Practicality of Learning Design Based on Realistic Mathematics Education of Derivative Topic for Grade XI Senior High School

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Abstract. The derivative is one of the important subjects in mathematics. One of the goals of derivative learning is that students can solve math problems in real life. In this study, derivative learning design was developed based on Realistic Mathematics Education to make the products that consist of teacher books and student books to improve students' mathematical problem-solving skills. The development models are used Plomp and Gravemeijer & Cobb models. Data collection was the form of questionnaires filled out by teachers and students. Then, the data is analyzed by using descriptive analysis. The results of this study can be concluded that the practical value of teacher response 81.25% and the practicality value of student response is 82.04%, so the design of learning derivative topics based on Realistic Mathematics Education has been categorized as practical. It means the RME-based learning design of derivative topics developed in teacher and student books can be used to develop students' mathematical problem-solving skills.

1. Introduction
Mathematics skills consist of five basics skills that have been mastered by students [1]. Students are expected to master the mathematics skills to face the rapid, development, and the advancement of science. In Indonesia, the students' mathematical skills are still low or not satisfactory, especially in problem-solving skills [2-6]. Most students are considered mathematics as an unrelated study in daily life. Whereas, mathematics is very close in daily life like budgeting the production costs. For example in developing business, profit affects whether or not the business can run to produce a big profit. It is necessary to analyze the production cost, sales, and so on. In this case, derivatives can help to analyze the maximum profit in production [7].

Derivative learning is mostly accepted by students by knowing the only formula with no experience to find the concept of derivatives. In fact, learning is not based on the student experience tends to be easily forgotten and incapable of applying mathematics [8]. Students are employed in recognizing the concepts by solving the problems of daily life to remember it longer and improve students' mathematical abilities [9].

Books used in the learning process also affect the students due to books can support them in the learning process. In addition, the books should be able to motivate students in learning. But some
books do not motivate the students in learning. For example, books that used the students to show the derivative concept and lead the students to memorize derivative concepts like figure 1 below.

![Derivative concepts in the Mathematics book](image)

**Figure 1.** Derivative concepts in the Mathematics book

In figure 1 shows that the book gives the derivative concepts directly. It makes the students only memorize the formula without know the derivative concept comes from. Whereas, students should be able to be active in the learning process, not only memorize or know but should be able also to apply the concept that has been learned\(^1\). In other words, the students need to give experience in finding the form of derivative concepts and developing the students' mathematical skills.

One of the importance of mathematics is the students must have problem-solving skills. Problem-solving is a basic skill in mathematics learning\(^2\). In mathematics learning, problem-solving can be a story problem, which presents a problem with a procedure that requires more in-depth thinking. Problem-solving can improve critical, logical, and systematic thinking abilities. Muhsetyo in Nurfatanah\(^3\) also said that problem-solving skills will improve the students' creative attitudes in math learning so the learning atmosphere will more significantly improve students' abilities. One of the approaches that can use in developing students' problem-solving skills is the Realistic Mathematics Education (RME) approach.

RME is a theory of mathematics learning that provides real problems related to the students' daily life\(^4\). The real context is the beginning for students to know that mathematics is very close to real life. In learning, the RME approach is oriented towards students' daily lives to make students easily imagine math, and learning becomes more interactive. Therefore, it is necessary to try to get mathematics closer to the daily lives of students and make it real for students\(^5\).

Innovative mathematics learning must be learned, to achieve the goal of learning well. The method employed by teachers is one that supports the learning process to achieve the learning goals by students\(^6\). It needs a planned learning process to run properly so that it needs learning design. The design of learning is a systemic learning design in accordance with specific theories so that the purpose of learning can be achieved\(^7\). The development of learning design must conduct practical tests on developed products namely teacher books and student books. Practicality tests were conducted to measure the practicality of teacher books and student books\(^8\). This study discusses the practicality of products that have been developed in learning design based on RME for the derivative topic for grade XI Senior High School in teacher book and student book.

2. Materials and Methods

The development of learning design based on RME of the derivative topic employed the combination of two development designs namely Plomp, and Gravemeijer and Cobb development designs. The combination of two types of research design is due to the Gravemeijer and Cobb models, in the development of early-stage learning flows only leads to literature studies and also products developed.
do not consider to be validated. Meanwhile, in the implementation of the learning process, a product is needed in the form of teaching materials (teacher's books and student books). The combination of the two designs also aims to produce Local Instruction Theory (LIT), a valid, practical, and effective teacher's book and student book. Plomp model consists of three stages namely; the initial stage of investigation by having analyzed needs and context, the prototype stage by having carried out formative design, development and evaluation activities, and assessment stages. Gravemeijer & Cobb models consist of three phases, namely; preparing for the experiment, conducting the experiment, and retrospective analysis.

The products that have designed need to do practicality test to know the practicality of learning design based on RME. Data are obtained by collecting response questionnaires from teachers and students who have tried the book that has been designed. In the practical teachers’ questionnaire includes 15 statement items consists of the aspects of ease of use, time efficiency, attractiveness, ease of understanding, and book equivalence. Then in the students’ questionnaire, there are 16 statement items consisting of aspects of ease of use, time efficiency, attractiveness, ease of understanding, and the benefits of books. The student's questionnaire response is given to students who have used those books at the small group evaluation.

The teacher's and student's response questionnaires are organized in the form of Likert scales. Next, the data were analyzed based on the assessment guidelines that have been set by using analytical techniques for practicality data can use formulas (1).

\[
P = \frac{\text{score}}{\text{maximum score}} \times 100\% \tag{1}
\]

Further, to categorize the results of the analysis on teacher books and student books, this study is used a table of criteria submitted by Purwanto as in Table 1.

| P (Achievement degree) (%) | Category         |
|---------------------------|------------------|
| 85 ≤ P ≤ 100              | Very Practical   |
| 75 ≤ P < 85               | Practical        |
| 60 ≤ P < 75               | Quite Practical  |
| 55 ≤ P < 60               | Less Practical   |
| 25 ≤ P < 55               | Impractical      |

3. Result and Discussion
Before conducting practicality tests, the products have been declared valid by five lecturers. The validator consists of three areas of expertise, three mathematics lecturers, one language lecturer, and one educational technology lecturer. After the products have been declared valid, the next step is to evaluate the products in the form of teacher books and student books. The teacher's book and questionnaire responses were given to two math teachers. The teacher's response questionnaire aims to know the success of learning in using products. The results of the teacher's response questionnaire can be seen in Table 2.

| No. | Scoring aspects         | Practicality score (%) | Category |
|-----|-------------------------|------------------------|----------|
| 1.  | Easeness                | 83.33                  | Practical|
| 2.  | Time efficiency         | 75.00                  | Practical|
| 3.  | Attractiveness          | 81.25                  | Practical|
| 4.  | Understandable          | 83.33                  | Practical|
| 5.  | Equivalence of teacher’s guidance book | 83.33 | Practical |

Average 81.25 Practical
Table 2 shows the average of the teacher response questionnaire is 81.25% with practical categories. This means that RME-based student books can be used properly by students in learning. Based on the teacher's response, the instructions for using the book have made it easier for the teacher to use in the learning process so that the time used can match with the time allocation that has been set. In the teacher's book, there are steps of learning along with time allocation that helps teachers to implement RME in learning derivative topics. The teacher's book gives the predictions of students' answers, and teachers can provide anticipation for students' answers that are not yet correct. In addition, the teachers also agree if the teacher's book can be used as an interesting and practical learning resource. From the results of the teachers' response questionnaire, the teacher's book based on RME for the derivative topic is easy to use, efficient time in using books in learning, easy to understand, interesting and can assist teachers in carrying out mathematics learning of RME-based derivative topics.

Furthermore, the practicality of student books can be seen from the results of student questionnaires from small group evaluation. In the implementation of small group evaluation, this study asked teachers to choose six students with various abilities, namely two highly skilled students, two moderate-skilled students, and two low-skilled students. Small group evaluation activities are also conducted outside of students' study hours. The results of the student response to the student book can be seen in Table 3 below.

**Table 3. Results of the student response questionnaire**

| No. | Scoring aspects          | Practicality score (%) | Category     |
|-----|--------------------------|------------------------|--------------|
| 1.  | Easeness                 | 88.89                  | Very Practical |
| 2.  | Time efficiency          | 79.17                  | Practical    |
| 3.  | Understandable           | 81.94                  | Practical    |
| 4.  | Attractiveness           | 80.21                  | Practical    |
| 5.  | The benefits of the book | 80.00                  | Practical    |
|     | Average                  | 82.04                  | Practical    |

Table 3 shows the average of student response questionnaire is 82.04% with a practical category. This means that RME-based student books can be used properly by students. From the analysis, 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.

The instructions on the student's book are easy to understand due to the exact size of the writing makes the student easy to read the book and the language used is easy to understand. Further, the time it takes students to work on student books is appropriate with the time allocation that has been set. The explanations are easy to understand and lead students to rediscover derivative concepts so that students are able to understand derivative concepts. In addition, most students agree if the student book is interesting in the content and appearance of the book because the selection of colors matches the student's needs is predominantly blue, a blend of red with orange and purple color. This color selection is based on the needs of students that have got from the student needs questionnaire.

The student's book is equipped with the activities that contain real-life problem-solving questions and images that support students' understanding of problems. The response offered by students shows that every activity that has been done in the book has led students to find the concept of derivatives. The instructions given to the book can help students to understand the problem. The benefits of books that have supported the students to understand derivative concepts, making learning more interesting and allowing students to discuss. Students also recognize the benefits of derivatives in their daily lives, so students become aware that math is extremely close to their lives. From the student response questionnaire, it can be concluded that student books are practically used in the learning of RME-based derivative topics.
Table 2 and Table 3 shows the information about the students and teachers book has been categorized as practical due to ease of use, time efficiency in using books, books attracts the students and the book is useful to help students in the learning process of RME-based derivative topics.

The learning design based on RME has been categorized as practical because of the result of teacher's and student's response questionnaire. It shows that products like student books and teacher books can help the students and teachers during the derivative learning process. Practicality for the students due to the context that used represent the close problem in students daily life, a mathematical process that guides the students to find the concept, problem-solving can be done as independently or in the group, and the students must be active in the learning process [2].

4. Conclusion
Based on the results and discussions, it can be concluded the results of the student response questionnaire is 82.04% and the teacher response questionnaire is 81.25%. Therefore, student books and teacher books in RME-based derivative topic learning have been categorized as practical. It means, the learning design of derivative topics based on RME for XI grade Senior High School has been practical and can be used by teachers and students due to its easily understood for students, have an efficient time to study them, the books given attract students' attention, and are useful in learning mathematics.

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