

# DEVELOPMENT OF STUDENT WORKSHEETS (SWS) BASED ON REALISTIC MATHEMATICAL EDUCATION (RME) FOR MATERIAL SYSTEM OF LINEAR EQUATIONS OF TWO VARIABLES

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**Abstract.** This study aims to produce teaching materials in the form of valid and practical RME-based worksheets on two-variable linear equation system materials for students of SMP N 1 Bangkinang Kota and find out whether these worksheets have a potential effect on meaningful learning for students. The method used is the development method with the Plomp model with the preliminary analysis stage, development stage, and assessment stage. The subjects of this study were 8th-grade students of SMP N 1 Bangkinang Kota. Data collection methods used are questionnaires, documentation, and interviews. The result of this research is to get an RME-based worksheet with a valid and practical two-variable linear equation system material. SWS validity is based on content, presentation, and language. Based on the content, the developed SWS is following the characteristics of the RME with a percentage of 76.7%. Based on the presentation, SWS is well structured with a percentage of 80%. Meanwhile, based on language, SWS has used good and correct language where there are no students who misunderstand and have multiple interpretations when reading it with a percentage of 95%. The practicality of the SWS can be seen from the students being able to use the SWS well.

**Keywords:** *Development, SWS, Two-Variable Linear Equation System, RME*

## 1. INTRODUCTION

Math is one of the disciplines taught at every level of education. The existence of this science is so important as it relates to the environment of daily life. This is in line with Permendikbud No. 58 of 2016 on Guidelines of mathematical subjects, which states that mathematical learning is needed to understand the world around it. But in fact, many learners still struggle with the mathematics problems they get in the learning materials. This is the result of learners' meager knowledge of the benefits of mathematics which are closely related to everyday life.

One factor is the learning done is still peer-oriented in schools. Learners are accustomed to receiving firsthand knowledge and there is no process of reconstructing knowledge by the learner himself. Thus, it is only natural for many educated students to have difficulty with math subjects. As Ruseffendi [2] says that mathematics (sure science) for children is generally an unpopular subject, if not a hated subject. These suggestions continue to hereditary and make mathematics a lesson that deals with calculation.

To minimize such suggestions, educators are required to employ meaningful learning. The point of meaningful learning is that educators can direct learners toward connecting knowledge gained with everyday life, making it easier for learners to understand and solve the math problems they find.

Based on an interview with an educator of compulsory mathematics at SMP N 1 Bangkinang Kota the ability to understand learners is still severely lacking. According to the teacher's presentation that when held a quiz on basic competence, the student's average score is always below KKM, only 1-8 people have a full score and therefore must be remedial. One is the reason protégé scores are always less likely to be difficult to understand, too many formulas, and very boring.

Teachers as an essential component of learning play a crucial role in improving the learning process. The success of the learning process is largely determined by the quality or ability of teachers [5]. The teacher's duty as an educator is based on the standard learning process, the assessments of learning, the supervision of the learning process for effective and efficient learning processes to accomplish [4]. One of the steps a teacher can take is by making mature learning planning.

One of the teaching materials that can facilitate learning is the learner's worksheet. The worksheet of the learner is selected because the educators can design teaching materials on their own according to the conditions of the trainees. The learner's worksheet can be arranged in a way with one of its purposes to build the learner's knowledge. The development of the learner's worksheet is expected to be a solution to both facilitate and exercise tools for learners to be able to solve math problems that come from real problems (realistic)

According to [3], the educational worksheet can be made on its own and can be much more relevant and contextual to both the circumstances and conditions of the school or the cultural environment of the student audience. Thus, the development of the educational worksheet of learners is necessary in the world of education. Development of the teaching materials is needed to facilitate the desired goals of learning, one of the excellence of the development of the SWS is to be designed according to the circumstances of the student and school characteristics.

One of the learning approaches that can be applied to math learning is a realistic mathematical approach. The current educational concept of realistic mathematic education (RME) corresponds to the requirements of learning for learners to build up their knowledge. Learners are no longer recipients of the information presented by teachers but rather learners as learning subjects that build knowledge upon the experience experienced in the learning process. Learners cannot be regarded as passive recipients of mathematical learning, but mathematical learning should allow learners to reinvent mathematical knowledge by exploiting the opportunities and real-life situations of learners [1]. The knowledge a learner acquires is his understanding of what he learns.

It has been observed that teachers made of Linear Two-Variable Equations Materials (SPLDV) class VIII of Junior High School, that learning still does not make use of the real world for the process of building knowledge, even though SPLDV material is very close to real life. The real world is simply presented as a form of material application, not as the first foundation for creating material concepts. Teachers tend to give common equations from SPLDV without beginning with the concept forming in learners about SPLDV so that few learners will understand the material. The first thing that may come to the minds of

learners is that this material is too abstract because it only talks about variable variables that learners do not know what they mean. It is different when teachers begin learning by presenting contextual problems by having learners build mathematical models of the problem. Then learners will understand the meaning of the variables. It is hoped, therefore, that education-mathematic education (RME) in SPLDV materials will improve the conception of learners and learners will no longer see mathematics as an abstract lesson of insignificance in real life, but math is an essential lesson because it is closely related to human activity in its daily life.

Based on the above background, the authors conducted research entitled: Development of SWS Based on Realistic Mathematical Education (RME) for Materials on Two-Variable Linear Equation Systems in Class VIII SMP.

## 2. RESEARCH METHOD

The kind of research that people do is research and development. The development model in this study is the Plomp model with our using our preliminary research phase, prototype development stage, and assessment phase. The research facility was conducted at SMP N 1 Bangkinang Kota. The subjects of this study were class VIII students of SMP N 1 Bangkinang Kota in the 2021/2022 academic year. The sample in this study is 9 people, 3 people for individual evaluations, and 6 people for small group evaluations.

The data collection instruments in this study were a validation sheet to obtain data on the results of the validation of the RME-based SWS experts, and a questionnaire sheet to obtain RME-based SWS student response data. Data analysis techniques used in this study are:

### 1. Validity Analysis of SWS

**Table 1.** Likert Scale Item Score

Score	Category
5	Very Good
4	Good
3	Pretty Good
2	Not Good
1	Very Not Good

Source: (Riduwan, 2015)

According to (Riduwan, 2015) to measure the calculation of the value data, the validity results were analyzed on a scale (0-100) using the formula:

$$NA = \frac{PS}{SM} \times 100\%$$

Description:

*NA*: Final Score

*PS*: Score

*SM*: Maximum Score

The criteria for obtaining the level of validity of SWS use the criteria as shown in Table 2.

**Table 2.** Validity Criteria

Average	Criteria
81% – 100%	Very Valid
61% – 80%	Valid
41% – 60%	Pretty Valid
21% – 40%	Not Valid
0% – 20%	Very Not Valid

Source: (Riduwan, 2015)

Based on the criteria in table 3.6, it can be concluded that the Learner Worksheet based on Realistic Mathematical Education (RME) for opportunity material is said to be valid if the average obtained is 61%.

## 2. Practical Analysis of SWS

The teacher and student response questionnaires are arranged in the form of a Likert Scale. Scoring for each item using a Likert scale with alternative answers can be seen in table 3

**Table 3.** Likert Scale Item Score

Score	Category
5	Very Agree
4	Agree
3	Quite Agree
2	Not Agree
1	Very Not Agree

Source: (Sugiyono, 2013)

The teacher and student response questionnaires are arranged in the form of a Likert Scale. Scoring for each item using a Likert scale with alternative answers can be seen in table 3:

$$NA = \frac{PS}{SM} \times 100\%$$

Description:

NA: Final Score

PS: Score

SM: Maximum Score

The practicality category of the Student Worksheet (SWS) is based on the final score obtained and can be seen in Table 4:

**Table 4.** Practical Criteria

Interval (%)	Category
0% – 25%	Less Practical
26% – 50%	Enough Practical
51% – 75%	Practical
76% – 100%	Very Practical

Source: (Riduwan, 2015)

## 3. RESULTS AND DISCUSSION

The results of the research on the development of s SWS based on Realistic Mathematical Education (RME) on the material for the Two-Variable Linear Equation System (SPLDV) in class VIII SMP are as follows:

## A. RESULTS PRELIMINARY RESEARCH

The prototype in the form of SWS based on Realistic Mathematical Education (RME) was prepared based on preliminary research. The preliminary research stage aims to determine and define the learning requirements needed in developing a prototype. At this stage, needs analysis activities, student characteristics analysis, curriculum analysis, and concept analysis are carried out. This analysis is carried out to produce prototypes needed by students and teachers.

## B. PROTOTYPING PHASE

### 1. SWS Validation Results by Experts

Based on the results of the assessment of 3 validators, it was found that in general the whole SWS based on Realistic Mathematical Education (RME) was declared valid

#### a. Content Validation

**Table 5.** Validation Results by Content Experts

No	Rated Aspect	Score	Category
1.	The problems presented are rightly directed to the learning principles of Realistic Mathematical Education (RME)	4	Valid
2.	The problem is appropriate for mathematical activities	4	Valid
3.	Image according to context	3	Quite Valid
4.	Horizontal and vertical mathematization activities are clear	4	Valid
5.	The concept discovery activity is right	4	Valid
6.	Its role is to encourage students to find concepts independently	4	Valid
<b>Sum</b>		<b>23</b>	
<b>Feasibility Presentation</b>		<b>76,7%</b>	<b>Valid</b>

The results of the validation by content experts showed the total score was 23 and the percentage was 76.7% with the "Valid" category so that it was feasible to be used as teaching material for class VIII students of SMP N 1 Bangkinang Kota. However, there are a few comments and suggestions to improve the teaching materials of this Student Worksheet. The comments and suggestions from the validator are that the addition of questions must describe the RME and include the original image in SWS.

#### b. Presentation Validity

**Table 6.** Validation Results by Presentation Expert

No	Rated Aspect	Score	Category
1.	The problems given are problems of everyday life that need to be translated from verbal form to mathematical form or involve mathematical ideas to solve them.	4	Valid
2.	Questions in the Students' Worksheet (SWS) facilitate students to understand the problem	4	Valid
3.	The sequence of steps for the Realistic	4	Valid

No	Rated Aspect	Score	Category
	Mathematical Education (RME) approach is correct		
<b>Sum</b>		<b>12</b>	
<b>Feasibility Presentation</b>		<b>80%</b>	<b>Valid</b>

The results of the validation by the presentation expert showed the results of the total score of 12 and the percentage of 80% with the "Valid" category. However, there are a few comments and suggestions to improve this Student Worksheet (SWS) teaching material. The comments and suggestions from the validator are adding numbers from the steps of Realistic Mathematical Education (RME) to become the hallmark of Realistic Mathematical Education (RME).

c. Language Validation

**Table 7.** Validation Results by Language Expert

No	Rated Aspect	Score	Category
1.	Compatibility of language use with EBI	4	Valid
2.	The sentences used are easy to understand	5	Very Valid
3.	Sentences do not cause multiple interpretations or misunderstandings	5	Very Valid
4	Clarity of directions and directions	5	Very Valid
<b>Sum</b>		<b>19</b>	
<b>Feasibility Presentation</b>		<b>95%</b>	<b>Very Valid</b>

The results of the validation by the discussion experts showed the results of the total score of 19 and the percentage of 95% with the "Very Valid" category".

2. Results One-to-One Evaluation

In the results of the revision of prototype 1, namely prototype 2, a trial was carried out on 3 students using SWS which had been declared valid by an expert validator. The three students have heterogeneous abilities. These abilities start from students with low, medium abilities, to students with high abilities. The summary of student response data can be seen in table 8.

**Table 8.** The Average Results of SWS Practicality by Students in the One-to-One Evaluation Stage

No	Statement	Score
1	SWS displays or pictures make me happy in learning the material	4,7
2	The activities in the SWS make it easy for me to understand the material	4,3
3	With SWS I find it easy to remember the concepts of the subject matter	4,3
4	The display or picture of the math worksheet is boring	1,0
5	I like math lessons in groups	5,0
6	I understand better if the mathematical formula is obtained by finding it yourself	4,0
7	Learning like this is too convoluted so that it makes me confused about understanding the material	1,7
8	Math learning like this is more fun	5,0
9	This kind of learning process makes it easier for me to understand the	3,7

No	Statement	Score
	material	
10	I'm lazy to interact with friends during group discussions	1,0
11	Learning mathematics like this makes me lazy to listen to the material being studied	1,3
12	The activities in the SWS made me understand the material	4,7
13	By learning mathematics, it makes it easy for me to express ideas or opinions	4,7
14	The orders in the SWS make me confused	2,3
15	I prefer learning activities as usual	1,7
<b>Final Score</b>		<b>49,4</b>
<b>Persentase</b>		<b>66%</b>
<b>Category</b>		<b>Practical</b>

Based on the results obtained in the One-to-One stage with a practical category level with a percentage value of 66%. This result is stated practically based on table 3.8. So the SWS based on Realistic Mathematical Education (RME) is stated to be practical to use.

### 3. Results Small Group Evaluation

In prototype 3, another trial was conducted on several students of class VIII SMP. In the small group evaluation, students consist of 6 people. The six students have different abilities. These abilities start from students with high, medium abilities, to students with low abilities. The student is given a valid and practical SWS based on the One-to-One Evaluation stage. From the practicality questionnaire, namely the response questionnaire from 6 students who took the test on SWS that was tested, the results were obtained as shown in table 9 below.

**Table 9.** Data on Student Response Questionnaire Results in Small Group Trials

No	Rated Aspect	Practical Value	Category
1	SWS displays or pictures make me happy in learning the material	90%	VP
2	The activities in the SWS make it easy for me to understand the material	90%	VP
3	With SWS I find it easy to remember the concepts of the subject matter	87%	VP
4	The display or picture of the math worksheet is boring	30%	EP
5	I like math lessons in groups	100%	VP
6	I understand better if the mathematical formula is obtained by finding it yourself	90%	VP
7	Learning like this is too convoluted so that it makes me confused about understanding the material	37%	EP
8	Math learning like this is more fun	97%	VP
9	This kind of learning process makes it easier for me to understand the material	90%	VP
10	I'm lazy to interact with friends during group discussions	37%	EP
11	Learning mathematics like this makes me lazy to listen to the material being studied	40%	EP
12	The activities in the SWS made me understand the material	93%	VP

No	Rated Aspect	Practical Value	Category
13	By learning mathematics, it makes it easy for me to express ideas or opinions	83%	VP
14	The orders in the SWS make me confused	40%	EP
15	I prefer learning activities as usual	40%	EP
<b>Practicality Average</b>		<b>69,6%</b>	<b>P</b>

Based on table 9, it can be seen that the overall percentage value is 69.6% in the practical category. This means that SWS based on Realistic Mathematical Education (RME) to facilitate students' conceptual understanding skills is declared practical. As for the results of the analysis of the practicality of small group evaluation questionnaire data, the percentage results for each indicator are between 51% - 75%. The summary of student response data is as follows:

**Table 10.** Results of Small Group Student Response Questionnaire Analysis

No	Student Name	Score	Practical Value	Criteria
1	Nova Engela	51	68%	P
2	Muhammad Hardin	53	71%	P
3	Virat Togatorop	57	76%	VP
4	Yogi Damara Putra	52	69%	P
5	Panggawa Mukti	51	68%	P
6	Pairegen T	54	72%	P

Based on the results obtained at the Small Group stage with the category level of each student in the practical to very practical category with an average value of 51%-75%. So SWS based on Realistic Mathematical Education (RME) is stated to be practical to use.

**Table 11.** Practical Results of SWS by Mathematics Subject Teachers

No	Statement	Value
1	SWS mathematics emphasizes process skills	5
2	Learning activities in mathematics worksheets are student-centered	5
3	The concepts listed on the SWS are following the correct mathematical concepts	5
4	The composition of the material in the SWS is presented in sequence	5
5	The depth of the material in the SWS is following the abilities of students based on content standards	5
6	The material presented is following the RME approach	5
7	Sentences in SWS have a double meaning	1
8	The sentences used in SWS are easy to understand	5
9	The language used is EBI compliant	5
10	The language used is communicative	5
11	Learning assessment can measure the achievement of KD	5
12	SWS can increase students' interest in learning	5
13	Learning activities provide direct experience to students in understanding the material	4
14	The activities carried out to encourage students to conclude concepts or facts	5
15	The learning activities carried out confuse students	2
16	SWS physical appearance design is attractive	5



No	Statement	Value
17	The text and pictures in the SWS relate to and support the clarity of the concept	4
18	SWS directs students to find concepts	5
<b>Final Score</b>		<b>81</b>
<b>Persentase</b>		<b>90%</b>
<b>Category</b>		<b>VV</b>

On the acquisition of the practical value of SWS based on Realistic Mathematical Education (RME) by the teacher, SWS based on Realistic Mathematical Education (RME) is declared practical without revision with good comments and is easily understood by students. Then it is declared practical to use.

#### 4. CONCLUSION

Based on the analysis of the data obtained from the validation results and the results of the questionnaire, it can be concluded that this study produced a Student Worksheet (SWS) based on Realistic Mathematical Education (RME) that met the valid and practical criteria with very good interpretation based on the validation analysis of the validators, indicating that The Student Work (SWS) is valid based on aspects of content, presentation, and language, and practically based on the results of student responses when conducting one-to-one trials and small group trials. The results of the response indicate that there is an ease in using SWS based on Realistic Mathematical Education (RME).

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