

# Development Student Worksheet Based on RME Assisted by Cabri 3D Oriented to Mathematical Connections

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## ABSTRACT

This study aims to produce student worksheets based on realistic mathematics education (RME) and assisted with cabri 3D oriented to mathematical connection ability which have valid, practical, and effective criteria. The development of this student worksheet uses the ADDIE development method. The stages of the ADDIE development method are analysis, design, development, implementation, and evaluation. The sample in this study population was students of junior high school 19 Jambi city class IXB. The instruments used the Mathematical Connection Ability test, Student Worksheet, and student activity observation sheets. The results of this study show that the student worksheets based on a realistic mathematics education and assisted by cabri 3D oriented to mathematical connection ability are valid, practical and effective

**Keywords:** *Student worksheet, Realistic Mathematical Education (RME), Cabri 3D, Mathematical connections*

## 1. INTRODUCTION

In education, especially in mathematics learning, of course we encounter many problems in the learning process. Many students feel afraid of and face difficulties in studying mathematics. Commonly, mathematics problems are made so complicated that it is difficult for the students to solve them [1]. One of the approaches recommended in the 2013 Curriculum is RME. The application of RME provides hope for mathematics education in Indonesia to improve mathematical abilities and mathematics learning achievement[2]. Learning will be more meaningful if the learning process applies realistic concepts[3]. However, not all teachers have made innovations in their learning. In mathematics learning, students are still accustomed to waiting for the teacher's explanation, then the teacher will explain the concept of giving an example then proceed with giving exercises while students just sit quietly listening and taking notes [4]. Mathematical connections are one of the abilities that must be possessed to solve problems [5]. Based on the research of Sukmaningthias that the RME learning approach can improve learning outcomes and students' interest in learning mathematics can increase [6]. in the

learning of mathematics in schools, mathematical connections ability is one of the mathematical forces that must be developed [7]. to various ideas or mathematical ideas accepted by students The ability of a mathematical connection is required to relate [8]. the ability of students' thinking in mathematics is expected to become more widespread with the ability of mathematical connections [9]. Prawiradilaga stated that every teacher in providing material lessons are required to be able to compose a learning strategy with utilize information technology and communication to develop a variety teaching materials as a learning resource for students [10]. Cabri is a program applications that can be used as learning media to instill mathematical concepts, especially geometric concepts. Cabri in learning geometry can be used to build, view, and manipulate various kinds of three dimensional objects interaction. Cabri can also be used for measure length, calculate distance, calculate the angles, calculate the volume and can even play back (replay) the process of how we build a three dimensional objects [11].learning that uses realistic mathematics has three main principles, that is guided reinvention and progressive mathematilizing, Didactical phenomenology and self-developed models [12]. Interactive activities: learning

activities are interactive, which may occur communication with negotiations between students. Related topics: learning a mathematical material related to various mathematical topics in an integrated manner

Cabri 3D is an interactive geometry software in mathematics learning, known as Dynamic Geometry Software (DGS). This software is a development of the Cabri II geometry software. Cabri 3D with its newest version, Cabri 3D V2, can help students solve geometric problems quickly and accurately, especially in helping to visualize abstract geometric concepts.

when students can connect mathematical ideas, their understanding is deeper and more lasting. They can see mathematical connections in the rich interplay among mathematical topics, in contexts that relate mathematics to other subjects, and in their own interests and experience[13] Mathematical connection capabilities include the ability to: (1) Integrate information, (2) Making connections within and between mathematical materials, (3) Determine the formulas (tools) that will be used to solve the problem, and (4) Troubleshoot irregularities[14]. Based on what has been stated previously, it shows that there is a need for mathematics learning based on Realistic Mathematic Education (RME) assisted by Cabri 3D to improve students' mathematical connection ability

## **2. METHOD**

This research is a research development This research aims to develop a material called with the prototype. What is meant by prototype according to Nieveen in Hadi [15] is a product that is designed before the final product is created and used in full in practice.

The method used in this research is the ADDIE development method. to design a learning system. The ADDIE development method consists of analysis, design, development, implementation, and evaluation stages.

### **2.1. Research Subject**

The subjects in this study were students of class IXB Junior high school 19 in Jambi.

### **2.2. Research Stages**

#### **2.2.1. Analysis**

The analysis stage is the pre-planning stage of product development in the form of realistic mathematical learning tools based on realistic mathematic education (RME) assisted by 3D cabri. The analysis stage consists of needs analysis, student analysis, and material analysis. Needs analysis aims to find out what problems are found in mathematics

learning. This stage also identifies gaps between the objectives in the curriculum and the facts about what is happening in the field.

Student analysis is carried out to identify student characteristics according to their level of education according to developmental theory students, and associated with learning topics to be developed. The results of the analysis will be used as a reference in developing student worksheets Material analysis is used to determine the material used in research based on Core Competencies (KI) and Basic Competencies (KD) in mathematics learning for grade IX junior high school according to the 2013 curriculum.

#### **2.2.2. Design**

At this stage: student worksheets based on Realistic Mathematical Education (RME) assisted with cabri 3D and mathematical connection ability test instruments Preparation of student worksheets: (1) Preparing materials and learning resources in the form of books, the first stage to be carried out is the design stage, at this stage books are needed to design student worksheets to be developed. (2) Develop a map of student worksheet needs. In this arrangement, the number and order of things will be determined taking into account the KI, KD, and indicators of achievement to be achieved. (3) Writing student worksheets. Create a mathematical connection ability test grid. This test grid will be adjusted to KD, and the indicators that must be achieved.

#### **2.1.3 Development**

At the development stage, the development of mathematics learning tools in the form of student worksheets, and also assessment tools in the form of teacher assessment sheets, student assessment sheets, mathematical connection ability tests. The development of student worksheets is adjusted to the order of the curved side space building material.

#### **2.1.4 Implementation**

After the learning tools were revised, the researcher then continued to the implementation stage. At this stage the researcher will try out the product. The trials carried out are as follows: (1) Testing of test instruments (2) Small group trials (Limited trials (3) Field trials: Field trials are the final stage of the development stage. Field trials are intended to determine the quality of the equipment to be made valid, effective, and practical.

#### **2.1.5 Evaluation**

At this stage it will be carried out by referring to the results of the mathematics learning device trial. At the evaluation stage, an analysis of the practicality and

effectiveness of RME-based learning tools was carried out. This practicality will be obtained from the results of the teacher's assessment.

**2.3. Method of collecting data**

The instruments used in this study were Student Worksheets, Mathematical Connection Ability Tests, and also assessment tools in the form of teacher assessment sheets, student assessment sheets and learning implementation observation sheets.

**2.4. Data analysis method**

The data analysis technique of this research is to obtain learning tools that meet the criteria of being valid, practical, effective. If this criterion has been met, the device can be said to be

**2.4.1. Analysis of the Validity and Reliability of the Instrument**

The instruments used in the research must be tested beforehand to prove their validity and reliability estimates. The accuracy and accuracy of the interpretation of the scores obtained is a definition of validity[16]. This statement means that the instrument is said to be valid if it can measure what it wants to measure. While reliability means that the results of the assessment have consistency or stability [16](1) Content Validity, The assessment of the test instrument was carried out by the mathematics subject teacher. The assessment is done by filling out the validation sheet of the connection ability test mathematical sheet regarding the assessment of content validity, namely face validity and logical validity. (2) Construct validity, The trial was conducted on class IX who was not a sample. The construct validity itself is intended to analyze the factors and to review the extent to which the instrument can measure the theoretical construct to be measured. In determining the construct validity, the researchers analyzed with the help of the SPSS 21 for windows software.

Developing an instrument that is said to be feasible certainly cannot be separated from its reliability value, so that the appropriateness of this student achievement test instrument is also viewed from its reliability value. To get an estimated value on the reliability of the test results, the test results were analyzed using the *Cronbach's alpha*[17] formula. (3) Testing of Test Instruments, In this step, the instrument is tested to measure the effectiveness of the test questions. The instrument being tested was a mathematical connection ability test. This step is intended to determine the reliability of the test

**2.4.2. Analysis of the Results of the Feasibility Test of the Connection Ability Test Instrument**

The mathematical connection ability test instrument was 3 items in the essay consisting of 12 question items. The test instrument is validated by the teacher. The questions were tried out before the instruments were used in the research process. The purpose of this trial is to determine the appropriateness of the instrument in data collection. The trial is done by giving a mathematical connection ability test to subjects who already have knowledge of circles. Namely, with 34 subjects from class X SMA. Data from the test results of the test instruments were analyzed using SPSS 21 for Windows software. Following are the results of the analysis of the mathematical connection ability test.

**Table 1.** Reliability of the mathematical connection ability test

Cronbach's Alpha	N of Items
0.931	12

The instrument is said to be reliable if the minimum value of its estimated reliability is 0.658. Based on the table above, it can be seen that the mathematical connection ability test has a reliability value greater than 0.65, that is 0.931, so that the mathematical connection ability test is reliable.

*Validity Analysis*

To measure the validity of student worksheets, the data obtained from the validator, namely the mathematics subject teacher, were analyzed. In addition, the data obtained is also used to determine the answers to the criteria for effectiveness and criteria for practicality of learning devices. To measure the validity of learning tools, it is done by obtaining qualitative data, quantitative data, and then converting the average score into a value on a scale of 5 according to Widoyoko[18] which is obtained into a qualitative value.

**Table 2.** Conversion of score into scale value 5

No	Criteria interval	Quality
1	$X > \bar{X}_i + 1,8 SB_i$	Very good (VG)
2	$\bar{X}_i + 0,6 SB_i < X \leq \bar{X}_i + 1,8 SB_i$	Good (G)
3	$\bar{X}_i - 0,6 SB_i < X \leq \bar{X}_i + 0,6 SB_i$	Fairly Good (FG)
4	$\bar{X}_i - 1,8 SB_i < X \leq \bar{X}_i - 0,6 SB_i$	Not Good (NG)
5	$X \leq \bar{X}_i - 1,8 SB_i$	Not Very Good (NVG)

The items that are assessed on the LKS component are 30 items. The ideal maximum score is  $5 \times 30 = 150$ , and the ideal minimum score is  $1 \times 30 = 30$ ,  $x_i = 90$  and  $sb_i = 20,00$ . The Student worksheet score conversion interval can be seen in Table 3.

**Table 3.** The validity interval of the LKS criteria interval

Interval	Criteria
$X > 147$	Very good (VG)
119 $< X \leq 147$	Good (G)
91 $< X \leq 119$	Fairly Good (FG)
18 $< X \leq 91$	Not Good (NG)
$X < 18$	Not Very Good (NVG)

*Small Group Trial Analysis (Limited trial)*

The items assessed in the student limited trial component contained 18 items. The ideal maximum score is  $5 \times 18 = 90$ , and the ideal minimum score is  $1 \times 18 = 18$ ,  $x_i = 54$  dan  $sb_i = 12$ . and. The limited trial conversion interval can be seen in Table 4:

**Table 4.** Interval of the quality of the student limited trial assessment

Interval	Criteria
$X > 75.6$	Very good (VG)
61.2 $< X \leq 75.6$	Good (G)
46.8 $< X \leq 61.2$	Fairly Good (FG)
38.4 $< X \leq 46.8$	Not Good (NG)
$X < 38.4$	Not Very Good (NVG)

*Data analysis of the practicality of the product being developed*

To obtain data on the practicality of the developed learning tools, the researcher used the results of the assessment, the practicality of the teacher's practicality assessment results from students, and the observation data on the implementation of.

Teacher Practical Assessment Data Analysis The ideal maximum score is  $5 \times 9 = 45$ , learning in the classroom., the ideal minimum score is  $1 \times 9 = 9$ ,  $x_i = 90$  and  $sb_i = 20,00$ .

**Table 5.** Practical interval of teacher assessment for student worksheets aspects

Interval	Criteria
$X > 37,8$	Very good (VG)
30.6 $< X \leq 37.8$	Good (G)
23.4 $< X \leq 30.6$	Fairly Good (FG)
49.2 $< X \leq 23.4$	Not Good (NG)
$X < 49.2$	Not Very Good (NVG)

For Test Assessment The ideal maximum score is  $5 \times 8 = 40$ , the ideal minimum score is  $1 \times 8 = 8$ ,  $x_i = 24$  and  $sb_i = 5,33$ .

**Table 6.** Teacher assessment practical interval test assessment aspects

Interval	Criteria
$X > 33,6$	Very good (VG)
27.2 $< X \leq 33.6$	Good (G)
20.8 $< X \leq 27.2$	Fairly Good (FG)
50.4 $< X \leq 20.8$	Not Good (NG)
$X < 50.4$	Not Very Good (NVG)

For the assessment of Learning Implementation, the ideal maximum score is  $5 \times 7 = 35$ , the ideal minimum score is  $1 \times 7 = 7$ ,  $x_i = 21$  and  $sb_i = 4,67$ .

**Table 7.** Interval practicality of teacher assessment aspects and assessment of learning implementation

Interval	Criteria
$X > 29,4$	Very good (VG)
23.8 $< X \leq 29.4$	Good (G)
18.2 $< X \leq 23.8$	Fairly Good (FG)
51.6 $< X \leq 18.2$	Not Good (NG)
$X < 51.6$	Not Very Good (NVG)

To analyze the practicality assessment data from students, the assessment is done by calculating the number and average score given by students on the assessment sheet. It is said to be practical if at least it is of good quality. The items assessed on the sheet total 35 items. The ideal maximum score is , and the ideal minimum score is  $1 \times 21 = 21$  ,  $x_i = 63$  and  $sb_i = 14,00$ . The student worksheet score conversion interval can be seen in table [18]:

**Table 8.** Overall student assessment practical interval

Interval	Criteria
$X > 88,2$	Very good (VG)
71,4 $< X \leq 88,2$	Good (G)
54,6 $< X \leq 71,4$	Fairly Good (FG)
34,8 $< X \leq 54,6$	Not Good (NG)
$X < 34,8$	Not Very Good (NVG)

For Learning Implementation Observation Data Analysis to analyze the learning implementation observation sheet, that is by calculating the percentage of activity implementation at each meeting. Here's how to determine a percentage learning activities. The product developed is said to fulfill the practical aspects both if the minimum level of practicality achieved is good for analyzing teacher and student assessment sheets and meeting the percentage of learning implementation **85%**

*Analysis of the Effectiveness of the product being developed*

Data analysis to determine the effectiveness of mathematics learning tools is to analyze the mathematical connection ability test data, the steps to determine the level of effectiveness are to provide an answer score for each answer item obtained by students based on the assessment rubric that has been made. Calculating the value obtained by each student. The score is converted using a scale of 5 according to Widoyoko [18]. The assessment is done using the formula proposed by Widyoko [18] The connection test has a range of values from 0-50, the ideal maximum score is **50**, the ideal minimum score is **0**,  $x_i = 25$  and

$sb_i = 8,33$ . The score conversion interval can be seen in table 10 below:

**Table 9.** Interval of Mathematical Connection Capability Effectiveness

Interval	Criteria
$X > 40$	Very High
$30 < X \leq 40$	High
$20 < X \leq 30$	moderate
$45 < X \leq 20$	low
$X < 45$	Very low

### 3. RESULTS AND DISCUSSION

The development procedure used in development is to use the ADDIE development model. The ADDIE development model has five stages as follows: (1) analysis (2) design (3) development (4) implementation (5) evaluation.

#### 3.1. Analysis

##### 3.1.1. Needs analysis

A needs analysis is the first thing to do to find out what is needed from the existing conditions and problems. The initial analysis carried out was based on the results of the PISA and UN, it was seen that the achievement of SMP students was of low quality. Then the pre-research data collection was carried out, the results of the IXB connection ability test were not complete.

Based on what has been stated previously, it can be seen that the mathematical connection ability of students is still low so that mathematics learning tools are needed to improve students' mathematical connection skills.

##### 3.1.2. Student Analysis

The subjects in this study were students of class IXB SMP Negeri 19 Jambi City. Class IX students with an age range of 12-15 years are generally at the formal operation stage. In the formal operation stage, the student's thinking stage begins to change from a real way of thinking to a formal way of thinking. At this stage the students' logical thinking has not developed perfectly<sup>10</sup>. Efforts made to improve formal thinking are by providing appropriate learning methods, which provide contextual problems and guide students to direct their real ideas to be formally made.

Based on pre-research data and preliminary observations that have been made, it also shows that class IXB students have not completed the connection ability test that has been given. This shows the student's thinking stage needs to be improved.

##### 3.1.3. Material Analysis

The development of student worksheets in this study was carried out on the curved side space building material.

#### 3.2. Design

The next stage in this research is the design stage. At this stage the researcher conducts student worksheets and also at this stage the researcher compiles a mathematical connection ability test instrument. The first design stage produced a draft 1 lessons plan based on RME. The lesson plan consists of 2 meetings with the components contained in the worksheets as follows: The steps for learning activities used in this study are adjusted to the RME steps, namely understanding contextual problems (stage 1), describing contextual problems (stage 2), solving problems contextual (stage 3), Comparing and discussing answers (stage 4), Making conclusions (stage 5). Then the learning steps are adjusted accordingly to the appropriate steps to improve the mathematical connection skills. Furthermore, draft 1 also consists of a mathematical connection test instrument which consists of 3 description questions

#### 3.3. Development

The next stage in this research is the development stage. At this stage draft 2. Draft 2 is draft 1 which has been prepared previously in the form of student worksheets and a mathematical connection ability test is validated and then revised according to input from the validator. Following are the results of the draft 2 RPP based on RME.

##### 3.3.1. Expert Validation

Assessment of student worksheets and instruments is the result of expert validation. The assessment is in the form of suggestions for improvements to products and instruments.

Inputs were given in the form of language improvements, writing, layout, pictures and problems that were deemed unrealistic. The average assessment score obtained from the validator, namely the LKS score is 124.33. Based on this score, the LKS has been declared valid with good quality. The connection test instrument is already worth using however.

##### 3.3.2. Product Revision I

The revised result in draft 1 is draft 2 in the form of RME based products and instruments assisted by Cabri 3D oriented to mathematical connection capabilities. Then the results of the revised draft 2



will be implemented and applied to mathematics learning in class IX

### 3.4. Implementation

The student worksheet developed was then applied to the SMPN 19 Jambi. By taking 1 class, that is class IXB Class. At this implementation stage, data will be generated in the form of teacher assessment data, student assessment data, and outcome data observations of the feasibility of learning, data on the results of students' mathematical connection ability tests

The implementation stage is intended to obtain data used to determine the practicality of the learning tools that have been developed. The data used to determine the practicality of this learning device are observation data on the implementation of learning, teacher assessment data and student assessment results data. Meanwhile, the data from the mathematical connection ability test is intended to determine the effectiveness of the device that has been developed.

### 3.5. Evaluation

At this stage, data on the practicality and effectiveness of the RME-based learning tools that have been developed and applied to research subjects will be generated. At this stage the final results of the learning tools will also be obtained.

#### 3.5.1 Practical data analysis

As previously stated, practicality data will be obtained through teacher assessment data, student assessments, and observations of learning implementation. Learning devices based on teacher assessment data have a total score of 155 and an average of 4.43 by using the practicality criteria table the score indicates that the learning device is practical with very good quality. Furthermore, based on student assessments, in this case the subjects taken were students of class IXB totaling 36 students, the total score of 36 students was 2644 and the average was 77.76. The score indicates that the learning tools that have been developed have been practical in good quality.

Then based on observations of the feasibility of learning it has shown that the learning tools developed have been practical with very good quality where the average of the results of the analysis of observational observations is at a percentage of 98%.

#### 3.5.2. Effectiveness data analysis

In this study, the effectiveness of the mathematics learning device that has been developed is seen from the results of the mathematical connection test. Previously, researchers conducted pre- research data collection by giving a mathematical ability test that the mathematical connection ability test was 0%. The results of the students' mathematical connection ability test were 26 students or 76% of the students completed the test. From the test, it can be seen that there is a significant increase between before and after learning is carried out, this shows that the learning device has been effective. From the data taken after learning, it can be seen that there is an increase between before and after learning using the device is done. And this also shows that the student worksheets have been effective.

### 3.6. Trial Results

#### 3.6.1. Expert validation

This validation stage is the stage that is carried out before the product trial is carried out. At this stage the researcher hands over the products and instruments to the subject teacher to be examined and assessed regarding the validity of these products and instruments. There are 3 teachers who assess this instrument.

**Table 10.** Score Validator Assessment

NO	Validator	Student worksheet	
		Total Score	Quality
1	I	105	G
2	II	118	G
3	III	150	G
Total score		373	-
Average		124,33	G
Maximum score		150	

#### 3.6.2. Small Group Trial (Limited Trial)

The small group trial was intended to analyze the writing language and readability of the students. The data that will be obtained will later be used as a reference in revising the product. For the small group trial, 12 students from grade 9 were taken with different levels, namely 4 low-level students, 4 medium-level students and 4 high-level students. The students were asked to read the device that had been developed and then asked to make comments related to the device by filling out the readability assessment sheet by the students. If there is a sentence that the student does not understand or the word is wrong, the student is asked to mark the

sentence and word. the legibility test results showed an average of 77.83. with very good quality.

**3.6.3. Field Trial**

This field trial stage is the stage to obtain data on the practicality and effectiveness of the product that has been developed. Data on practicality results can be obtained through observations of the implementation of learning, assessment data carried out by students and teachers. Meanwhile data effectiveness is obtained from the test results of students' mathematical connection ability. The data collection process was carried out through the learning process carried out by the researcher.

**3.6.4. Product practicality data analysis**

(i) Analysis of teacher assessment results

Teacher assessment data is obtained from the results of teacher assessments of student worksheets, connection ability tests and the implementation of learning that has been developed.

**Table 11.** Results of Analysis of the Practicality of Learning Devices based on Teacher\_Assessments

NO	Tools	Score	Average	Quality
1	Student worksheet	4 3	4,778	G
2	Test	3 3	4,125	G
3	Implementation of learning	3 2	4,571	VG
	Total		155	VG
	average		4,43	
	Maximum score		175	

(ii) Analysis of student assessment results

Student assessment data were collected on the student worksheets used during the learning process and also on the instruments that students had worked on. Student assessments include all aspects of usefulness, clarity of instructions and language on worksheets and instruments, writing worksheets and instruments.

**Table 12.** Results of Analysis of the Practicality of Learning Devices Based on Student Assessments

NO	Aspects assessed	Total Score	Average	Quality
1	Student worksheet	1886	55,47	G
2	Mathematical connection tests	794	23,35	G
	The total score was	2644		
	Overall average		77,76	G

(iii) Analysis of data from the observation of learning implementation.

The observation data from the observation of late learning was obtained by the researcher by learning the material about the curved side of the room as much as 2 meetings. The data from the observation of learning implementation is used to see the learning steps using the RME that have been implemented. The observation sheet is adjusted to the steps that have been in the RPP. Observation of the implementation of learning is carried out by the mathematics subject teacher. The observation data on the implementation of learning shows that meeting 1 has a percentage of 92%, meeting 2 has a percentage of 96% and an overall average of 98%

(iv) Analysis of product effectiveness

a) Effectiveness in terms of the Mathematical Connection Ability Test of Students

The data on the results of the mathematical connection ability test showed that all students had completed the test. The KKM value applied in SMP Negeri 19 is 75. The average classical completeness is 85%. From the data, this shows that learning using student worksheets is of very good quality. This also means that the developed student worksheet has met the effective quality because the percentage of classical completeness has reached more than 85% of the results of the mathematical connection test achieved by students which are presented in the following table:

**Table 13.** Results of Mathematical Connection Ability Analysis

NO	Description	Value
1	total Student	16
2	students passed	16
3	students did not complete	0
4	The lowest score is	75
5	Highest score	90
6	Percentage of students who did not complete	0%
7	Percentage of students who completed	100%
8	Average	87,13
9	Quality	Very Good

It is only natural that there is an increase in mathematical connection capability by using a realistic learning-based approach. This is because the students themselves find the concept and master the true findings, while the teacher's role is to guide the students by giving guided and the students are encouraged to think for themselves so they can find general principles based on the directions / questions given by the teacher

and to how far Guided students depend on their abilities and the material being studied[19]. The study from sirait and azis showed that the ability of the students' mathematic connection by using the realistic of mathematic educational approach is better than conventional learning. Furthermore, based on the observation of student activity in the learning process by using the realistic of mathematic educational approach is very positive and they became more active than before [20].

#### 4. CONCLUSION

Student worksheets that have been developed have met the criteria of valid practical and effective. With good validity quality, Good practicality quality and very good quality of effectiveness.

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