The Practicality Of Realistic Mathematics Education Based Mathematics Learning Materials For Grade X Vocational High School Students Construction And Property Engineering Programme

Armiati, Dony Permana, Noperta

Abstract: This study aims to discuss the practicality of RME-based mathematics learning devices to improve the mathematical communication skills of Vocational Grade X students in construction and property engineering skills programs. Research focuses on the small group phase. This phase, the researcher applied a mathematics learning tool that involved 6 students, namely 2 high-ability students, 2 moderate-capable students, and 2 low-ability students, and a mathematics teacher acting as an observer. Data collection in this study was obtained from the results of the observation sheet, teacher and student response questionnaire. The results of the observation sheet and teacher response questionnaire showed that RME-based mathematics learning tools were practical with values of 84.85% and 82.67% respectively. the results of the student response questionnaire showed that the RME-based Students worksheet (LKPD) was very practical with a value of 87.23%.

Keywords: Practicality, RME, Mathematical Communication, Plomp Model.

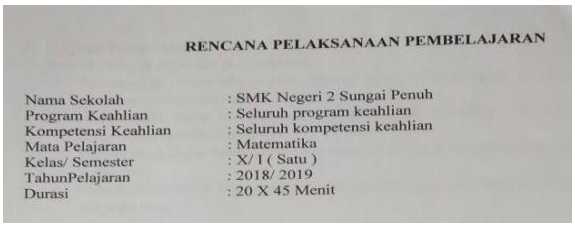
1. INTRODUCTION

Indonesia is a developing country that has a high unemployment rate. Based on the Statistics Center (BPS) the level of open unemployment in 2018 is 5.34% of the 131.01 million workforce people [1]. Therefore unemployment must be of particular concern to the Indonesian government.Indonesia tries to overcome unemployment problems by improving the education system. One of the efforts made by Indonesia is to improve the quality of vocational high school education. Because vocational education is expected to graduate students who are ready to work in accordance with the skills and expertise in the field studied by students. This ideal in accordance with Article 15 of Law Number 20 of 2003 concerning the National Education System states thatvocational education is secondary education which prepares students primarily to work in certain fields. Vocational graduates who are prepared are ready to work must have graduate standards that are in accordance with what is needed in the workforce. In accordance with the Minister of Education and Culture Regulation Number 29 of 2016 the competency standards of Vocational High School (SMK) graduates must have three dimensions, namely, the dimensions of attitude, the dimension of knowledge, and the dimensions of skills. These three dimensions will prepare SMK graduates to be able to face the world of work. In fact, SMK graduates are prepared to work contrary to what happens in the field. Because Vocational Schools give birth to high unemployment rates [2]. BPS data in 2018 said that the highest unemployment came from Vocational High Schools, which amounted to 11.24%. The results of the Asian Development Bank survey all occur because SMK graduates do not meet the expectations of job providers [3]. The cause of unemployment in SMK graduates is the lack of special skills in soft skills [4]. The ability of soft skills that are most expected by the world of work according to NACE, the National Accreditation of College and Employers is communication skills [5].

Communication skills can be improved through mathematics learning. Because mathematics learning has one goal to improve students' mathematical abilities. Mathematical communication ability is an important ability possessed by students. This is as stated that mathematics is not only a thinking tool that helps students to develop patterns, solve problems and provide conclusions, but also as a tool for communicating thoughts, varying ideas clearly, precisely and briefly [6]. Therefore, mathematics has an important role in improving the communication skills of SMK students. But in reality, the mathematical communication skills of SMK students are still low. The mathematical communication skills of SMK students were still low compared to high school mathematical communication skills, as well as mathematical communication skills students are divided into three criteria, namely 6.25% with high ability, 34.38% with moderate ability, and 59.37% with low ability [7][8]. This shows that students' mathematical communication skills are still low. Problems found in mathematics learning in vocational schools based on research results in the presence of 57 vocational mathematics teachers, 31% of teachers designed conventional learning, 38% used discovery learning and problem-based learning, 31% used cooperative learning [9]. But in the implementation, only 5.3% of teachers carried out learning according to planning. Most learning is carried out with a teacher-centered approach.It was also found by researchers at the Sungai Penuh City Vocational School, based on the results of interviews with teachers that the Student Worksheets (LKPD) they used in mathematical learning was developed by the teachers themselves. LKPD developed by teachers is still general in nature and does not pay attention to the

- *Armiati, Dony Permana, Noperta*
- *Department of Mathematics Educations, Universitas Negeri Padang armiati_math_unp@yahoo.co.id*
- *Department of Mathematics Educations, Universitas Negeri Padang Donypermana27@gmail.com*
- *Department of Mathematics Educations, Universitas Negeri Padang nopertanjung@gmail.com*

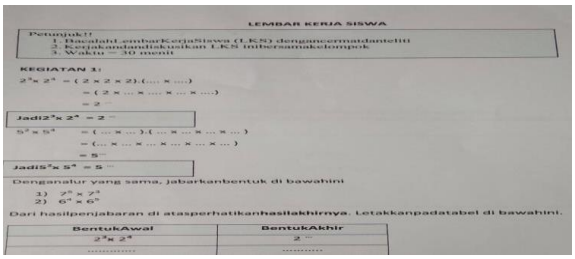
characteristics of different SMK students. This is due to the lack of understanding of the teacher in developing mathematics learning tools that are in accordance with the students' expertise program, the teacher makes learning plan (RPP) and LKPD together with other math teachers who teach in different skill programs so that the RPP and LKPD produced are the same for each program expertise. The teacher also has not fully implemented the device in the learning process. The RPP and LKPD made by the teacher can be seen in the following picture:



RENCANA PELAKSANAAN PEMBELAJARAN

Nama Sekolah	: SMK Negeri 2 Sungai Penuh
Program Keahlian	: Seluruh program keahlian
Kompetensi Keahlian	: Seluruh kompetensi keahlian
Mata Pelajaran	: Matematika
Kelas/ Semester	: X/ I (Satu)
TahunPelajaran	: 2018/ 2019
Durasi	: 20 X 45 Menit

Fig 1. *Teacher's learning plan*



LEMBAR KERJA SISWA

Petunjuk!!
1. Bacalah! LembarKerjaSiswa (LKS) dengancermatdanteliti
2. Kerjakanlah!diskusikan LKS bitersamakelompok
3. Waktu = 30 menit

KEGIATAN 1:

$2^3 \times 2^4 = (2 \times 2 \times 2).(\ldots \times \ldots)$
$= (2 \times \ldots \times \ldots \times \ldots \times \ldots)$
$= 2^{\ldots}$

Jadi $2^3 \times 2^4 = 2^{\ldots}$

$5^2 \times 5^3 = (\ldots \times \ldots).(\ldots \times \ldots \times \ldots)$
$= (\ldots \times \ldots \times \ldots \times \ldots \times \ldots)$
$= 5^{\ldots}$

Jadi $5^2 \times 5^3 = 5^{\ldots}$

Denganalur yang sama, jabarkanbentuk di bawahini

1) $2^5 \times 2^3$
2) $6^4 \times 6^2$

Dari hasilpenjabaran di atasperhatikanhasilakhirnya. Letakkanpadatabel di bawahini.

BentukAwal	BentukAkhir
$2^5 \times 2^3$	$2^{\ldots}$
.....	.....

Fig 2*. LKPD teacher*

The RPP and LKPD made by the teacher still appear to be general in nature and have not paid attention to the characteristics of vocational students who have different characteristics from one another. The RPP and LKPD made by the teacher are equated for all student skills programs. In addition, the device has not yet been tested for practicality, because the tools made by the teacher have not been fully implemented in mathematics learning. Even though practicality is one of the characteristics of quality-developed learning devices. Practicality is related to the ease of use of the products produced. A teaching material that has high practicality when teaching materials are practical, namely easy to implement and equipped with clear instructions [10]. Practicality can be assessed from the following aspects [11]:

1. Use, including ease of arrangement, storage, and can be used at any time.
2. Its use only requires a short, fast and precise time
3. Growing attractiveness and interest of students in using the device
4. Easy to understand or use by the teacher
5. Has the same equivalence

The practicality of the RME-based learning device in the construction and property technology expertise program in this study is seen from all aspects mentioned above. The instrument used to assess the practicality of RME-based mathematics learning devices uses the RPP implementation observation sheet, student response questionnaire, and teacher response questionnaire. The observation sheet was used to assess the practicality of RME-based lesson plans, student response questionnaires were used to assess the practicality of RME-based LKPDs, and teacher response questionnaires were used to assess the practicality of RME-based RPPs and LKPDs. The three instruments are used in the small group phase. Mathematical learning tools in the form of RME-based RPP and LKPD can be said to be practical if they fulfill: (1) Increasing the attractiveness of students in learning mathematics through the use of contextual problems related to construction and property engineering expertise programs. (2) Problems used are easy to understand and can facilitate the occurrence of horizontal and vertical mathematics. (3) The process of using the device does not cause confusion either from the use of language, context problems or instructions used for horizontal and vertical mathematical (4) Having sufficient time in using horizontal and vertical mathematical devices or mathematical devices. (5) The material presented in the device must use relevant problems for students on construction and property engineering expertise programs and in accordance with the applicable curriculum in Indonesia, the 2013 curriculum. Therefore in this study, the practicality of RME-based learning devices for students of class X of SMK construction and property engineering programs will be tested. RME is used because it can adjust mathematics learning with the characteristics of different SMK students and attract students' learning interest. Mathematics learning in vocational schools that associates with student skills programs can attract students' learning interest [12]. Therefore, RME-based mathematics learning devices can be used with the use of realistic problems related to student expertise programs, especially with construction and property engineering expertise programs. so that it can increase students' interest in learning mathematics. In addition, RME has five characteristics, namely (1) use of context, (2) use of models for progressive mathematicians, (3) utilization of student construction results, (4) interactivity, and (5) linkages [13]. These five characteristics illustrate how students communicate their ideas in solving context problems, the occurrence of communication or interaction between students and students and students and teachers. So that the learning process using the five characteristics of RME can improve students' mathematical communication skills. An important skill in mathematics for expressing mathematical ideas coherently to friends, teachers, and others is called mathematical communication [14].

2 METHOD

This research is research and development (R & D). Development research is a research method used to produce certain products. The development model used is the Plomp model which consists of three phases, namely the initial investigation phase (preliminary research), the phase of developing or making a prototype (development or prototyping phase), and the assessment phase. In the initial stage, we analyzed the context and needs in learning mathematics in vocational schools, especially in the construction and property engineering expertise program. At the prototype stage, we develop products that are produced from preliminary studies, namely in the form of RPE and LKPD based on RME for construction and property engineering expertise programs. Morever, Plomp`s model has advantages in assessing practicality of the developed learning materials through one-to-one evaluation, small group, and field test phase [15]. Production of prototypes includes formative design, development and evaluation activities. The evaluation phase is

the assessment stage of the prototypes produced using practicality and effectiveness tests. At this stage, semi-summative is also applied. Formative evaluations include self-evaluation, expert review, one to one, small group, and field tests. One to one is applied to one math teacher, and three students, namely high-ability students, one moderate-ability student, and one low-ability student. A summary of the stages is provided in Figure.

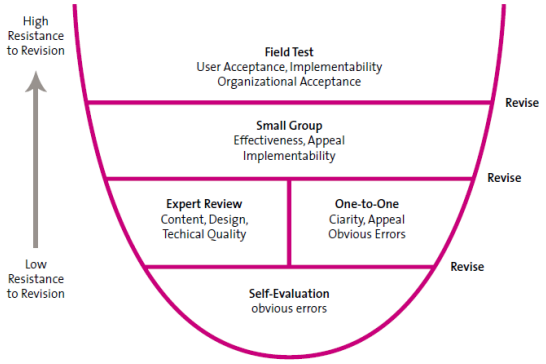


Fig 3. *Formative Evaluation Layer [16]*

Small groups are carried out by applying RME-based mathematics learning tools to 6 students, namely 2 high-ability students, 2 moderate-ability students, and 2 low-ability students. In the implementation of the small group, the researchers immediately applied the mathematics learning tools and teachers as observers. After the implementation of the small group, the researcher gave an assessment questionnaire to the teacher and the students involved in the small group. The assessment criteria can be seen in table 1.

Table 1.
Criteria For Practical Evaluation Of Devices

Alternative Answers	Score
Very Practical	5
Practical	4
Pretty Practical	3
Less Practical	2
Not Practical	1

The results of the practicality questionnaire or the practicality of the learning device are described by the data frequency analysis technique with the formula proposed [17].

$$P = \frac{R}{SM} \; x \; 100\%$$

Description:
P = Value of practicality
R = Score obtained
SM = Maximum score

Practical categories use classification in the following table:

TABLE 2.
Criteria For Practice [17]

Nilai Kepraktisan (%)	Kriteria
85 ≤ P ≤ 100	Very Practical
75 ≤ P < 85	Practical
60 ≤ P < 75	Pretty Practical
55 ≤ P < 60	Less Practical
0 ≤ P < 55	Not Practical

3 RESULTS AND DISCUSSION

The small group phase is carried out after an expert review and one to one evaluation. This phase was carried out to assess the practicality of the devices developed, namely RME-based RPP and LKPD. The assessment was carried out in several ways, namely by filling in the observation sheets conducted by the mathematics teacher, the teacher's response questionnaire and the student's response questionnaire. The following will explain the results of the practical assessment of mathematics learning devices based on the RME for students of class X in the vocational construction and property engineering expertise program.

3.1 Observation results

The results of the observation were obtained from filling out the observation sheet by the teacher as an observer. The results of the practicality of learning devices from observations made by teachers on the learning process carried out by researchers in the small group phase can be seen in table 3:

TABLE 3.
Recapitulation Of The Results Of The Observation Sheet

Meeting	Observation sheet values	Criteria
I	79.09%	P
II	88.18%	SP
III	86.36%	SP
IV	80%	P
V	87.27%	SP
VI	88.18%	SP
Average	84.85%	P

Ket: P = Practical, SP = Very Practical

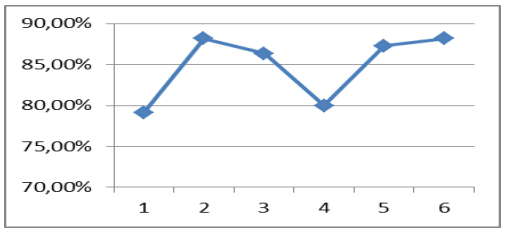


Figure 4*. Graph of observations at each meeting*

From the table 3, it can be seen that 2 meetings with practical categories, namely at meetings I and IV, while 4 other meetings with very practical categories, namely in meetings II, III, V, and VI. The chart shows a decline in the value of the second and fourth meetings. However, this is not a problem because when compared to the value at the first meeting the value is still increasing and is still in the practical criteria. In addition, the overall practicality has an average of 84.85% with practical criteria. So that with the results of observations it can be said that the RME-based mathematics learning device for students of class X SMK in the construction and property engineering expertise program is practical.

3.2 The results of the teacher's response questionnaire

The practical assessment of RME-based mathematics learning devices was also conducted by giving questionnaires to teachers. The aspects that will be assessed by the teacher are aspects of attractiveness, the process of use, ease of use, time, and equivalence. Questionnaires were given after the small group activities were completed. The results of the teacher's response armature can be seen in the following table 4:

TABLE 4.
Average Recapitulation of Questionnaire Practicality Results in Mathematics Learning Tools Based on RME (Small Group Teacher Response)

Aspects Assessed	P (%)	Categories
Attractiveness	80.00	P
Usage Process	86.67	SP
Ease of Use	80.00	P
Time	80.00	P
Equivalent	93.33	SP
Average	82.67	P

Ket: P = practical, SP = Very Practical

From the table 4, three practical aspects are obtained, namely the aspect of attraction with a value of 80.00%, ease of use with a value of 80.00%, time with a value of 80.00%. While the other two aspects are very practical, namely the aspect of the usage process with a value of 86.67%, and the equivalent value of 93.33%. The overall practicality of the device is categorized as practical with a value of 82.67%. From the results of the teacher response questionnaire, it can be concluded that the RME-based mathematics learning device is practical.

Based on the results of observations of researchers during the small group process, students have been able to study the LKPD given. Low-ability students are willing to try to solve problems by asking researchers and group friends. This shows that RME-based learning devices can attract students to learn mathematics. In this activity, mathematical communication skills also increase, because students have been willing to solve problems and they try to communicate their ideas in solving problems.

3.3 The results of the student response questionnaire

Apart from the results of observations and teacher responses the assessment was also conducted by giving questionnaires to students' responses. This questionnaire aims to assess presentation aspects, aspects of the ease of use of LKPD, aspects of readability, aspects of time. The results of student responses can be seen as follows:

TABLE 5.
Mean Recapitulation Of Results Of Questionnaire Practicality Of LKPD Based On RME (Small Group Student Response)

Aspects Assessed	P (%)	Categories
Presentation Aspect	85.56	SP
Facilitation Aspects of Using LKPD	91.67	SP
Readability Aspect	91.67	SP
Time Aspect	80	P
Average Overall	87.23	SP

Table 5 was found that one aspect thanks to practical labor was time with a value of 80%, and the other three aspects were very practical, namely presentation aspects with a value of 85.56%, ease of use of LKPD with a value of 91.67%, and readability with a value of 91.67% . LKPD practicality based on student responses as a whole has a very practical category with an average value of 87, 23%. The practicality of RME-based learning devices in responding to student responses already has very practical criteria.Based on student responses it can be concluded that students have been able to use RME-based learning tools easily. So that the mathematics learning tools based on RME can already be applied in the process of learning mathematics. But the ease of using learning tools must also be able to realize learning objectives, especially students' mathematical communication skills. This is evidenced by the results of students' mathematical communication ability tests in table 6:

Table 6.
Mathematical Communication Ability Test Results Of Students (Small Group Phase)

Initial Student Name	KKM	Test Results	Information
EF	66,67	83,33	complete
ND	66,67	78,33	complete
DAP	66,67	66,67	complete
UDP	66,67	76,67	complete
AM	66,67	73,33	complete
NAS	66,67	61,67	not complete
Percentage of students who complete		83,33%	Very effective

Information: KKM = Minimal Completeness Criteria

Table 6 shows that RME-based mathematics learning tools are not only easy to use. But it can also facilitate in achieving the goals of mathematics learning, specifically improving students' mathematical communication skills. This can be seen from the percentage of the number of students who reach the KKM, which is 83.33% which is in the category that is very effective in improving students' mathematical communication skills.

4 CONCLUSION

Based on the practicality assessment of mathematics learning devices, on the observation sheet obtained a score of 84.85% with practical criteria, the teacher's response questionnaire obtained a value of 82.67% with practical criteria, and the student response questionnaire obtained a value of 87.23% with very practical criteria, as well as observations of researchers shows students have an interest in learning mathematics and increasing students' mathematical communication skills. This refers to the RME-based mathematical learning tool to improve mathematical communication skills of Vocational Grade X students in construction and property engineering expertise programs. In addition, the practicality of learning devices is supported by the results of the test of mathematical communication skills of students with the number of students who achieve completeness as much as 83.33%.Therefore, the mathematics learning tool in the form of RME-based RPP and LKPD has fulfilled: (1) Increasing the attractiveness of students in learning mathematics through the use of contextual problems related to construction and property engineering expertise programs. (2) Problems used are easy to understand and can facilitate the occurrence of horizontal and vertical mathematics. (3) The process of using the device does not cause confusion either from the use of language, context problems or instructions used for horizontal and vertical mathematical (4) Having sufficient time in using horizontal and vertical mathematical devices or mathematical devices. (5) The material presented in the device must use relevant issues for students in the construction and property engineering expertise program and the curriculum that applies in Indonesia is the 2013 curriculum.

REFERENCES

[1] Badan Pusat Statistika. (2018). Tingkat pengangguran terbuka (TPT) sebesar 5.34 persen. Jakarta: Badan Pusat Statistika (BPS)

[2] Suryadi, A. (2010). Permasalahan dan Alternatif Kebijakan Peingkatan Relevansi Pendidikan. Seminar Nasional Pendidikan Luar Sekolah. Bandung: UPI.

[3] Puspitasari, SN. (2016). Formulasi Kurikulum SMK Diterapkan 2017.(http://www.pikiranrakyat.com/pendidikan/2016/09/15/formulasikurikulumsmk-diterapkan-2017-379878). diakses 28 Sep 2018.

[4] Ikram, S. (2017). Influence Of The Average Value Of Competency Test Of Manual Accounting On The Average Value Of Myob Competency Test. International Journal Of Scientific & Technology Research. Volume 6, ISSUE 10, October 2017 ISSN 2277-8616.

[5] Yuwono, I. (2015). Peningkatan Dayasaing Lulusan Program Studi Pendidikan Matematika dalam Menyongsong Masyarakat Ekonomi Asean (MEA). Prosiding Seminar Nasional Matematika dan Pembelajarannya. Malang: FMIPA Universitas Negeri Malang. 5 September 2015.

[6] Armiati. (2009). Komunikasi Matematis dan Kecerdasan Emosional. Prosiding Seminar Nasional Matematika dan Pendidikan Matematika. Yogyakarta: FMIPA UNY. 5 Desember 2009. ISBN: 978-979-16353-3-2.

[7] Paridjo & Waluya, B. (2017). Analysis Mathematical Communication Skills Students In The Matter Algebra Based NCTM. IOSR Journal of Mathematics (IOSR-JM). e-ISSN: 2278-5728, p-ISSN: 2319-765X. Volume 13, Issue I Ver. V (Jan. - Feb. 2017), PP 60-66.

[8] Aisyah. Rosyada, A. (2017). Analisis Kemampuan Komunikasi Matematis Dalam Menyelesaikan Soal Pada Materi Bentuk Pangkat, Akar, Dan Logaritma Siswa Kelas X Sma Islam Al-Falah Jambi. Nabla Dewantara: Jurnal Pendidikan Matematika. ISSN 2528-3901.

[9] Armiati. (2008). Workshop on Developing Mathematics Learning Instrument Character-Based to Vocational Mathematics Teachers in West Sumatera. Pelita Eksakta, Vol.01, No.02, 2018 pp. 128-134

[10] Arikunto, S. (2012). Dasar-Dasar Evaluasi Evaluasi Pendidikan. Jakarta: Bumi Aksara.

[11] Sukardi. (2008). Evaluasi Pendidikan. Jakarta: Bumi Aksara.

[12] Armiati & La`ia, HT. (2018). The Developed Mathematics Learning Tools Which Based on Professional Competency In The Phase of One to One Evaluation For Trigonometry Topic In The Major of Information and Communication Engineering of SMK. 2nd International Conference on Mathematics and Mathematics Education 2018 (ICM2E 2018) .advances in Social Science, Education and Humanities Research (ASSEHR), volume 285.

[13] Traffers, A. (1991) Three Dimentions. A Model of Goal and Theory Description in Mathematics Intruction – The Wiskobas Project. Dordrecht: Reidel Publishing Company.

[14] Armiati. (2009) "Komunikasi Matematis Dan Kecerdasan Emosional," Pros. Semin. Nas. Mat. dan Pendidik. Mat. Jur. Pendidik. Mat. FMIPA UNY, 5 Desember 2009 270, pp. 978–979.

[15] Arnawa, IM. Yerizon. Nita, S & Putra, RT. (2019). Development of students' worksheet based on apos theory approach to improve student achievment in learning system of linear equations. Int. J. Sci. Technol. Res., vol. 8, no. 4, pp. 287–292.

[16] Plomp, T & Nieveen, N. (2013). Educational Design Research. Enschede: Netherland Institute for Curiculum Development (SLO)

[17] Purwanto. (2012). Metodologi Penelitian Kuantitatif untuk Psikologi dan Pendidikan. Yogyakarta: Pustaka Belajar Offset.