

Development of Student Worksheets Based Realistic Mathematics Education (RME)

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ABSTRACT: This research aims to develop Student Worksheet (LKS) for students of XI SMA (grade 11 of Senior High School) of linier program based on Realistic Mathematics Education (RME) and to determine the feasibility of Student Worksheet based on the assessment of subject-matter expert, design expert and media expert, as well as student assessment on individual test, small group test and field test. It was a developmental research or Research and Development (R&D), adapted from ADDIE development model. There were 5 **ADDIE phases namely:** 1) Analysis, 2) Design, 3) Development, 4) Implementation, and 5) Evaluation. Validation was carried out by two subject-matter experts, one design expert and one media expert. The Student Worksheet developed was tested in three phases, namely individual test with the subject of 3 students, small group test with the subjects of 6 student and field test with the subject of 35 students. The results showed the feasibility level of Realistic Mathematics Education (RME)-Based Student Worksheet (LKS), on the linear program material from several assessments. 1) From the subject-matter expert, an average total of 3.72 was obtained and included in the "Good" category. If it was converted into percentages, a value of 74.4% was obtained, therefore, it was included in the "Valid" category. 2) From the design expert, an average total of 4.09 was obtained and included in the "Good" category. If it was converted into percentages, a value of 81.8% was obtained, therefore, it was included in the "Very Valid" category. 3) From the media expert, an average total was obtained and included in the "Very Good" category. If it was converted into percentages, a value of 92.2% was obtained, therefore, it was included in "Very Valid" category. The assessment by the students was performed in three phases. 1) From individual test, an average total of 4.52 was obtained and included in the "Very Good" category. If it was converted into percentages, a value of 90% was obtained, therefore, it was included in the "Very Valid" category. 2) From small group test, an average total of 4.42 was obtained and included in the "Very Good" category. If it was converted into percentages, a value of 88.5% was obtained, therefore, it was included in the "Very Valid" category. 3) From field test, an average total of 4.43 was obtained and included in the "Very Good" category. If it was converted into percentages, a value of 88.7% was obtained, therefore, it was included in the "Very Valid" category. As a result, this Realistic Mathematics Education (RME)-Based Student Worksheet- is reliable.

Keywords: Development, Student Worksheet (LKS), RME, ADDIE Model

I. INTRODUCTION

Mathematics as a basic science plays a very important role in the development of science and technology. Mathematics is a means of thinking to develop the power of reason as well as logical, systematic and critical way of thinking. Learning is a pattern of interaction between teachers and students and among students in learning situations. In the learning process, the students play an active role to find the knowledge, concepts, theories and conclusions and it is not only an attempt to gather information or facts. The role of teachers as a director of learning activities is needed in that process so that the students not only acquire knowledge but also able to build knowledge for them. In short, the learning is student-centered learning and not teacher-centered. In fact, in the mathematics learning process in the classroom, some students choose to remain silent or passive and wait for the teacher to solve a given problem. Mastery of the material studied is still low and the liveliness of the discussion is also lacking. They assume that mathematics is abstract and not easy to do, so the students are lazy to learn it. Laziness of students in studying the mathematics is also because mathematics is taught with methods that are considered less attractive to students where the teachers explain while the students just make notes. Therefore, the need for a change in the mathematics learning process to make it a pleasant and helpful learning for students is needed.

In the interviews, at some private courses, the high school students are found to have problem where they do not understand the math concepts taught in school. Then, in order to obtain accurate and complete information on the learning process the writer conducted some observations to the SENIOR HIGH SCHOOL (Public Senior High School 3) in Jambi city and interviews with several math teachers in Senior High School. From the results of interviews, it is obtained the information that there are many teachers use the old published textbooks and the Student Worksheet (LKS) used does not have a clear instruction for the students to achieve

basic competence and it is merely a collection of problem so that the teachers do not use the Student Worksheet. In addition, the writer also conducted interviews to several students and got the information that they do not like math that much because they think that mathematics is difficult to understand. Then they also said that they still do not understand the benefits they learn math because math is learned at school are not always used in everyday life.

Teachers as an educator need to find a solution so that the students can understand the concepts in mathematics. One solution that can be considered is to develop teaching materials printed in the form of Student Worksheet. Student Worksheet is a way to assist and facilitate in the learning activities that will form an effective interaction between students and teachers and may increase the activity of students in the improvement of learning achievement. As said by Prastowo (20: 207), the teaching material of Student Worksheet is simpler than the module, but more complex than book. In addition, the Student Worksheet contain several aspect such as title, basic competence, allocation time, brief information, instructions, tasks to perform and the report to make. According to Prastowo (20: 204), Student Worksheet is a teaching material printed in the form of sheets of paper containing materials, summaries and instructions of the implementation of learning tasks that must be performed by learners which refers to the basic competencies that must be achieved. That is why the writer chose to develop Student Worksheet in conducting this research.

Student Worksheet developed should be made as attractive as possible and created by linking it to the daily life so that the students can apply the lesson in real life and understand the benefits of learning mathematics. One approach to learn that the writer thinks suitable for the Student Worksheet that will be developed is the Realistic Mathematics Education (RME) approach. According to Susanto (2013: 205), Realistic Mathematics Education (RME) is a mathematics learning approach oriented to students and attributed significantly to the context of the daily life of students. In the learning process, the abstract mathematical concepts need to be transformed into real things for students.

The focus of this research is the development of Realistic Mathematics Education (RME)-Based Student Worksheet in mathematics of linear program subject. The instructions in the Student Worksheet are designed in accordance with the principles and characteristics of the Realistic Mathematics Education (RME) approach. The expected products specifications in this developmental research are as follows:

1. The teaching materials developed are printed teaching materials in the form of Realistic Mathematics Education (RME)-Based Student Worksheet.
2. In the making of Student Worksheet, it is motivated by an active learning system that supports the applicable curriculum, namely curriculum 2013.
3. Student Worksheet is developed according to the principles and characteristics of the Realistic Mathematics Education (RME) approach. This phase makes students understand the concept better, because in the Student Worksheet, the learning begins with a real problem.
4. Tasks and exercises on Student Worksheet is problem solving and presented both individually and collectively so that the students can be more cooperative and able to exchange opinions with their friends in a group.
5. Student Worksheet is made to have a well-structured sequence consisting of the subject title, learning instructions, basic competencies to be achieved, tasks and assessment.
6. Student Worksheet materials that will be developed is a linear program material in XI SMA (11th grade of Senior High School) in accordance with the curriculum 2013.

II. THEORETICAL FRAME WORK

1. Development Model

Development model of the research is the ADDIE development model. It is chosen since this development model is simple, easy to understand and has systematic structure.

ADDIE model development phases are as follows:

a. Analyze

It is to identify the existing problems. Steps to be taken at this phase is analyzing the curriculum, validating the performance gap, determining the goals, analyzing the learners, resources available and work plan (Branch, 2009: 24).

b. Design

Branch (2009: 59) explains that "design phase is a phase of designing and manufacturing products. Measures that should be implemented at this phase are to conduct or make the things needed".

c. Develop

In ADDIE model, develop is the phase where the Student Worksheet is developed based on the suggestion given by subject matter expert, design expert and media expert. Branch (2009: 83) explains that the general steps performed at this phase are to run the individual and small group test.

d. Implement

Branch (2009: 133) describes the product tested is tried to apply in real situations. After revision of the product during the development phase is declared as feasible, then the product will be implemented or tested in actual classroom.

e. Evaluate

Evaluate is a process to get a variety of reactions from various parties on the products developed. Branch (2009: 151) explains that "evaluate is an assessment of a product developed. Evaluate is carried out at each phase from analyze, design, develop and implement".

III. TEACHING MATERIAL

According to Widodo & Jasmadi (Lester, 2013: 1) "teaching material is a set of tools or learning tool containing learning materials, methods, limitations, and how to evaluate where all are designed systematically and attractively in order to achieve the desired objectives, namely to reach the competencies or sub competencies with all the complexity." National Center for Competency Based Training (Prastowo, 20:16) says that "teaching materials are all kinds of materials that are used to help teachers or instructors in implementing the learning process in class. Teaching materials in question can be written or unwritten material."

Prastowo (20:40) says that the types of teaching materials can be divided into four types, namely:

- a. Printed teaching materials are materials prepared in a paper that may serve for the purpose of learning or delivering information. For example: handouts, modules, textbooks, worksheets.
- b. Listening teaching materials or audio program, i.e. all systems that use radio signals directly which can be played or heard by a person or group of people. For example: tapes, radio, vinyl record and compact disc.
- c. Audiovisual teaching materials, i.e. everything that allows the audio signal which can be combined with moving images sequentially. For example: video compact disc and movies.
- d. Interactive teaching materials are a combination of two or more media (audio, text, graphics, images, animations and videos). The users are manipulated or given treatment to control a command and or natural behavior from a presentation. For example, Compact Disc-interactive (CD-i).

IV. STUDENT WORKSHEET (LKS)

Belawati (2007: 3:27) says that "Student Worksheet is a teaching material that has been packaged in such a way so that students are expected to learn the teaching material independently". According to Prastowo (20: 205), Student Worksheet has four functions, namely:

- a. As teaching materials that can minimize the role of educators and rather to enable learners.
- b. As teaching materials that facilitate learners to understand the material provided.
- c. As a brief teaching materials and rich task to practice for learners.
- d. Facilitate the teaching implementation to learners.

Prastowo (20: 206) says there are four points that became the objectives of Student Worksheet, namely:

- a. Present teaching materials that facilitate the learners to interact with the material provided.
- b. Train the independence of learners.
- c. Make it easy for educators to assign tasks to learners.
- d. Present tasks that can improve the mastery of learners.

According to Prastowo (20: 208), there are five types of Student Worksheet which are generally used by learners, namely:

- a. Student Worksheet that helps learners to find a concept.
- b. Student Worksheet that helps learners to apply and integrate the various concepts that have been found.
- c. Student Worksheet that serves as a study guide.
- d. Student Worksheet that serves as reinforcement.
- e. Student Worksheet that serves as a practical guide.

V. RESEARCH METHODS

1. Types of Research

It is a research and development. Sugiyono (2014: 297) said that "metode penelitian dan pengembangan or in English is Research and Development is a research method that is used to produce a specific product and test the effectiveness of the products." Seels & Richey (Court et al, 2014: 81) said that "developmental research is oriented on the development of products, where the development process is described as accurately as possible and the final product is evaluated". Products developed in this study was the printed teaching materials in the form of Realistic Mathematics Education (RME)-Based Student Worksheet of learning approach on a linear program material in class XI SMA.

2. Development Planning

In this developmental research, the ADDIE development model was used. The development planning was as follows:

a. Analyze

The steps to be performed on the analyze phase were as follows:

- Curriculum Analysis
This step was useful to know the curriculum used in schools, know the syllabus and competencies that will be achieved as well as what the existing materials in mathematics that can be used as resource materials for the making of math Student Worksheet in the form of Realistic Mathematics Education (RME)-Based Student Worksheet.
- Validating Performance Gaps
The purpose of validating the performance gap was to produce a statement relating to a problem, find out the cause and finally find the solutions from the gaps or problems that arise. To find out the problems that occurred, the researcher conducted observations addressed to teachers on learners and school environment.
- Determining Goals
After finding the problem and analyze it, then the next step was to set goals. These goals were expected to overcome the existing problems in the learning process. This was conducted by giving the right solution to the gap and desired expectations.
- Analysis of Learners
Analysis of learners was performed with the aim to identify the initial ability, experience, likes and learning motivation. To be able to know this problem, the researcher conducted interviews addressed to learners.
- Available Resources
There are four types of resources that should be known namely the content resources, technology resources, teaching facilities and human resources. All types of these resources must be known in order to complete the ADDIE process. To be able to know this problem, the researcher conducted interviews to the school regarding the resources available in schools.
- Work Plan
The work plan was needed in a development. A work plan in question was to set up the stage of manufacture of products that would be produced by the researcher until the final develop phase.

b. Design

At this phase, all the things that needed would be made in accordance with what was on the analyze phase. All begin to be realized to produce a product that could be used in learning activities. The products that would be produced by the researcher was in the form of Realistic Mathematics Education (RME)-Based Student Worksheet and used as teaching material during the learning process.

c. Develop

After the steps in the design phase were carried out, the next step was to develop. The steps to be performed in this phase was to make the Realistic Mathematics Education (RME)-Based Student Worksheet, validate the Students Worksheet to four experts, namely two subject matter experts, one media expert and one design expert. Individual and small group tests were also conducted in this phase.

d. Implement

Once the development phase was conducted, the next step was to implement. Realistic Mathematics Education (RME)-Based Student Worksheet was put on test in the actual class.

e. Evaluate

Evaluation on ADDIE development model was carried out at every phase from analyze, design, develop and implement. Evaluation in this research was to improve Student Worksheet in each phase in order to obtain feasible Student Worksheet for use in the learning process.

VI. VALIDATION, EVALUATION AND REVISION OF PRODUCTS

a. Validation and Evaluation

This study used a questionnaire enclosed to validate and evaluate the Realistic Mathematics Education (RME)-Based Student Worksheet. Validation was carried out by four experts, namely two subject matter experts, one media expert and one design expert. Product tests were conducted to individual, small group and field test. The following validation and evaluation procedures were carried out on this research and development:

- Expert Judgment
Closed questionnaire was given to subject matter expert, design expert and media expert during the validation by experts. Sugiyono (2014: 143) said that "closed questionnaire is a question that expected a short answer or expected the respondents to choose one of the alternative answers to each question that had been provided".

- Individual Test (One To One Test)
Individual test with the closed questionnaire inside was conducted to obtain early feedback on Student Worksheet with the subject of individual test was 3 students.
- Small Group Test
In this phase, the test subjects consisted of 6 students with low, medium and high ability.
- Field Test
In this phase, the suggestion obtained from the test was used to improve Student Worksheet prior to the field test.

b. Revision of Product

Revision of product was carried out after the validation results by subject matter expert, expert design and media expert were obtained, after the test to individual and small group test were performed. It was carried out at each phase of the ADDIE development model from analyze, design, develop, implement and evaluate.

VII. DATA COLLECTION TECHNIQUES

In this research development, the type of data was qualitative and quantitative. The quantitative data obtained from the validation team namely a team of subject matter expert, design expert and media experts in the form of filling questionnaire to give scores on Student Worksheet, questionnaire on individual, small group and field test. While the qualitative data was obtained from the comments and suggestions at the time of validation, individual, small group and field test.

VIII. DATA ANALYSIS TECHNIQUES

a. Quantitative Data Analysis

- Quantitative Data Analysis of Expert Validation
Quantitative data was obtained from the assessment result through a questionnaire about the Student Worksheet products developed. The data obtained would be:
 - Assessment scores from the subject-matter expert on the feasibility of Student Worksheet product which included the quality of material content.
 - Assessment scores from media experts on the feasibility of Student Worksheet product on technical aspects.
 - Assessment scores of design experts on the feasibility of Student Worksheet product in the form of Student Worksheet suitability with Realistic Mathematics Education (RME).To analyze the expert validation data, qualitative descriptive analysis would be used by revising the Student Worksheet based on the input and record provided. Phases to analyze the level of Student Worksheet (LKS) validation were as follows:
 - Provide scores for each item with excellent (5), good (4), moderate (3), not good (2) and is not very good (1) answer.
 - Sum up the overall score given by the validator on each aspect of questionnaire assessment subject matter expert, media expert and design expert.
 - Calculate each aspect from the questionnaire assessment of subject matter expert, media expert and design expert. Analysis of calculation according to Sudjana (2005: 67) is:

$$\bar{x} = \frac{\sum x_i}{n}$$

Description:

\bar{x} = Mean

x_i = Total validation score of all respondents

n = Total questions

b. Qualitative Data Analysis

The qualitative data was obtained from the responses of experts and students. It was analyzed by descriptive qualitative. Responses from experts and students which were considered constructive and deemed appropriate for the development of Student Worksheet were used as an improvement material in the revision phase of Student Worksheet.

IX. DEVELOPMENT RESULT

1. Presentation of the Results of Development

The results of the developmental research are: (1) A Realistic Mathematics Education (RME)-Based Student Worksheet on a linear program material in class XI SMA. (2) Material, media and design assessment by subject matter expert, media expert and design expert. (3) The response of students on the math Student Worksheet that have been made. In developing the math Student Worksheet, ADDIE development model was used where there are several phases, namely: (1) Analyze, (2) Design, (3) Develop, (4) Implement and (5) Evaluate.

a. Analyze

The analysis phase is the initial phase in developing the math student worksheet. In this phase the researcher conducted several activities, namely, curriculum analysis, validating performance gap, determining goals, analysis of learners, resources available and the work plan. Here are things to perform during analysis:

(1) Curriculum Analysis

This phase is useful to know the curriculum used in schools, know the syllabus and competencies that will be achieved as well as know what materials are there to math instruction that can be used as resource materials for the manufacture of Realistic Mathematics Education (RME)-Based Student Worksheet.

(2) Validating Performance Gaps

At this phase, observations were conducted at Senior High School which aims to see what might be causing a gap to occur.

(3) Determining Goals

The goal set here is to develop the math student worksheet to help students in the learning process while enhancing students' understanding of the lesson so that they no longer think that mathematics is difficult to learn.

(4) Analysis of Learners

From this phase, it is obtained that there are still many student of class XI who do not like math. This is caused by the initial perception of students who do not love math, and they assume that math is a difficult subject to understand.

(5) Available Resources

Resources available at Senior High School, among others: (a) content resource in the study including teacher books and student books, (b) technological resources available in are electricity network, wifi network, computer lab, (c) facilities for teaching learning including library, classrooms with electrical power, science laboratories, has a projector and more than 30 students are accommodated in a classroom and (d) human resources at Senior High School is the number of teachers who are active in teaching.

(6) Work Plan

The work plan that has been designed by the researcher namely: schedule, validator and specifications of Student Worksheet.

(7) Results of Analysis

From the analysis conducted, the teachers want to use the Realistic Mathematics Education (RME)-Based Student Worksheet in learning activities. However, they have not been able to provide this worksheet, while the resources available at the school are adequate such as the students and educators. Therefore, a Realistic Mathematics Education (RME)-Based Student Worksheet is developed to assist in the learning process.

b. Design

The general procedure is carried out in the design phase which is conducting or making things that are needed. At this phase all the things that needed to be made in accordance with the analyze phase. All begin to be realized to produce a product that can be used in learning activities. The results obtained from the realization are in the form of Realistic Mathematics Education (RME)-Based Student Worksheet are as follows:

(1) Preparation of Making the Products

What to do at this phase is to find and collect some reference books for use in developing the Student Worksheet. References are taken from various sources which are considered relevant and in accordance with the selected material in the development of Student Worksheet.

(2) Preparation of the Basic Framework for Student Worksheet Student Worksheet which will be developed to have a framework consists of cover, preface, table of contents, competencies to be achieved, learning guide, concept maps, material display which is customized with five characteristics of Realistic Mathematics Education (RME) and assessment.

(3) Preparation of Assessment Instruments

Preparation of assessment instruments is conducted by making the questions that will be included on the questionnaire. The questions listed are in questionnaire required and refer to the questionnaire indicators. Assessment instruments are given to the expert judgment, individual test, small group test and field test.

c. Develop

The design of teaching materials is in the form of Realistic Mathematics Education (RME)-Based Student Worksheet on the linear program material which includes several aspects. Once the design phase is determined, then the next will be making Realistic Mathematics Education (RME)-Based Student Worksheet on the linear program material as follows:

- (1) Design of Student Worksheet Cover
- (2) Foreword Display
- (3) Table of Content Display
- (4) Competencies to Achieve Display
- (5) Learning Instructions Display
- (6) Map Concept Display
- (7) Material Display

In this study, teaching materials will be validated by four educational experts to see the validity of the Student Worksheet. It consists of 3 data namely the validity of the data obtained from the subject matter validator, design validator and media validator.

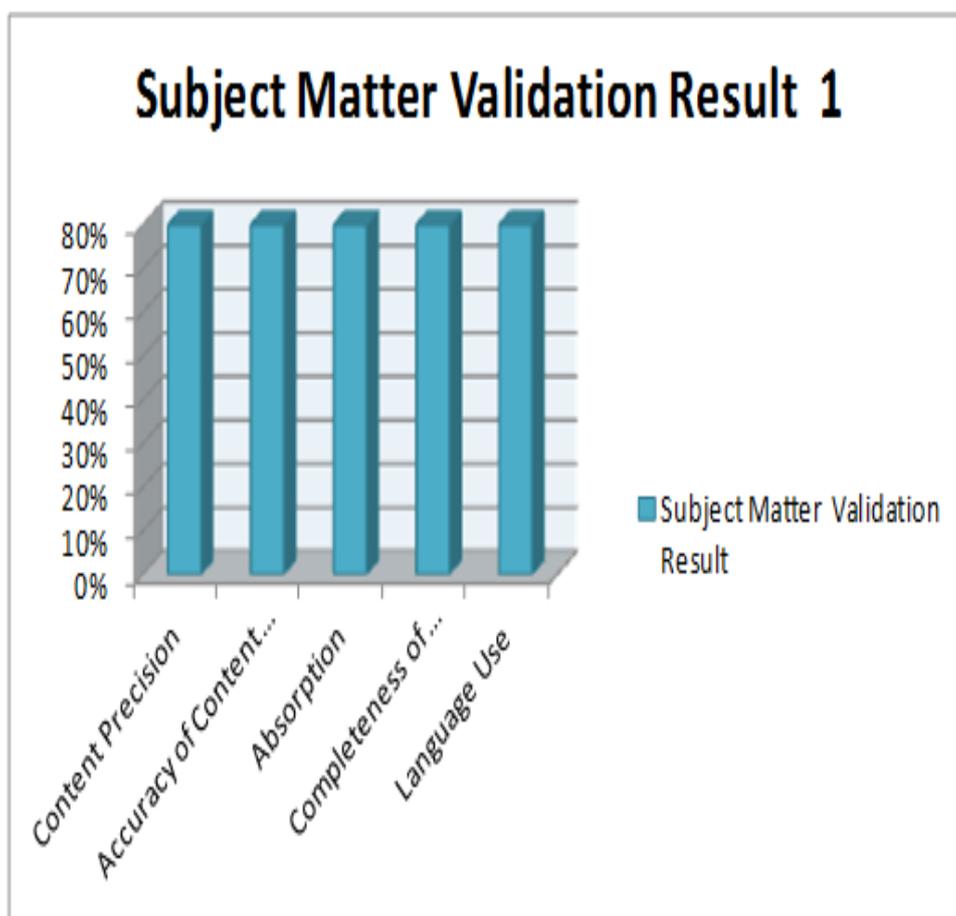


Figure 1. Diagram of Subject Matter Validation Results 1

From the diagram above, the percentage of 80% was obtained for the aspect of content precision, 80% for accuracy of content coverage, 80% for absorption, 80% for completeness of component and 80% for language use. So, the material in this Student Worksheet is valid and appropriate to proceed to the next phase.

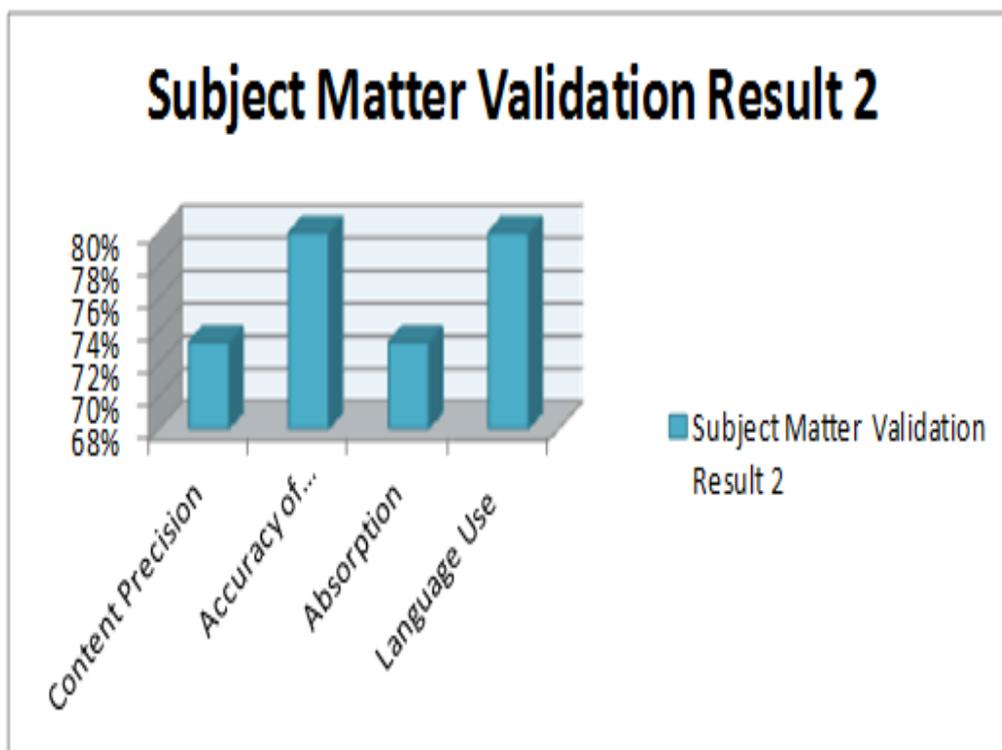


Figure 2. Diagram of Subject Matter Validation Results 2

From the above diagram, the percentage of 73.3% was obtained for the aspect of content precision, 80% for accuracy of content coverage, 73.3% for absorption and 80% for language use. So, the material in this Student Worksheet is valid and appropriate to proceed to the next phase.

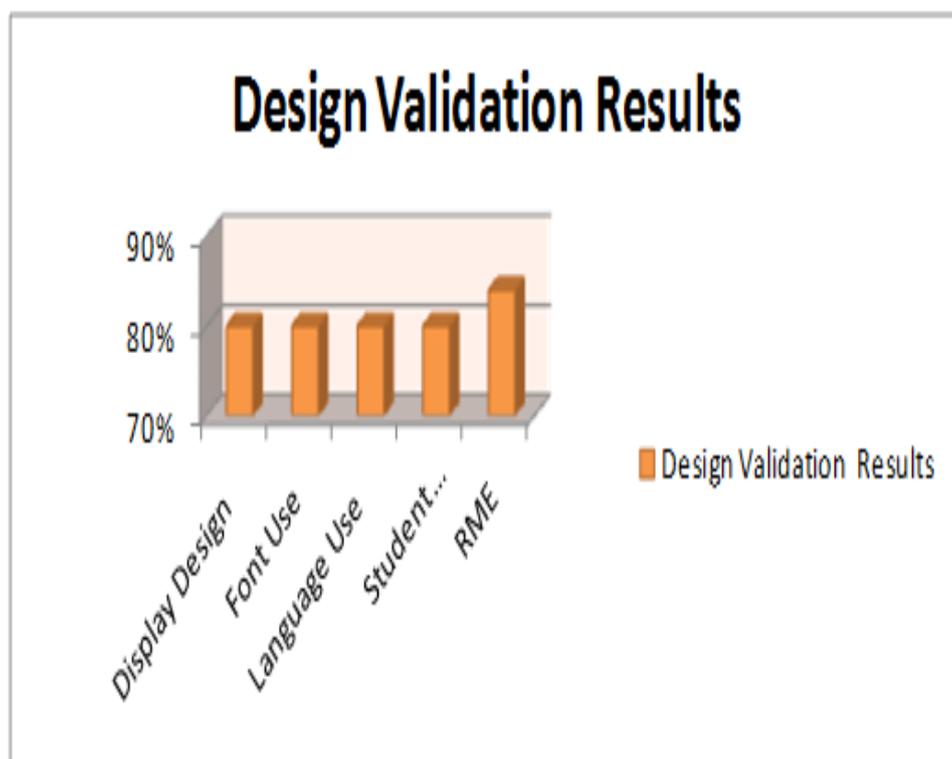


Figure 3. Diagram of Design Validation Results

From the diagram above, the percentage of 80% was obtained for the aspect of display design, 80% for font usage, 80% for language use, 80% for student worksheet instructions and 84% for Realistic Mathematics Education (RME). So, the design in this Student Worksheet is valid and appropriate to proceed to the next phase.

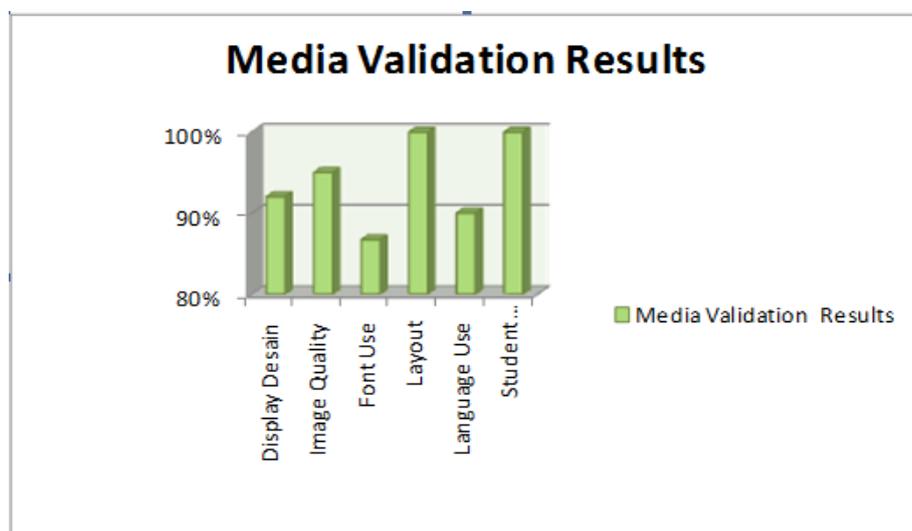


Figure 4. Diagram of Media Validation Results

From the diagram above the percentage of 92% was obtained for the aspect of display design, 95% for image quality, 86.7% for font use, 100% for layout, 90% for language use and 100% for student worksheet instructions. So, in the media in this Student Worksheet is valid and appropriate to proceed to the next phase. After the Student Worksheet is revised according to the comments and suggestions, then the test on Student Worksheet is run namely individual test (One to One Test) and a small group test.

- Individual Test (One To One Test)

Individual test was conducted by the researcher to 3 students of XI MIA 1 (grade 11 of math science class) who will assess Student Worksheet made by the writer as a whole. Results obtained from the questionnaire addressed to the subject of the test was a total score of 190 with a mean score of 4.52 including a score range of $4.20 < x \leq 5.0$. It is categorized as "Very Good" and with a percentage of the product by 90% then the Student Worksheet is categorized as "Very Valid". The following is a diagram of individual test results in at SMAN:

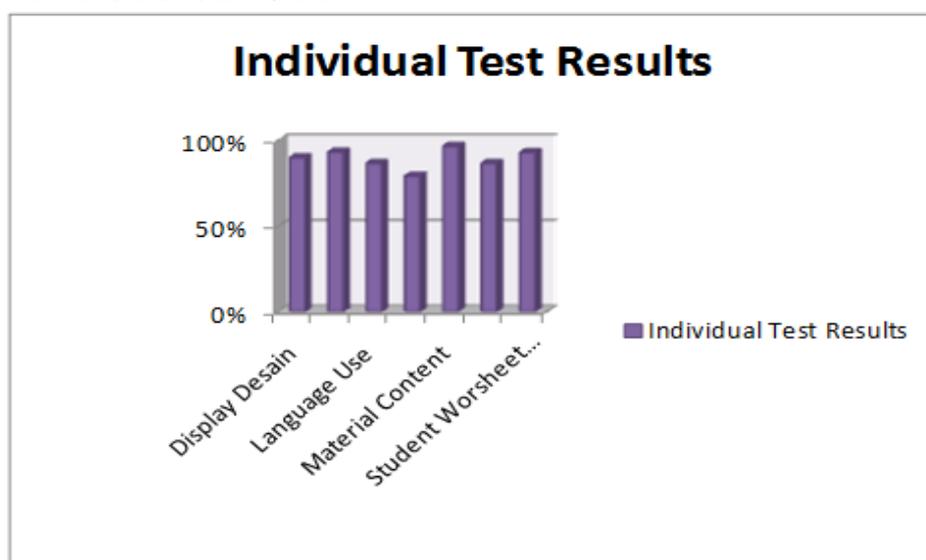


Figure 5. Diagram of Individual Test Results

From the diagram above, the percentage of 90% was obtained for the aspect of design display aspect, 93.3% for image quality, 86.7% for language use, 79.2% for font use, 96.7% for material content, 86.7% for layout and 93.3% for student worksheet instructions. From the results obtained in individual test, the Student Worksheet is excellent and appropriate to proceed to the next phase.

- **Small Group Test**

Small group test was conducted by the researcher with non-subject of research test; the students selected were as many as six people from students of XI MIA 2 who have low, medium and high ability. Selection of students who became the subject of small group test was helped by the math teachers who taught the class and already know the mathematical ability of the students in class XI MIA 2. The results of the small group test evaluation were used to revise the Student Worksheet which had been constructed by directing the students to observe the entire Student Worksheet and then fill out a response questionnaire that had been given. Result obtained from the questionnaire addressed to the test subject is a total score of 239 with a mean score of 4.42 including a score range of $4.20 < x \leq 5.0$ which is categorized as "Excellent" with a percentage of 88.5%, while the Student Worksheet is categorized as "Very Valid". The following diagram of small group test results in at Senior High School:

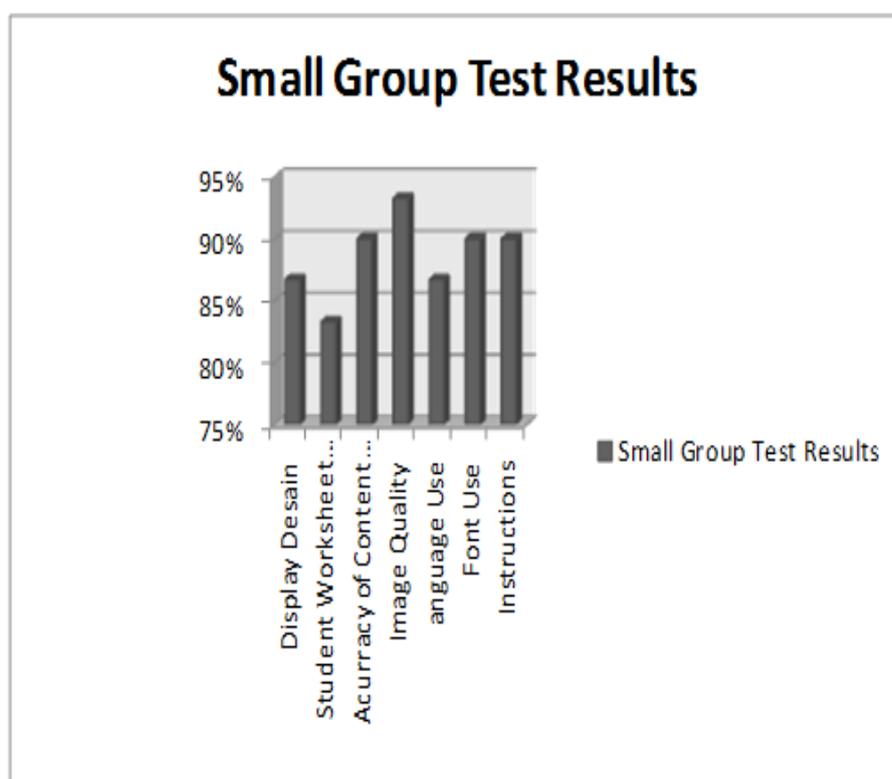


Figure 6. Diagram of Small Group Test Results

From the diagram above, the percentage of 86.7% was obtained for the aspect of display design, 83.3% for student worksheet instructions, 90% for accuracy of content coverage, 93.3% for image quality, 86.7% for language use, 90% for font usage and 90% for instructions. From the results obtained on the small group test, the Student Worksheet is excellent and appropriate to proceed to the next phase.

X. IMPLEMENT

In the implementation phase, the products which have been tested is applied in a real situation with the actual teaching using Realistic Mathematics Education (RME)-Based Student Worksheet involving 35 students or one class of class XI MIA Senior High School. At this phase, observations are conducted to see the activity of students in the study using the Realistic Mathematics Education (RME)-Based Student Worksheet approach. Observations made during the learning process took place are based on Realistic Mathematics Education (RME) approach. The following is a diagram of field test results at Senior High School:

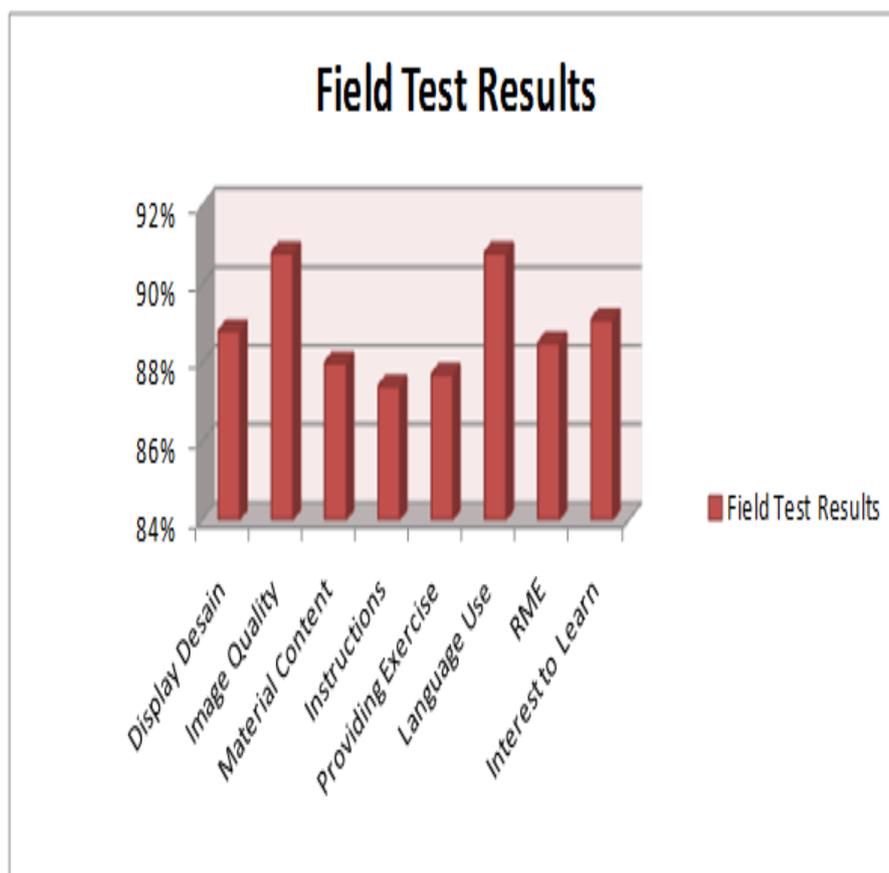


Figure 7. Diagram of Field Test Results

From the above, the percentage of 88.8% was obtained for the aspect of display design, 90.8% for image quality, 88% for material content, 87.4% for instructions, 87.7% for providing exercise, 90, 8% for language use, 88.5% for RME and 89.1% interest to learn. From the results obtained in field tests, the Student Worksheet got excellent category.

XI. EVALUATE

Evaluate in this research is to improve student worksheet in each phase. It is called formative evaluation in order to obtain feasible Student Worksheet for use in the learning process. Formative evaluation was carried out in develop phase. Here are the results of the evaluation of student worksheet developed based on the comments and suggestions provided by subject matter expert, design expert and media expert:

a. Evaluation results Student Worksheet by Subject Matter Expert

From the subject matter validation results 1 on the Student Worksheet that was created by filling in the closed questionnaire consisting of five aspects with 16 questions, a total score of 60 with a mean score of 3.75 including a score range of $3.40 < x \leq 4.2$ with percentage of products by 75% was obtained, therefore the Student Worksheet was considered as "Valid".

After revision was conducted according to the comments and suggestion from the subject matter experts, a total score of 62 with a mean score of 3.87 including a score range of $3.40 < x \leq 4.2$ with a percentage of 77.5% was obtained, therefore, the Student Worksheet product was categorized as "valid " to proceed to the next phase.

b. Evaluation of Student Worksheet Results by Design Expert

Results of design validation by design expert on the Student Worksheet that was created by filling in the closed questionnaire consisting of five aspects with 16 questions, a total score of 40 with a mean score of 3.63 including a score range of $3.40 < x \leq 4.2$ with a percentage of 72.7% was obtained, therefore, the Student Worksheet product was considered as "Valid". After revision was conducted according to the comments and suggestion of design expert, a total score of 45 with a mean score of 4.09 including a score range of $3.40 < x \leq 4.2$ with a percentage of 81.8% was obtained, therefore, the Student Worksheet product

was categorized as "Very Valid". So, the design in the Student Worksheet is a very valid and appropriate to proceed to the next phase.

c. Evaluation of Student Worksheet Results by Media Expert

Results of design validation by Media Experts on the Student Worksheet was created by filling in the closed questionnaire consisting of five aspects with 18 questions, a total score of 71 with a mean score of 3.94 including a score range of $3.40 < x \leq 4, 2$ with a percentage of 78.8% was obtained, therefore, the Student Worksheet product was considered as "Valid". After revision was conducted according to the comments and suggestion from media expert, a total of 83 with a mean score of 4.61 including a score range of $4.20 < x \leq 5.0$ with a percentage of 92.2% was obtained, therefore, the Student Worksheet product was categorized as "Very Valid". So, the media in the Student Worksheet was a very valid and appropriate to proceed to the next phase.

XII. DISCUSSION

First, the researcher conducted an analysis to Senior High School to find out the existing problems in Senior High School. Then, the researcher designed the Realistic Mathematics Education (RME)-Based Student Worksheet on a linear program material. The design refers to the characteristic and the principle of Realistic Mathematics Education (RME). Five characteristics of Realistic Mathematics Education (RME), namely: (1) the use of context, (2) the use of progressive mathematical models, (3) the use of the results of student construction, (4) interactivity and (5) linkage. The principle of Realistic Mathematics Education (RME), namely (1) Guided Re-invention and Progressive mathematization, (2) didactical Phenomenology and (3) Self-Developed Models.

On the Realistic Mathematics Education (RME)-Based Student Worksheet; the beginning of learning uses context in the realistic problems. Through the use of context, students are involved actively to explore the problem. The results of student exploration are not only aim to find a final answer to a given problem, but also to develop a variety of problem strategies that can be used. In addition, the material content of Realistic Mathematics Education (RME)-Based Student Worksheet emphasizes the student's ability to construct a concept.

After the Student Worksheet had been designed, then it was validated by subject matter expert, design expert and media expert. In the Student Worksheet assessment by subject matter expert 1, a total score of 72 with a mean score of 4 was included in the category of $3.40 < x \leq 4.2$ with a percentage of 80%, so the product was "Valid". On the Student Worksheet assessment by subject matter expert 2, a total score of 62 with a mean score of 3.87 was included in the category of $3.40 < x \leq 4.2$ with a percentage of 77.5%, so the product was "Valid". The results of validation conducted by design expert, a total score of 45 with a mean score of 4.09 was included in the category of $3.40 < x \leq 4.2$ with a percentage of 81.8%, so the product was "Very Valid". Then for the Student Worksheet assessment by media expert, a total score of 83 with a mean score of 4.61 was obtained and included in the category of $4.20 < x \leq 5.0$ with a percentage of 92.2%, so the product was "Very Valid". There are a few comments and suggestions given by subject matter expert, design expert and media expert and the researcher has revised the Student Worksheet based on comments and suggestions from the validator.

From the validation activities, it can be concluded that the Realistic Mathematics Education (RME)-Based Student Worksheet deserves to be tested according the suggestion and comments of the experts. The next step, Student Worksheet was tested. There are two phases of test, which is individual and small group test. The researcher conducted individual test which consisted of 3 students of non-subject research, small group test which consisted of 6 students of non-subject research with the low, medium and high ability. Selection of students who became the subject of non small group test was helped by the mathteacher who taught the class. The next phase was tests in class XI MIA of Senior High School. In the field test, the response of students obtained on the use of Realistic Mathematics Education (RME)-Based Student Worksheet, on the linear program material has a very good response from the students because it has a percentage of 88.7%.

To determine the validity of the Realistic Mathematics Education (RME)-Based Student Worksheet, on the linear program material, the expert judgment was used. From the results of material validation, a mean score of 3.72 including a score range of $3.40 < x \leq 4.2$ with a percentage of 74.4% was obtained, so the product was valid. While from the design validation results, a mean score of 4.09 including a score range of $3.40 < x \leq 4.2$ with a percentage of 81.8% was obtained, so the product was very valid. As well as for media validation, a mean score of 4.61, including a score range of $4.20 < x \leq 5.0$ with a percentage of 92.2% was obtained, so the product was very valid. Based on the results of analysis performed, it can already be used to determine valid, quite valid and invalid because the four validators are competent people in the field of subject matter, design and media. As for some comments and suggestions provided by the validators, the researcher had revised the Student

Worksheet based on comments and suggestions from the validators. Revisions on the Realistic Mathematics Education (RME)-Based Student Worksheet, on the linear program material were conducted until the validity of Student Worksheet product obtained.

Next, the results of this study also illustrate the levels of practicality seen from the positive responses of students which was shown through the questionnaires given. The assessment of positive responses of students on the Student Worksheet was by giving questionnaires to students through field test in the implement phase. The questionnaires given consisted of 9 indicators with 15 questions. Based on the results of the student assessment of on a field test, a mean score of 4.43 including a score range of $4.20 < x \leq 5.0$ was obtained so category of products was very good and the product percentage of 88.7% by was included in very valid category. From these data it can be concluded that the Realistic Mathematics Education (RME)-Based Student Worksheet, on the linear program material got very positive feedback so that the students appreciate that the Student Worksheet used can increase the interest to learn by having excellent criteria as a teaching material.

XIII. LIMITATIONS OF STUDY

Limitations of this developmental research are:

- a. Student Worksheet produced is still included in the entry-level development that includes only one chapter of linear program material.
- b. Tests on the implementation and evaluation of student worksheet are only performed at one school, namely Senior High School.
- c. Student Worksheet quality developed is only seen from the validity and practicality aspect.
- d. Costs incurred during the making process of Student Worksheet are quite large.

XIV. CONCLUSIONS AND SUGGESTIONS

1. Conclusions

Based on the results of research on the development and discussion of the development of teaching materials in the form of Realistic Mathematics Education (RME)-Based Student Worksheet, on linear program material in class XI of Senior High School, it can be concluded as follows:

- a. The making of teaching material on the linear program material at class XI Senior High School is in the form of Realistic Mathematics Education (RME)-Based Student Worksheet. The development design in this research using ADDIE development model that consists of five phases: Analyze, Design, Develop, Implement and Evaluate. Initial activities undertaken in the process of making these materials are carrying out the analysis which consists of curriculum analysis, validating performance gaps, determining goals, analysis of learners, checking the available resources and work plan. If the analysis phase has been carried out, then the researcher begins to design the Student Worksheet product based on Realistic Mathematics Education (RME) on linear program material. In making the Student Worksheet, first, the researcher made draft of what would be created in the Student Worksheet such as the presentation of the material and display of Student Worksheet. Once the design was finished, then the validation of subject matter expert, design expert and media expert was performed. In the validation of material, design and media, there were several things that need to be revised. Once the revision was completed, the development proceeded to carry out some tests consisting of individual test of 3 students of class XI MIA 1 and Senior High School group test of 6 students of class XI MIA 2 with high, medium and low ability. On the individual and Senior High School group test, closed questionnaire was given to see the response on Student Worksheet. The next phase was the implementation carried out in class XI MIA Senior High School. Next, the evaluation phase on the use of Realistic Mathematics Education (RME)-Based Student Worksheet on a linear program material in class XI MIA 3 was conducted.
- b. Quality of Student Worksheet based on validity and practicality aspect are as follows:
 - (1) The validity of the Realistic Mathematics Education (RME)-Based Student Worksheet on the material is seen from the results of the linear program validation of material, design and media. From the results of material validation, a mean score of 3.72 with a percentage of 74.4% was obtained, so the product was valid. From the results of design validation, a mean score of 4.09 with a product percentage of 81.8% was obtained, so the product was very valid. From the results of media validation, a mean score of 4.61 with a product percentage of 92.2% was obtained, so the product was very valid. From the data obtained Realistic Mathematics Education (RME)-Based Student Worksheet on the linear program material appropriate to use on the quality validity level of a product designed by the researcher.
 - (2) Practicality of Realistic Mathematics Education (RME)-Based Student Worksheet on linear program material is viewed from the positive responses of students which are seen through the questionnaires given. Results of the assessment of student responses, it was obtained that a mean score of 4.43 with

the categories of products was very good and a percentage of 88.7% was included into very valid category. From these data it can be concluded that the S Realistic Mathematics Education (RME)-Based Student Worksheet on the linear program material has excellent criteria as teaching materials.

2. Suggestions

- a. The availability of quality teaching materials may help the learning process. The writer suggests to the math teachers to use teaching materials in the form of Realistic Mathematics Education (RME)-Based Student Worksheet on a linear program material in class XI Senior High School.
- b. The writer also suggests conducting a research and further development of the Realistic Mathematics Education (RME)-Based Student Worksheet on another material.
- c. The writer suggests to researcher conducting a further development to be tested regarding its use with the effectiveness Student Worksheet developed.

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