

The Practicality of Development Research on The Two-Variable Linear Equation System Topic Based on Realistic Mathematics Education Students in Class VIII SMP

V Oktaviani, A Fauzan, A Asmar, Yerizon

Department of Mathematics Education, Department of Mathematics,

Faculty of Mathematics and Natural Sciences Padang State University

Jln. Prof. Dr. Hamka, Air Tawar, Padang, 25131 Indonesia



Abstract— This study aims to determine the practicality of the learning design for the topic of the two-variable linear equation system based on Realistic Mathematics Education (RME). A two-variable linear equation is an equation that has only two variables and each variable has the power of one. While the two-variable linear equation system is a unit of several similar two-variable linear equations. The topic of a two-variable linear equation system is one of the learning topics that is close to the daily lives of students and is expected to be able to assist students in developing problem solving skills and mathematical communication skills. The development of the learning design was carried out by combining two designs, namely the Plomp development design and the Gravemeijer and Cobb development. Meanwhile, to find out the practicality of the learning design that has been designed, data collection is carried out in the form of questionnaires by teachers and students. The data were analyzed using quantitative and qualitative analysis. From this study, it was found that the designed RME-based learning of two-variable linear equation system topic was practical. So that the learning design of the RME-based two-variable linear equation system topic which is implemented in teacher's books and student's books can be used to develop problem solving skills and mathematical communication skills of students in class VIII SMP.

Keywords— Learning Instructions, RME, Practicality.

I. INTRODUCTION

Learning mathematics has several goals that are expected to be achieved by students. In NCTM it is explained that students must have basic mathematical abilities which include problem solving, reasoning, and proofing, communication, connection and representation skills [1]. Students are expected to master mathematical skills to deal with the rapid development, and progress of science. In Indonesia, students' mathematical abilities are still low or unsatisfactory, especially in problem solving skills [2-6] and also on mathematical communication skills [7]. Problem solving skills and communication skills are two important aspects that must be developed and possessed by students in learning mathematics. Some students consider mathematics as an unrelated study in everyday life. Therefore, learning mathematics should be oriented to the daily experiences of students [8]. One of the mathematics materials that students have low mastery of is on the subject of making mathematical models and solving contextual problems of a two-variable system of linear equations. Many students have difficulty converting on contextual sentences into mathematical sentences, so that students have difficulty in analyzing the contextual questions given by the teacher. If the contextual questions

given are different from the material described, and another difficulty experienced by students is that they tend to memorize formulas, so that if they are given contextual questions that are different from the examples, they will find it difficult [9]. According to Prastowo, teaching materials are all materials (both information, tools and texts) that are systematically arranged to display a complete figure of a competency that will be used and must be mastered by students in the learning process with the aim of planning and studying the implementation of learning [10]. The following is an illustration of one of the textbooks used in school.

Contoh

Asep membeli 2 kg mangga dan 1 kg apel dan ia harus membayar Rp15.000,00, sedangkan Intan membeli 1 kg mangga dan 2 kg apel dengan harga Rp18.000,00. Berapakah harga 5 kg mangga dan 3 kg apel?

Penyelesaian:

Misalkan harga 1 kg mangga = x
 harga 1 kg apel = y

Kalimat matematika dari soal di samping adalah

$$\begin{cases} 2x + y = 15.000 \\ x + 2y = 18.000 \end{cases}$$

Selanjutnya, selesaikan dengan menggunakan salah satu metode penyelesaian, misalnya dengan metode gabungan.

Langkah I: Metode eliminasi

$$\begin{array}{rcl} 2x + y = 15.000 & \times 1 & 2x + y = 15.000 \\ x + 2y = 18.000 & \times 2 & 2x + 4y = 36.000 \\ \hline & & y - 4y = 15.000 - 36.000 \\ & & \Leftrightarrow -3y = -21.000 \\ & & \Leftrightarrow y = \frac{-21.000}{-3} = 7.000 \end{array}$$

Langkah II: Metode substitusi

Substitusi nilai y ke persamaan $2x + y = 15.000$

$$\begin{array}{l} 2x + y = 15.000 \\ 2x + 7.000 = 15.000 \\ \Leftrightarrow 2x = 15.000 - 7.000 \\ \Leftrightarrow 2x = 8.000 \\ \Leftrightarrow x = \frac{8.000}{2} = 4.000 \end{array}$$

Dengan demikian, harga 1 kg mangga adalah Rp4.000,00 dan harga 1 kg apel adalah Rp7.000,00.

Jadi, harga 5 kg mangga dan 3 kg apel adalah

$$\begin{aligned} 5x + 2y &= (5 \times \text{Rp}4.000,00) + (3 \times \text{Rp}7.000,00) \\ &= \text{Rp}20.000,00 + \text{Rp}21.000,00 \\ &= \text{Rp}41.000,00 \end{aligned}$$

Figure 1. Examples of Material in System of Two Variable Linear Equations in Textbooks

In Figure 1, an example of the questions presented begins with a problem that is directed at the conclusion to find the concept of finding the price of an item. However, in presenting the material, students have been given direct instructions and only observe the steps from books that have been completed without giving students the opportunity to construct on their own. Students have been directed to assume variables with x and y . The description of the material above does not fully contain information that directs students to solve problems because they are not directed to find the concept with problem-solving steps. Students' understanding of the problems of a two-variable linear equation system is related to their mathematical problem-solving abilities and their mathematical communication skills in understanding the problems of a two-variable linear equation system. Without a good and correct understanding of the problem, it is difficult for students to plan problem solving, furthermore to solve them correctly.

One of the importance of mathematics is that students must have problem solving skills. Problem solving is a basic skill in learning mathematics [11]. In addition, mathematical communication skills are also important in the 21st century era. Through communication skills in mathematics, students can develop the ability to understand mathematical material, help make arguments about mathematical problems, and present mathematical ideas orally, mathematical images, graphs, and mathematical symbols [12]. One approach that can be used in developing problem solving skills and mathematical communication skills is Realistic Mathematics Education (RME) [13-14].

RME is a theory of mathematics learning developed by Freudenthal in the Netherlands which views mathematics as a human activity which includes problem solving, problem solving, and organizing the subject matter [15]. RME learning activities emphasize problems that are close to the daily lives of students, so that contextual problems are used as a starting point for learning to show that mathematics is actually very close to the daily lives of students [16]. Through RME which is oriented to everyday life, it is easier for students to imagine in carrying out learning activities and students will become interactive in developing their knowledge. Therefore, mathematics must be cultivated close to the lives of students, must be linked to everyday life, and if possible willingly for students [17].

To improve the quality of education, it is necessary to innovate in learning mathematics. The method used should be able to be mastered by the teacher concerned so that it can lead students to the planned changes [18]. Innovation is expected to be a means of

developing learning systems in order to improve the quality of learning, one of which is learning design. Learning design is a systematic development of teaching that is used specifically learning theories to ensure the quality of learning [19]. In developing a learning design, it is necessary to do a practical test of the product being developed. The practicality test aims to measure the level of practicality from the teacher's point of view, namely whether the learning design is easy and can be used by teachers and students [20].

II. METHOD

The development of learning design on the topic of a two-variable linear equation system based on RME used a combination of two development designs, namely the Plomp development design and the Gravemeijer and Cobb development design. The merging of these two types of design research is because in the Gravemeijer and Cobb model, the development of the early-stage learning flow only leads to a literature review and also the products developed do not consider validation. Meanwhile, in this study for the implementation of the learning flow, a product is needed in the form of teaching materials (teacher's book and student's book). The merging of these two designs also aims to produce a valid, practical, and effective LIT. The Plomp model consists of 3 stages, namely: (1) the initial investigation stage is carried out by needs and context analysis, (2) the prototype stage is carried out by design, development and formative evaluation activities, (3) the assessment stage [21]. While the Gravemeijer and Cobb development models are used in the prototype development phase/learning flow in the Plomp model design [22].

After conducting the research, it is necessary to conduct a practical test in the RME-based development design that has been developed. Data collection is done by providing a teacher response questionnaire to the teacher's book that will be used later. Then the questionnaire was given to students who had used student books at the one to one evaluation and small group evaluation stages. The practicality questionnaire used consists of aspects of ease of use, time efficiency, ease of understanding, attractiveness and book equivalence. Therefore, this study aims to see the practicality of a learning design that has been designed so that it can be used in the form of a Likert scale. Then the data obtained is analysed according to the assessment guidelines that have been set. Data is processed using analytical techniques for practicality data can use formula (1).

$$\text{Achievement level } (P) = \frac{\text{the obtained score}}{\text{maximum score}} \times 100\% \quad (1)$$

Furthermore, to categorize the analysis result in teacher books and student books, the criteria table proposed by Purwanto [23] is used. As in Table 1.

Table 1. Practicality Category	
Range of Achievement Level	Category
$0 \leq P \leq 55$	Not Practical
$55 \leq P < 60$	Less Practical
$60 \leq P < 75$	Practical enough
$75 \leq P < 85$	Practical
$85 \leq P < 100$	Very Practical

III. RESULT AND DISCUSSION

After the product was declared valid by 3 mathematicians, 1 linguist, and 1 educational technology expert, then data collection was carried out to see the practicality of the learning design in the form of a teacher's book and an RME-based student book on the topic of a two-variable linear equation system. Data collection was carried out by giving teacher response questionnaires to the developed teacher's book and student response questionnaires to the books that students had used. The teacher's response questionnaire aims to determine the success of learning [20]. Teacher response questionnaires were given to 3 mathematics teachers. The results of the teacher's book practicality questionnaire can be seen in Table 2.

Table 2. Result of Teachers' Questionnaire

No.	Aspek yang Dinilai	Nilai Kepraktisan (%)	Kategori
1.	Ease of Use	86.11	Very Practical
2.	Time Efficiency	83.33	Very Practical
3.	Attractiveness	91.67	Very Practical
4.	Ease of Understanding	89.58	Very Practical
5.	Teacher's Book Equivalence	88.89	Very Practical
	Overall Average	87.92	Very Practical

Based on the results of the teacher response questionnaire analysis in Table 2, the overall average of the analysis is 87.92% with a very practical category. From the results of the questionnaire, it can be concluded that the RME-based teacher book on the topic of the two-variable linear equation system is easy to use, time consuming efficient in using books in learning, interesting, easy to understand, and books can help teachers in carrying out mathematics learning the topic of a two-variable linear equation system.

Furthermore, to see the response of students to student books used by students in learning the topic of a two-variable linear equation system based on RME. Student responses are used as a parameter to determine student responses to the use of learning tools that have been developed [24]. Data collection was carried out by distributing questionnaires in two stages, namely the one to one evaluation stage and the small group evaluation stage. The distribution of the questionnaire at the one to one evaluation stage was carried out to three students of class VII and VIII who took part in the one to one evaluation. The results of the student book practicality questionnaire on one-to-one evaluation students can be seen in Table 3 and Table 4.

Table 3. Results of the Class VII Student Response Questionnaire (*One to One Evaluation*)

No.	Aspek yang Dinilai	Nilai Kepraktisan (%)	Kategori
1.	Ease of Use	86.11	Very Practical
2.	Time Efficiency	75.00	Practical
3.	Attractiveness	77.78	Practical
4.	Ease of Understanding	77.08	Practical
5.	Student Book Equivalence	81.67	Very Practical
	Overall Average	79.53	Practical

Table 4. Results of the Class VIII Student Response Questionnaire (*One to One Evaluation*)

No.	Aspek yang Dinilai	Nilai Kepraktisan (%)	Kategori
1.	Ease of Use	91.67	Very Practical
2.	Time Efficiency	83.33	Very Practical
3.	Attractiveness	88.89	Very Practical
4.	Ease of Understanding	91.67	Very Practical
5.	Student Book Equivalence	83.33	Very Practical
	Overall Average	87.78	Very Practical

From Table 3 and Table 4, it can be seen that the overall average of the practical analysis of student books is 79.53% with a practical category for class VII students and 87.78% with a very practical category for class VIII students in one to one evaluation. Then the distribution of practicality questionnaires at the small group evaluation stage was given to six students in grades VII and VIII who took part in the small group evaluation. The results of the practicality questionnaire analysis at the small group evaluation stage can be seen in Table 5 and Table 6.

Table 5. Results of the Class VII Student Response Questionnaire (Small Group Evaluation)

No.	Aspek yang Dinilai	Nilai Kepraktisan (%)	Kategori
1.	Ease of Use	79.17	Practical
2.	Time Efficiency	79.17	Practical
3.	Attractiveness	75.00	Practical
4.	Ease of Understanding	80.21	Practical
5.	Student Book Equivalence	77.50	Practical
	Overall Average	78.21	Practical

Table 6. Results of the Class VIII Student Response Questionnaire (Small Group Evaluation)

No.	Aspek yang Dinilai	Nilai Kepraktisan (%)	Kategori
1.	Ease of Use	91.67	Very Practical
2.	Time Efficiency	95.83	Very Practical
3.	Attractiveness	88.89	Very Practical
4.	Ease of Understanding	93.75	Very Practical
5.	Student Book Equivalence	94.17	Very Practical
	Overall Average	92.86	Very Practical

The results of the student response questionnaire analysis in Table 5 and Table 6 have an average of 92.86% with a very practical category for class VIII students and 78.21% with a practical category for class VII students in small group evaluations. Based on Table 3, Table 4, Table 5, and Table 6 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 help students in learning. learning mathematics based on RME, especially the topic of system of a two-variable linear equations.

Based on the results of data collection conducted during one to one evaluation and small group, it can be concluded that the RME-based learning design produced has met the practical criteria or is easy to use both by teachers and for students. Seen in the overall average practicality of the one to one evaluation and small group evaluation which is already in the practical category for class VII students and very practical for class VIII students. The practicality of using student books is due to the experiments carried out in the learning process. Also due to RME-based learning, learning places more emphasis on connecting in real life and daily life that is close to students [25]. Because RME-based learning emphasizes more on context, students can find mathematical ideas from the activities they do and can solve math problems both individually and in groups [14]. Furthermore, the realistic problems used can be a source for the emergence of mathematical concepts or formal mathematical knowledge that can encourage students in problem solving activities, looking for problems, and organizing the subject matter [26]. So that students play an active role in the ongoing learning process and find their own concepts informally.

IV. CONCLUSION AND SUGGESTION

Based on the results and discussion of this assessment, the average results of data collection on student responses in one to one evaluation were 79.53% for class VII students and 87.78% for class VIII students. Data collection on student responses in the small group evaluation was 78.21% for class VII students and 92.86% for class VIII students. While the average result of data collection on the teacher's response to the books used was 87.92%. The results of the practical analysis carried out also show that the products used can help students learn by relating real life that is close to students. So that students can imagine in developing ideas in finding concepts. So it can be concluded that the learning design of the topic of a two-variable linear equation system based on RME in the form of a teacher's book and student's book has been practical and can be used by teachers and students of SMP class VIII:

REFERENCES

- [1] NCTM. 2000. Principles and Standards for school Mathematics. Reston, VA; NCTM
- [2] S Syelfia and A Armiati The Development of learning devices with realistic mathematics education based in the pharmaceutical program to improve mathematic problem-solving J. Phys. Conf. Ser. 1554 012061

- [3] Rahmi N, Arnawa I M, and Yerizon Y 2019 Preparation development of learning device problem based learning model with scientific approach to improve mathematical problem solving ability *Int. J. Sci. Technol. Res.* 8(8) pp 522–529
- [4] Arnawa I M, Yerizon, and Nita S 2020 Improvement students' achievement in elementary linear algebra through APOS theory approach *J. Phys. Conf. Ser.* 1567 022080
- [5] Sutiaharni S and Armiami A Development of mathematics learning devices based on realistic mathematics education for financial accounting expertise program in vocational high school (preliminary research) *J. Phys. Conf. Ser.* 1554 012060
- [6] Sarvita L and Syarifuddin H The developed hypothetical learning trajectory for integral topic based on realistic mathematics education *J. Phys. Conf. Ser.* 1554 012032
- [7] Ismail R N, Arnawa I M, and Yerizon Y 2020 Student worksheet usage effectiveness based on realistics mathematics educations toward mathematical communication ability of junior high school student *J. Phys. Conf. Ser.* 1554 012044
- [8] Mustamin S H 2017 Pembelajaran matematika dengan pendekatan realistik *Lentera Pendidik: J. Ilmu Tarb. dan Kegur.* 20(2) pp 231–239
- [9] Lede, Yulius Keremata., Kii, Yuliana Ina. 2018. "Lintasan Belajar untuk Membelajarkan Materi Membuat Model Matematika Sistem Persamaan Linear Dua Variabel (SPLDV) bagi Siswa Kelas VIII". *Prosiding Seminar Nasional Etnomatnesia*.
- [10] Prastowo, 2011. *Panduan Kreatif Membuat Bahan Ajar Inovatif*. Yogyakarta: Diva Press
- [11] Effendi, Leo Adha Pembelajaran Matematika dengan Metode Penemuan terbimbing untuk meningkatkan Kemampuan Representasi dan Pemecahan Masalah Matematis Siswa SMP. Bandung: *Jurnal Penelitian Pendidikan*, Vol. 13 No. 2 Oktober
- [12] Ashim M, Asikin M, and Kharisudin I 2019 Perlunya Komunikasi Matematika dan Mobile Learning Setting Problem Based Learning untuk Meningkatkan Kemampuan 4C di Era Disrupsi," *Pros. Semin. Nas. Mat.* 2 pp 687–697
- [13] Prastowo, 2011. *Panduan Kreatif Membuat Bahan Ajar Inovatif*. Yogyakarta: Diva Press.
- [14] Atika N and Amir Z 2016 Pengembangan Lks Berbasis Pendekatan Rme Untuk Menumbuhkembangkan Kemampuan Berpikir Kritis Matematis Siswa Suska *J. Math. Educ.* 2(2) p 103
- [15] Nurhayati N 2017 Pengembangan perangkat bahan ajar pada pembelajaran matematika realistik indonesia untuk meningkatkan kemampuan komunikasi matematis mahasiswa Fibonacci 3(2) pp 121-136
- [16] Widyastuti N S and Pujiastuti P 2014 Pengaruh pendidikan matematika realistik indonesia (pmri) terhadap pemahaman konsep dan berpikir logis siswa *J. Prima Edukasia* 2(2) p 183
- [17] Atika N and Amir Z 2016 Pengembangan Lks Berbasis Pendekatan Rme Untuk Menumbuhkembangkan Kemampuan Berpikir Kritis Matematis Siswa Suska *J. Math. Educ.* 2(2) p 103
- [18] Trisnawati and Astuti D 2013 Upaya meningkatkan kemampuan komunikasi matematis siswa kelas vii dalam pembelajaran matematika dengan pendekatan realistic mathematics education (rme) di smp negeri 1 muntinan *Pros. Semin. Nas. Mat. and Pend. Mat. UNY.* pp 609–616
- [19] Yasin H S 2012 Metode belajar dan pembelajaran yang efektif *J. Adab.* 12(1)
- [20] Sari B K 2017 Desain Pembelajaran Model ADDIE dan Impelentasinya dengan Teknik Jigsaw *Pros. Semin. Nas. Pendidik* pp 87–102 [http://eprints.umsida.ac.id/432/1/ARTIKEL Bintari Kartika Sari.pdf](http://eprints.umsida.ac.id/432/1/ARTIKEL%20Bintari%20Kartika%20Sari.pdf).
- [21] Roliza E, Ramadhona R, and Rosmery L 2018 Praktikalitas lembar kerja siswa pada pembelajaran matematika materi statistika *Jurnal Gantang* 3(1) pp 41–46
- [22] Doli W and Armiami A, 2020 Development of Mathematics Learning Tools Based on Realistic Mathematics Education for Vocational High School Students *J. Phys. Conf. Ser.* 1554 012021
- [23] Sari S K 2017 Pengembangan Desain Pembelajaran Statistika Berbasis IT Menggunakan Pendekatan Realistic Mathematics Education untuk Kelas VIII SMP *Jurnal Nas. Pendidik. Mat.* 1(2) p 290

- [24] Roza N, Arnawa I M, and Yerizon 2018 Practicality of mathematics learning tools based on discovery learning for topic sequence and series Int. J. Sci. Technol. Res. 7(5) pp 236–241
- [25] Muchlis E 2012 Pengaruh Pendekatan Pendidikan Matematika Realistik Indonesia (Pmri) Terhadap Perkembangan Kemampuan Pemecahan Masalah Siswa Kelas Ii Sd Kartika 1.10 Padang Exacta 10(2) pp 136 –139
- [26] Fahrudin A G , Zuliana E, and Bintoro H S 2018 Peningkatan Pemahaman Konsep Matematika melalui Realistic Mathematic Education Berbantu Alat Peraga Bongpas ANARGYA J. Ilm. Pendidik. Mat. 1(1) pp 14 –20.