thinking and reasoning abilities are still in a concrete operational stage. They have not been able to think abstractly, because learners are still experiencing a transition phase from a concrete operational stage to a formal operational stage. Learners still need help teacher to think abstractly.

c. Material Analysis

The subject matter of quadrilateral has been introduced in Elementary School. The prerequisite materials that should be learned by learners are lines and angles. Based on curriculum 2013 for class VII of the even semester, quadrilateral consists of rectangular,

square, parallelogram, trapezoid, split, and kite.

Considering subject matter of quadrilateral, learning material is organized into 6 meetings. Details of learning materials can be seen in Table 2.

Table 2. Learning Materials of each Meeting

Meeting	Learning Material	Time Allocation (Hours of Learning)
1	Rectangular	3
2	Square	2
3	Parallelogram	3
4	Trapezoid	2
5	Split	3
6	Kite	2

2. Learning Device Design

Researcher designed mathematics learning device based curriculum 2013 on subject quadrilateral through problem based learning.

**Product Validation**

Design mathematics learning device based curriculum 2013 on subject quadrilateral through problem based learning have been made then validated by three validators. Validator in this research is two lecturers University of Riau and math teacher in SMP Negeri 3 Tambang. The validation of mathematics learning device based curriculum 2013 on subject quadrilateral through problem based learning can be seen in Table 3.

Table 3. Validation Results of Learning Device

Learning Device	Meeting						Average	Category
	1	2	3	4	5	6		
Lesson Plan	3,80	3,82	3,79	3,79	3,77	3,77	3,79	Very Valid
Student Worksheet	3,83	3,78	3,87	3,85	3,78	3,81	3,82	Very Valid

### Design Revision

LP and SW which has been validated then analyzed for revising the design. LP and SW are revised in accordance with suggest of validator.

#### 1. Revision of Lesson Plan (LP)

At this stage, researchers revised LP based curriculum 2013 on subject quadrilateral through problem based learning in accordance with assessment on validation sheet, comments, and suggestions from validator. Validator said that sentence in LP is still general, it is not know what the teacher will do. Researcher revised steps in LP, so as know the activities that teachers will do in the classroom.

In addition, indicator of attitudes and skills assessment is not appropriate. Validator suggests that indicator more detailed to be observed by teacher. For assessment, researcher refers to Permendikbud Nomor 53 Tahun 2015, on Assessment Guide for Junior High School. In attitude assessment, researchers use instruments such as journal sheets. Furthermore, assessment of knowledge has not been in accordance with the purpose of learning. Researchers revised it by compiling test instructions, so that instrument according to the purpose of learning.

#### 2. Revision of Student Worksheet (SW)

At this stage, researchers revised SW based curriculum 2013 on subject quadrilateral through problem based learning in accordance with assessment on validation sheet, comments, and suggestions from validator. Validator said that steps in problem based learning are not repeated. Validator suggestions should be directed to problem-1, problem-2, and problem-3, then collect all information, and finally resolve the

problem. But repeated activity in SW is a scientific approach. SW consists of three activities, activity-1 about properties of quadrilateral, activity-2 about circumference of quadrilateral, and activity-3 about area of quadrilateral. Every activity in SW refers to scientific approach that includes observing, asking, gathering information, and reasoning. So that learners can be more focused in understanding learning materials. Learners are directed to know properties of quadrilateral, then determine circumference and area of quadrilateral.

Additionally, problem in SW is not quite correct. Researchers revise the problems in SW for contextual so that learners can understand usefulness of mathematics in their life. Furthermore, sentences in SW is not effective. Researcher revise sentences in SW can be more communicative so that learners can understand the material being studied. Then researcher revises activities on SW so that according to problem based learning.

### Small Group Trial

At small group trial stage, mathematics learning device based curriculum 2013 on subject quadrilateral through problem based learning were tested with eight student of VII-4 SMP Negeri 3 Tambang with heterogeneous academic ability. Learners are selected based on daily test value in the even semester 2015/2016. Small group trial is conducted on May 3, 2016; May 4, 2016; May 13, 2016; May 14, 2016; May 16, 2016; and May 17, 2016. At this stage, researcher provide questionnaire to learners.

Researchers then analyzed of questionnaire using Cochran Q test. From result of Q

Cochran test, the value of Q Cochran is 18 and the value of  $\chi^2$ (khi squared) with  $\alpha = 5\%$  and  $df = 19$  is 30.14. That is, the value of Q Cochran is smaller than value of  $\chi^2$ (18 <30.14). Judging from the value of Asymp.Sig.= 0.522 which means probability is greater than 0.05 (0.522 > 0.05). The results show that  $H_0$  is accepted. It can be concluded that learners give the same or uniform value. This indicates that questionnaire of SWbased curriculum 2013 on subject quadrilateral through problem based learning is good. The results of Cochran Q test on small group trials can be seen in Table 4.

Table 4. Results of Cochran Q Test on Small Group Trials

N	8
Cochran's Q	18.000 <sup>a</sup>
df	19
Asymp. Sig.	.522

a. 1 is treated as a success.

### Large Group Trial

At this stage, mathematics learning device based curriculum 2013 on subject quadrilateral through problem based learning revised according to results of small group trial. Then learning device was tested for 29 students of class VII-4 SMP Negeri 3 Tambang with heterogeneous academic ability. Students who follow small group trial stage also follow a large group trial stage because researchers want to see the level understanding of learners who follow two stages. In addition, learners who have attended small group testing stages can know the results of revisions that researchers do in small group trial.

This stage is conducted on May 20, 2016. Researcher only carry out large group trial for one meeting on rectangle material.

Researcher did not conduct large group trials for all meetings due to time constraints. Researcher conducted large group trial in the classroom according to hours of learning. At this stage, the researcher acts as a teacher who conducts learning in accordance with LP and learners use SW that has been developed. At the end of lesson study, researcher provide a questionnaire to learners.

Researchers then analyzed of questionnaire on large group trial using Cochran Q test. From result of Q Cochran test, the value of Q Cochran is 19 and the value of  $\chi^2$  (chi squared) with  $\alpha = 5\%$  and  $df = 19$  is 30.14. That is, the value of Q Cochran is smaller than the value of  $\chi^2$  (19 <30.14). Judging from the value Asymp.Sig. = 0.457 which means that probability is greater than 0.05 (0.457 > 0.05). The results show that  $H_0$  is accepted. It can be concluded that learners give the same or uniform value. This indicates that questionnaire of mathematics learning device based curriculum 2013 on subject quadrilateral through problem based learning is good. The results of Cochran Q test on large group trial can be seen in Table 5.

Table 5. Results of Cochran Q Test on Large Group Trials

N	29
Cochran's Q	19.000 <sup>a</sup>
df	19
Asymp. Sig.	.457

a. 1 is treated as a success.

### Product Revisions

LP and SW which have been tested by large groups then revised again so that obtained mathematics learning device based curriculum 2013 on subject quadrilateral

through problem based learning that is valid and practical.

### Discussion

Research and Development (R&D) is a research that aims to produce a product. This research aimed to develop mathematics learning device that are Lesson Plan (LP) and Students Worksheet (SW) based curriculum 2013 on subject quadrilateral through problem based learning. This research use development model by Borg and Gall modified by Sugiyono (2008). Development is done through the following steps: (1) research and information collecting; (2) planning; (3) develop of product; (4) preliminary field testing; (5) revision; (6) main field testing; and (7) revision.

In the development stages, mathematics learning device based curriculum 2013 on subject quadrilateral through problem based learning have been made then validated by three validators. Validator in this research is two lecturers University of Riau and math teacher in SMP Negeri 3 Tambang. Based on data analysis obtained that average for LP 3,79 and 3,82 for SW. Overall, mathematics learning device are considered very valid. Validator said that mathematics learning device can be tested with revisions as recommended.

Mathematics learning device were twice tested as small group trials and large group trials. In the testing stage, Cochran Q test results show that learners' response to mathematics learning device based curriculum 2013 on subject quadrilateral through problem based learning is good. Learners can use SW well. The material explanation on SW is easy to learn and language used is easy to understand. SW is interesting so learn to be fun. SW can

facilitate learners in understanding the material being studied.

Based on description of validation results and questionnaire responses of learners to mathematics learning device based curriculum 2013 on subject quadrilateral through problem based learning, it can be concluded that the mathematics learning device based curriculum 2013 on subject quadrilateral through problem based learning is valid and qualified practicality for use of class VII.

### Conclusion

This research aimed to develop mathematics learning device that are Lesson Plan (LP) and Students Worksheet (SW) based curriculum 2013 on subject quadrilateral through problem based learning. Mathematics learning device is considered valid after validation process by validator and qualified practicality for use of class VII students after after two test stages.

In conducting this research, researchers have experienced various obstacles and success. For that reason, researchers want to provide some recommendations to this research development. Recommendations to anyone who want to do the same research. The recommendations are as follows.

1. In this research, researcher limits mathematics learning device only to the subject matter of quadrilateral class VII Junior High School. Researchers suggest that learning device can be developed for other subject matter.
2. In this research, researcher only conducts large group trials for one meeting on rectangular material. Researchers did not conduct large group trials for all meetings due to time constraints. Researchers suggest that learning device that have been tested on

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a small group trials can be continued to be tested in large groups.

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