The practicality of learning design based on realistic mathematics education for probability topic of grade VIII junior high school

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Abstract. This study aimed to determine the practicality of Realistic Mathematics Education (RME) based learning design for probability topics. Probability is a learning topic that is close to daily life and is expected to assist students in developing students' communication skills. The Learning design development was done by combining two designs, namely the development design of Plomp and Gravemeijer & Cobb; meanwhile, to find out the practicality of the design, data collection was done in the form of filling out questionnaires by teachers and students. The data obtained were analyzed quantitatively and qualitatively. From the research conducted, it was obtained that the RME-based learning design for the topic of Probability was practical so that the RME-based learning design of probability topics that were implemented to teacher books and student books could be used to develop mathematical communication skills of grade viii junior high school students.

1. Introduction

Indonesian students' mathematical abilities are still far from satisfactory [1-13], especially mathematical communication skills [3]. Most students think mathematics has nothing to do with their daily lives. Therefore, learning mathematics should be oriented towards students' daily experiences [14]. One topic that is closely related to everyday life is Probability. Probability is material that discusses the uncertainty of an event that occurs in life [15]. Decision making that we often think about is one form of this Probability. One example is in the election to continue further education levels. Suppose University A and University B have the same student admission quota. If University A has more devotees than University B, then the possibility is that we will place University B as an option. The reason is that there are more competitors to enter University A than to University B. So the opportunity to join University B is more significant than University A.

On the topic of Probability for concepts to be easily understood by students, learning should begin by experimenting. Through games, one of them is by using dice and coins that can help students understand concepts [16]. Because through experiments, students can find out how to find images from the topic of Probability itself. Also, if students do not learn based on their experience, students will tend to forget what has been taught and cannot apply mathematics [14].

Based on Government Regulation No. 32 of 2013 concerning national standards of education, textbooks are the primary source of learning to achieve predetermined competencies [17]. As one of the necessary tools used in the learning process, books should help students understand the material and impact learning. Textbooks used by students in schools have provided experimental or
experimental activities, but in these activities, students have been led to find answers, as shown in Figure 1.

Figure 1. Experiments on the 2017 Revised Edition of Student Book K2013

In Figure 1, a table is provided for students to directly fill in the correct answers and lead to the formula that will be used in the empirical probability sub-topic. This has an impact on students' ability to solve the questions given on practice and examinations. Students will tend to use the formulas they know in answering questions. This is also consistent with the analysis of students' difficulties on the topic of opportunities conducted by Jamal [18] that impact students' lack of understanding of the concept of Probability, where most students incorrectly enter a formula for solving a given problem. So that the experiment should include students who record their own investigations without the help of a given table, so students can find formulas or concepts from Probability while also being able to develop students' mathematical abilities.

One important mathematical ability in the 21st century is mathematical communication skills. Students can develop abilities in understanding mathematical material through communication in mathematics, help make arguments about mathematical problems, and present mathematical ideas orally, mathematical images, graphics, and mathematical symbols [19]. Furthermore, mathematical communication activities can be a benchmark of students in learning as in discussion activities, students will combine mathematical thinking results. Also, communication occurs between students and teachers in conveying the results of their thoughts [20]; through mathematical communication skills, students can develop thinking skills by giving arguments in discussion activities to build their knowledge in learning mathematics, especially for Probability topic. One learning mathematics approach that can have a positive impact on mathematical communication skills is Realistic Mathematics Learning (RME) [21].

RME is a mathematical learning theory developed by Freudenthal in the Netherlands that defines mathematics as a human activity that includes problem-solving activities, finding problems, and organizing subject matter [22]. Learning activities using RME emphasize issues that are close to students' daily lives. So that contextual problems serve as a starting point for learning to show that mathematics is actually very close to students' daily lives [23]. Through RME, which is oriented to everyday life, students can more easily imagine their learning activities and will become more interactive in developing their knowledge. So, mathematics must be sought close to students' lives, must be associated with everyday life, and, if possible real for students [24].

To improve the quality of education better, there needs to be innovation in learning mathematics. The method used should be mastered by the teacher concerned so that it can lead students to planned changes [25]. Innovation is expected to be a tool in developing learning systems in order to improve the quality of learning, one of which is the learning design. Learning design is the development of
systematic teaching that is used explicitly to learning theories to guarantee the quality of learning [26]. Based on the research conducted, in developing a learning design, practicality analysis needs to be done to develop the product. For measuring the level of practicality seen from whether the teacher (and other experts) consider that the material is easy and can be used by teachers and students [27].

2. Materials and Methods
The development of learning design based on RME for Probability topic uses two development designs, namely the Plomp development design and the design of Gravemeijer and Cobb models. The combination of these two types of design research is due to the Gravemeijer and Cobb models. The development of the early stages of learning flow only leads to the study of literature, and the products developed do not consider validation; meanwhile, in this research for the implementation of the learning flow products needed in the form of teaching materials (teacher books and student books). The combination of these two designs also aims to produce a valid, practical, and effective LIT (local instructional theory). Tjeerd Plomp developed the Plomp model; the Plomp model consists of 3 stages, namely: (1) the initial investigation phase to check the needs and context analysis, (2) the prototype stage as the formative design, development and evaluation activities, (3) the assessment stage [28]. At the same time, the Gravemeijer & Cobb model was used in the prototype development phase/learning flow in the Plomp model design [29].

After it is designed, the practicality testing needs to be done in the RME-based learning design that has been developed. Data collection was done by giving questionnaires to check the teacher's responses to teacher's guide books that will be used later—then giving questionnaires to student who have used students' books at the stage of one to one evaluation and small group evaluation. The practicality questionnaire used consisted of 15 statement items and consisted of the aspects of ease of use, time efficiency, ease of understanding, appeal, and equivalence of books.

Therefore, this study aimed to see the practicality of a learning design that has been designed so that it can be used by teachers and students. Questionnaire responses of teachers and students were arranged in the form of a Likert scale. Then the data obtained was analyzed in accordance with predetermined assessment guidelines. Data processed using analysis techniques for practicality data could use the formula (1).

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

Furthermore, if \( 81 \leq P \leq 100 \) then teacher books and student books were categorized as very practical (VP) criteria [27].

3. Result dan Discussion
After the product was categorized valid by three mathematicians, one language expert, and one education technology person, data collection was check to see the practicality of the learning design implemented in the teacher and student books based on RME on the topic of Probability. Data collection was done by giving questionnaires for teacher responses toward the teacher's guide book that was developed and questionnaires for students' reactions toward the books that have been used by students. The teacher response questionnaire was aimed to find out the success of learning [27]. Aspect Questionnaire teacher responses were given to 3 mathematics teachers. The results of the teacher's practicality questionnaire can be seen in Table 1.

| No. | Scoring aspects | Practicality score (%) | Category |
|-----|-----------------|------------------------|----------|
| 1.  | Easiness        | 86.11                  | VP       |
| 2.  | Time efficiency | 83.33                  | VP       |
| 3.  | attractiveness  | 91.67                  | VP       |
Based on the analysis of the questionnaire responses of teachers in Table 1, the overall average of the study was 87.92% with the very practical category. From the questionnaire results, it could be concluded that the RME-based for teacher's guidance book on the topic of Probability was easy to use, time-efficient in using books in learning, interesting, easy to understand, and books could help teachers in discussing out probability topic based on RME.

Next to see students' responses to student books used by students based on RME for Probability topics. Student responses were used as parameters to determine student responses to the use of learning tools developed [30]. Data collection was done by distributing questionnaires in two stages: the one to one evaluation stage and the small group stage. The distribution of questionnaires at the one to one evaluation stage was in three students who took one one evaluation. The results of the questionnaire practicality of student books on one to one student evaluations can be seen in Table 2.

Table 2. Results of the student response questionnaire in to one evaluation

| No. | Scoring aspects                          | Practicality score (%) | Category |
|-----|------------------------------------------|------------------------|----------|
| 1.  | Easiness                                 | 88.89                  | VP       |
| 2.  | Time efficiency                          | 83.33                  | VP       |
| 3.  | attractiveness                           | 90.63                  | VP       |
| 4.  | understandable                           | 81.25                  | VP       |
| 5.  | Equivalence of teacher’s guidance book   | 81.67                  | VP       |
|     | Average                                  | 85.15                  | VP       |

Table 2 above shows that the overall average analysis of student book practicality was 85.15%, with a very practical category in one to one evaluation. The spread of practicality questionnaire at the small group evaluation stage was given to six students who took the small group evaluation. The results of the practicality questionnaire analysis at the small group stage can be seen in Table 3.

Table 3. Result of the student questionnaire in small group evaluation

| No. | Scoring aspects                          | Practicality score (%) | Category |
|-----|------------------------------------------|------------------------|----------|
| 1.  | Easiness                                 | 84.72                  | VP       |
| 2.  | Time efficiency                          | 87.50                  | VP       |
| 3.  | attractiveness                           | 88.89                  | VP       |
| 4.  | understandable                           | 83.33                  | VP       |
| 5.  | Equivalence of teacher’s guidance book   | 85.00                  | VP       |
|     | Average                                  | 85.89                  | VP       |

The results of the questionnaire analysis of student responses in Table 3 had an overall average of 85.89% with a convenient category in the evaluation of small groups. Based on Table 2 and Table 3 it can be concluded that student books are easy to use, time-efficient in using student books can attract students' attention in learning, are easy to understand, and can be useful and can help students in learning mathematics based on RME specifically the topic of Probability.

Based on the results of the data collection conducted at the time of one to one evaluation and small groups, it can be concluded that the design of the RME-based learning produced has fulfilled practical criteria or is easy to use both by the teacher and for students. It can be seen from the overall average of one-to-one evaluation and small group evaluation, which are already in a very practical category. The
practicality of the use of student books is caused by the experiments conducted in the learning process. Also, due to RME-based learning, learning places more emphasis on connecting in real life and everyday life that is close to students [31]. Because RME-based learning places more emphasis on context, students can find their own mathematical ideas from their activities and can solve mathematical problems individually or in groups [21]. Furthermore, realistic problems that are used can be a source for the emergence of mathematical concepts or mathematical knowledge formally that can encourage students in problem-solving activities, look for problems, and organize the subject matter [32]. So students play an active role in the ongoing learning process and find their own concepts informally.

4. Conclusion

Based on the results and discussion of this study, the average results of data collection on student responses in one to one evaluation was 85.15%, in the small group was 85.59%. While the average results of data collection on the teacher's response to the book to be used is 87.92%. The results of the practicality analysis also showed that the products could help students to learn by linking real-life situation or actual problem and that students could use imagination in developing ideas and finding concepts. So it can be concluded that the design of RME-based learning for Probability topic that was implemented in teacher books and student books has been practical and can be used by teachers and students of grade viii junior high school.

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