Practicality of Realistic Mathematics Education Based Learning Design of Linear Programming For Financial Accounting Major in Vocational High School

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Abstract. This study discusses the practicality of Realistic Mathematics Education based learning design of linear programming for financial accounting and major in Xth grade vocational high schools. The research method used is qualitative research. This article discusses the practicality of learning design in the one-to-one evaluation and small group evaluation. The subjects were mathematics teachers and Xth grade students in financial accounting majors at SMKN 2 Padang. The instruments used were interview guidelines and practicality questionnaires. Descriptive techniques are used to describe data from interviews. The practicality questionnaire of learning design is described by data frequency analysis techniques using the formula proposed by Purwanto. The results of the teacher’s questionnaire responses were 89.17% with a very practical category. The results of the student response questionnaire were 77.79% with the practical category. Based on the results of interviews and questionnaires show that the learning design developed has been practically used both for teachers and students in learning linear programming.

1. Introduction
In the era globalization with presence of the ASEAN Economic Community (AEC), Indonesia faces challenges, particularly in the aspects of Human Resources (HR) and employment. To be able to compete in the working world requires a workforce or HR who can compete globally, not only compete with workers in Indonesia. So the problem must be anticipated immediately.

Education has a strategic role in the effort to develop highly competitive HR. One of the suggested efforts is improving the quality of Vocational High School (VHS) education. Prospective VHS graduates are expected to be well-prepared with proficient field of expertise and work professionally. As written in Act of Republic Indonesia No. 20 Article 15 in 2003 [1] related to National Education System, it states that VHS is secondary high school in preparing students to work in specific field.

As economic development, one of the most interested by the community is financial accounting major. VHS graduates of financial accounting major are prepared to work as financial technicians in various companies, for example accessing accounts receivable debt accounting, and financial administration. In VHS especially financial accounting major, one of the mathematical material taught is a linear programming. Linear programming related to production and trade activities in the Company. Through linear programming, students are trained to create several strategies to determine
maximum income by minimizing expenditure. Therefore, linear programming material is highly needed by VHS students in financial accounting major.

However, reality shows that students have difficulty solving linear programming problems. Students have difficulty turning story problems into mathematical language and also difficulty determining the area of resolution \(^2\). This is caused by the lack of students’ understanding of the problem, making it difficult to carry out the plan of completion. Besides, there are still some errors in changing verbal sentences into mathematical models.

The same condition was also found when conducting a preliminary study in April 2019 at SMK Negeri 2 Padang and SMK Negeri 3 Padang. Information obtained that learning linear programming topic is still based on existing textbooks, without designing by self how linear programming topics should be taught. Based on textbooks, teachers tend to teach mathematics mechanically and algorithmically \(^3\).

Linear programming material in the textbook is directly presented in the guidance table to turn verbal problems into mathematical models, and the steps to solve the linear programming problem are presented. The teacher explains examples of problems to students. The teaching materials available lead to teacher-centered learning. Students await instructions from the teacher to work on practice questions based on the examples provided. Based on the learning trajectory undertaken by the teacher, less contribute to the development of student learning, especially in development of mathematical problem-solving skills.

From the test results of mathematical problem-solving skills, students still have difficulty solving linear program questions. The percentage of student answers can be seen in Table 1 below.

| Answer Type | Understood Problem Solving Skill Indicators Answer Type | Amount | Percentage |
|-------------|--------------------------------------------------------|--------|------------|
| Type I      | Have not mastered all indicators                        | 18     | 31.03 %    |
| Type II     | Have mastered the 1st indicator and have done the 2nd indicator but it is still wrong | 17     | 29.31 %    |
| Type III    | Have mastered the four indicators, the 2nd indicator is still wrong | 8      | 13.79 %    |
| Type IV     | Have mastered the four indicators, the 4th indicator is still wrong | 5      | 8.62 %     |
| Type V      | Correct Answer                                         | 4      | 6.90 %     |
| Correct Answer | Have mastered all indicators                        | 6      | 10.35 %    |

Based on Table 1, it can be seen that there are 60.34% of students who have not mastered all indicators of problem-solving skills and only 10.35% of students who have mastered all indicators of problem-solving skills. This shows that students still have difficulty solving linear programming questions, especially those related to mathematical problem-solving skills. If this condition continues, it will cause the students' mathematical problem-solving skills to be lower. Whereas, skill to solve problems is important for financial accounting major to solve financial problems faster and more cost-effectively. One of the goals of learning mathematics in VHS as stipulated in Permendikbud No. 60 of 2014 is the skills to solve mathematical problems.

Problem-solving is one of the most important skills in working world, based on NACE (National Assosiation of College and Employers) \(^4\). The reason behind such failure is lack of soft skills \(^5\). VHS scores high numbers on national unemployment rates \(^6\). Data from Indonesia Central Statistical Agency shows that VHS hit 17.26 % in unemployment rates. It happened because prospective VHS graduates fail to meet employers demand \(^7\).

Based on description of the problem above, learning trajectory of linear programming topic has
been designed that can develop students' mathematical problem-solving skills to solve problems that occur. The solution chosen is to develop a learning design for linear programming topic based on Realistic Mathematics Education (RME). RME approach has a positive impact on the development of student learning because it is guided reinvention mathematical concepts, and use of real life as a learning starting point. Implementation of RME approach will create a learning atmosphere that is meaningful and expected to be effective in improving students' mathematical problem-solving skills [8].

Based on the problems found, the researcher discussed the result of research development entitled “Practicality of Realistic Mathematics Education Based Learning Design of Linear Programming for Financial Accounting Major in Vocational High School”.

2. Research Methods
This research is a part of development research. Borg and Gall [9] state that development research is a research method used to develop or validate products used in education and learning. The development model used is the Plomp model. Plomp divides the development stage into three stages, namely preliminary analysis, the development phase or prototyping, and the assessment phase [10].

The research method used in this article is a qualitative method, which discusses the practicality of the learning design in the one-to-one evaluation and small group evaluation stages. The subjects in this study were mathematics teachers and Xth grade students of financial accounting major in SMK Negeri 2 Padang. Students involved in the one to one evaluation stage consisted of 3 people, and students involved in the small group evaluation stage consisted of 6 students with different skills. The data collection instruments used were interview guidelines and practicality questionnaires.

Descriptive techniques are used to describe the interview data. Practicality questionnaires are arranged in the form of a Likert scale. This Likert scale is arranged in a positive category, so that positive statements get a score by Arikunto [11]. The practicality questionnaire or the practicality of the learning design is described by using the data frequency analysis technique with the formula proposed by Purwanto [12]. A learning design is said to be practical if the average practicality value is more than or equal to 75 [13].

3. Result and Discussion
The one to one evaluation activity aims to identify possible errors such as poor grammar, incorrect spelling, unclear clues, appropriateness of examples, material systematics, ease of use, student satisfaction, and interest. In the one to one evaluation activity, students were called one by one to conduct interviews. Researchers sit with students when they use / review student books, observe how these students use the student books according to the instructions given, record their comments, ask them during and after using the student books. Comments and responses from students will be very useful in improving student books.

Practicality questionnaires were given to students of SMK Negeri 2 Padang in financial accounting major after participating in learning mathematics using the RME-based linear program topic student book. At the end of the one to one evaluation and small group evaluation meetings, students were given a questionnaire to determine the practicality of the product. The results of the practicality of the student response questionnaires at the one to one evaluation stage can be seen in Table 2 below.

| No | Rated Aspect       | Practicality of Each Student (%) | Practicality Average | Category  |
|----|--------------------|----------------------------------|----------------------|-----------|
|    |                    | R  | S  | T     |                    |           |
| 1  | Ease of Use        | 75 | 75 | 91,67 | 80,56 %            | Practical |
| 2  | Time efficiency    | 75 | 75 | 75     | 75 %             | Practical |
| 3  | Attractiveness     | 75 | 75 | 83,33 | 77,78 %           | Practical |
| 4  | Ease of Understanding | 75 | 81,25 | 81,25 | 79,17 %          | Practical |
From Table 2, it can be seen that the overall percentage of practicality value is 78.84% with practical categories. This means that RME-based student books can be used properly by students in learning. Furthermore, the practical results of the student response questionnaire at the small group evaluation stage can be seen in Table 3 below.

**Table 3. Results of the Small Group Evaluation Student Book Practicality Questionnaire**

| No | Rated Aspect         | Practicality Average | Category     |
|----|----------------------|----------------------|--------------|
| 1  | Ease of Use          | 79,17 %              | Practical    |
| 2  | Time efficiency      | 75 %                 | Practical    |
| 3  | Attractiveness       | 79,17 %              | Practical    |
| 4  | Ease of Understanding| 78,13 %              | Practical    |
| 5  | Equivalence          | 77,5 %               | Practical    |
|    | **Overall Average**  | **77,79%**           | **Practical**|

Based on results of the student response questionnaire analysis after using student books during the small group, the overall average was 77.79% in the practical category. This means that RME-based student books can be used properly by students. From the analysis of the questionnaire it can be concluded that the student books that have been designed by researchers can be used and easily understood for students, have an efficient time to study them, the books given attract students' attention, and are useful in learning mathematics.

Based on results of interviews with students, in general students, the appearance of students' books is because the book design is blue and other bright colors and some pictures are more interesting. The font size used is also just right, not too big and not too small. Then the language used is also easy for students to understand. Students are also happy with learning with the RME approach. Because they know the application of linear programming in everyday life, especially in their major, namely financial accounting major, students also understand the concepts given because they discover these concepts themselves.

Practicality questionnaires were given to Xth grade mathematics teachers of SMK Negeri 2 Padang specifically for financial accounting major after the teacher understood and studied RME-based teacher books and made observations while researchers taught at the small group evaluation stage. The results of questionnaire on the practicality of the teacher's book can be seen in Table 4 below.

**Table 4. Results of the Teacher's Book Practicality Questionnaire**

| No | Rated Aspect         | Practicality Average | Category     |
|----|----------------------|----------------------|--------------|
| 1  | Ease of Use          | 91,67 %              | Very Practical|
| 2  | Time efficiency      | 75 %                 | Practical    |
| 3  | Attractiveness       | 100 %                | Very Practical|
| 4  | Ease of Understanding| 87,5 %               | Very Practical|
| 5  | Equivalence          | 91,67 %              | Very Practical|
|    | **Overall Average**  | **89,17%**           | **Very Practical**|

Based on the results of questionnaire analysis of the teacher's response to the teacher's book, the overall average was 89.17% in the Very Practical category. From the results of the questionnaire, it can be concluded that RME-based teacher book is designed to be easy to use, has an efficient time to study it, is interesting and easy to understand, and can help teachers in learning mathematics, especially the topic of linear programming. Information obtained from interviews with teachers, states that the teacher's book is designed to be very interesting and easy to use. Then the learning trajectory
in the teacher's book can be understood and followed properly, facilitating the presentation of the material, and allocating time used efficiently.

4. Conclusion
Based on the assessment of the practicality of the learning design, the results of the teacher response questionnaire were 89.17% in the very practical category, and the results of the student response questionnaire were 77.79% with the practical category. After collecting and analyzing data based on interviews with teachers and students, as well as practicality questionnaires for teachers and students, it was concluded that the learning design of the RME-based linear programming that had been developed was practically used in learning, both for teachers and Xth grade students in financial accounting major. This study uses a context related to financial accounting major as a starting point to start learning linear programming, and a probing question is given to direct students to find the concept of linear programming. It is recommended to develop a learning path that uses the context of other problems related to students' majors or their daily lives.

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