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Development of Digital Pocket Book Based on Realistic Mathematics Education (RME) Fort Supports Students' Literacy Ability

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ABSTRACT

This research aims to create a digital pocket book that supports reading skills and is based on Realistic Mathematics Education. Research and development are the term for this type of study. This development study was carried out with the use of a 4-D model. A total of 30 students from SMP Negeri 7 Muaro Jambi participated in field trials. The digital pocketbook met the validity, practicality, and effectiveness requirements, according to the findings. Teachers should be able to develop creative ideas for developing teaching materials that support reading skills based on the findings of this study.

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Literacy skills are explicitly taught in mathematics. Literacy in mathematics can be done by linking mathematical concepts and rules to real situations in everyday life. When planting mathematical concepts, you must start from real-world problems and be close to the student's life. Students can solve real problems using the abilities they have acquired through school experiences and daily life. The process is "mathematicalization". Mathematicalization or mathematical modelling is related to literacy (Stacey, 2011; Lange, 2006). Because according to Ojose (2011), the essence of literacy is the ability of a person to use mathematics knowledge confidently. They learn to solve problems in everyday life. In line with that, Stacey & Turner (2015) stated that mathematical literacy could use mathematical content (concepts, facts, procedures and tools) in real situations. Meanwhile, according to Han et al., (2017), literacy is the knowledge or ability to use numbers and symbols in basic mathematics to solve everyday life problems and analyze information to predict and make decisions. Mathematical literacy skills involve seven basic abilities that students must have (OECD, 2013): communication skills, mathematical skills, representation skills, ability to explain and argue, ability to develop strategies to solve problems, ability to use standard symbols, language techniques, and quality. Moreover, the ability to use math tools.

Learning characteristics that make real-world contexts in everyday life are at the core of the Realistic Mathematics Education (RME) approach. In RME, mathematics is designed as students' findings to provide a deep understanding of students. Mathematics is no longer just memorizing formulas. According to Heuvel-panhuizen et al (2014), realistic mathematic education (RME) is an approach in mathematics learning theory that emphasizes real learning situations. This real-life situation can include problems that students can imagine. Solving this real problem will be the process of planting concepts in students. RME in mathematics learning places students' realities and experiences as the starting point of learning. Real problems are used as sources of the emergence of mathematical concepts or formal mathematical knowledge (Febriyanti, Bagaskorowati, & Makmuri, 2019). Correspondingly, in RME, the use of a broad and realistic context has a vital position in learning (Lerman, 2020). Gravemeijer (2020) argues that there are three basic principles in realistic mathematical education (RME): rediscovering/advanced mathematics, educational phenomena, and developing their models. Where the learning sequence in Realistic Mathematical Education (RME) is (a) contextual problems, (b) models of contextual problems, (c) models towards formal, and (d) formal knowledge (Soedjadi, 2001).

So far, teachers have linked mathematical concepts to the daily context of students through textbooks and worksheets. There are various weaknesses faced in the field when teachers only focus on using textbooks. According to Nuzula & As'ari (2013), some students rarely use textbooks because they are lazy to carry large and heavy textbooks. Textbooks sometimes cannot be used all the time and wherever they are, so some students are considered boring (Sulistyani, Jam, & Rahardjo, 2013). The need for other learning media that is lighter, and more practice makes it easier for students to understand the concept. Pocketbooks are also one of the media used in the learning process (Sulistyani et al., 2013). The pocketbook presentation uses lots of pictures and

colors to give it an attractive appearance. This statement is supported by Rudisil (Sudjana, 2007), children prefer pictures to words. The image will look real when presented with coloring. It is because the colors in the image can create a realistic impression on the image.

Because students are now a native digital generation, where students have been familiar with digital since birth, most students have used smartphones both in their daily lives and in the learning process. According to research (Crompton & Burke, 2016) dan (Sung, Chang, & Liu, 2016), learning media's development trend using cell phones is overgrowing and resulting in positive learning. Also, learning media using cell phones can increase student interest, independence, motivation and achievement (Handayani & Suharyanto, 2016; Handayani, 2015; Irawan, 2015). One of the learning media that in practice only uses cellphones is a digital pocketbook. Because according Saputra et al., (2018) and Herawati et al. (2020), this Android-based digital pocketbook is practical mathematics learning medium for high school students. A digital pocketbook is an application that can be stored in an application package (apk) format and uploaded to the Google Play Store. A digital pocketbook is a learning medium using a mobile phone called mobile learning (m-learning) is a learning device with personal digital (PDA), tabs, iPhone, or cellphones as the primary device (Sulastri & Hakim, 2014; Wirawan & Ratnaya, 2011). M-learning is used as a learning complement that student can use anytime and anywhere and allows students to learn more about learning topics. One of the advantages of m-learning is that it can be used to replace textbooks in schools.

METHOD

This type of research is research and development (research and development). According to Sugiyono, research and development are research method used to produce specific products and test their effectiveness (Sugiyono, 2016). This development research was conducted using a 3 4-D development model, namely define, design, develop, and disseminate. However, this research is limited to the first three stages: define, design, and develop. Field trials were carried out in class VII G SMP Negeri 7 Muaro Jambi, totalling 30 students.

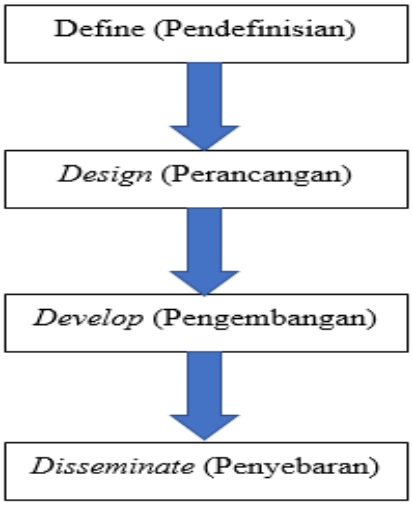


Figure 1. Development Procedure for the 4G Model

Information is obtained about students' characteristics at the defining stage, using the media, mathematical concepts in the material, and the material's learning objectives. At the design stage, the digital pocketbook media draft one was obtained. The validator then validated activities at the developing stage of the 1st draft obtained at the design stage. Based on the results of the assessment by the validator, it will be decided whether revisions need to be made or not. Pocketbooks that have been declared valid will be referred to as draft 2. The pocketbook draft two was then tried out in field trials. Field trials were carried out to see the practicality and effectiveness of the pocketbooks being developed. The material developed in this digital pocketbook is social arithmetic and comparison.

The instrument used in this study, namely, to assess the pocket book's validity, used the material expert validation assessment sheet and design expert. The teacher and students used the assessment sheet to assess the practicality. Meanwhile, to assess the teacher and student activity's effectiveness, observation sheets and student literacy test sheets were used. The types of data used to process the development result data are qualitative data and quantitative data. This qualitative data is in the form of a summary of the results of the material expert validator's questionnaire and design expert's assessment, which has been converted to qualitative data and criticism and suggestions from the validator to the pocket book. While the quantitative data in the form of the results of the practicality assessment scores of teachers and students, the teacher and student activity observation sheets results, and the results of students' literacy scores.

Data analysis techniques in this study include analysis of the validity, practicality and effectiveness of pocket books. Data analysis of the validity, practicality and effectiveness of the pocket book was obtained from the results of the assessment from the validator, the results of the practicality assessment from teachers and students and the results of the assessment of the teacher and student activity observation sheets which were analysed using the Likert scale and the results of the student literacy tests. The Likert scale is used to measure attitudes, opinions, and perceptions of a group of social events or symptoms (Riduwan, 2015). The first step is to provide a score on each criterion with the conditions shown in table 1.

Table 1. Guidelines for Assessment Scores of Validities, Practicality and Effectiveness of Handbooks

Criteria	Score
Very Good	5
Good	4
Average	3
Bad	2
Very Bad	1

Furthermore, calculations are carried out to see the percentage of validity, practicality and effectiveness of using a pocket book using the formula (Tegeh, 2014) as follows:

$$P = \frac{\sum X}{SMI} \times 100\%$$

Information :
P = percentage of validity / practicality / effectiveness
∑X = Total score
SMI = Maximum Ideal Score
The final step is to conclude the calculation results based on the criteria shown in Table 2 below (Modified from Tegeh, et al., 2014).

Table 2. Criteria for Validity, Practicality and Effectiveness of Handbooks

Level of Achievement	Qualification
90—100%	Very Valid/Practical/effective
75—89%	Valid / Practical/effective
65—74%	Quite valid / Practical/effective
55—64%	Less valid / Practical/effective
0—54%	Not valid / Practical/effective

A Pocket Book is said to be valid, practical and effective if it gets an assessment that meets the criteria of "very valid / practical / effective", "valid / practical / effective", and "quite valid / practical / effective". Assessment of literacy test results uses scoring guidelines. To assess the literacy test results is considered complete or does not refer to the student's Minimum Completeness Criteria (KKM). The pocket book is said to be effective in achieving the learning objectives if the student's test results are above the KKM that has been determined by SMP Negeri 7 Muaro Jambi, namely 70, with the standard of class completeness is 80%. To calculate the percentage of student completeness using the following formula:

$$P = \frac{\sum X}{SMI} \times 100\%$$

Information :
P = Percentage of effectiveness
∑X = Total student complete score
SMI = Maximum score complete Ideal

After obtaining the percentage of completeness data, it is determined whether it is effective or not by looking at the effectiveness criteria based on table 2. The student literacy test was used to analyze the effectiveness of the digital pocket book that was developed. According to the literacy skills indicator based on the level, there are three questions in the literacy test. The literacy indicators based on the level and literacy questions are shown in table 3.

Table 3. Indicators and Literacy Questions

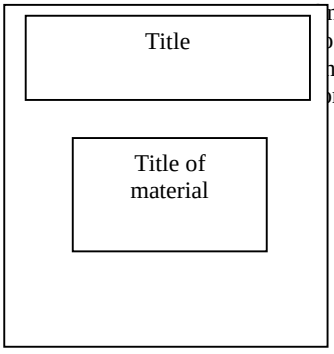
Literacy indicator	Questions No.
Level 1 1. Students can answer questions in which the relevant general context is provided, and the questions are clearly defined 2. Students can identify information and complete routine procedures according to direct instructions in explicit situations. 3. Students can take actions that are almost always clear and immediately followed by the stimulus given	1. The price of the 18 clothes is Rp. 540,000.00. How much are the 2.5 dozen shirts?
Level 2 1. Students can interpret and recognize situations in contexts that do not require drawing direct conclusions 2. Students can sort relevant information from a single source and use a single conclusion 3. Students can apply basic algorithms, formulate using carry out procedures, or introductory provisions 4. Students can provide reasons directly and interpret the results	2. If to make six slices of cake, it takes 18 ounces of refined sugar, then how much is needed to make nine slices of cake?
Level 3 1. Students can carry out procedures well, including procedures that require sequential decisions. 2. Students can select and apply simple problem-solving strategies 3. Students can interpret and use representations based on various sources of information and state their reasons directly from what is obtained 4. Students can develop simple communication through the results of their interpretation and basic reasoning	3. Twelve people can complete a job in 15 days. Because a job must be completed in 9 days, how many additional workers are there for the job to be completed on time?

RESULT

At the define stage, an analysis of student characteristics and material analysis is carried out. Based on the results of preliminary observations made by researchers in class VII SMP Negeri 7 Muaro Jambi, students in class VII have cognitive abilities that vary from high, medium and low. In addition to the observed student characteristics, researchers also made observations of students' teaching materials and textbooks in the learning process, from the observations obtained during student learning using mathematics textbooks that present material, sample questions and various exercises, and evaluation (assessment) the material. Based on the results of the material analysis, it was also found that the materials to be developed in the digital pocket book were social arithmetic, comparisons and statistics.

At the design stage, the researcher began to determine the initial design of the mathematics pocket book developed in a storyboard and an initial digital pocket book design. According to Branch (2010), the general procedure carried out at the design stage is to hold or make the things needed. According to Branch (2010), all the things needed will be made according to the definition stage. An example of a digital pocket book storyboard design is shown in table 4.

Table 4. Example of a Digital Pocket Book Storyboard

Description	Math pocket book visualization	Narrative	Location
Cover		n the cover display, there is the title "Math pocket ook." here is a material title: social arithmetic, mparison, and statistics just below the title.	Math themed background and blue colour

The existence of a storyboard design helps researchers to design a draft mathematics pocket book 1. At this stage, an RME-based mathematics pocket book has been designed to support literacy by the storyboard with a display, as shown in Figure 2 below.

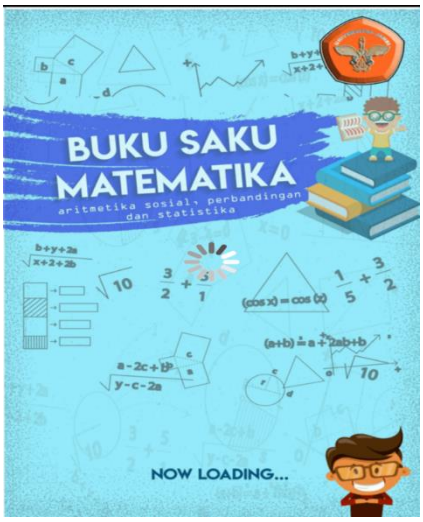


Figure 2. The cover view (start page) of draft 1 of the digital mathematics pocket book

At the development stage, material expert validators and design experts assessed the pocket book's validity, practical assessments by teachers and students, and effectiveness assessments. Assessment of the validity of the mathematics pocketbook.

Table 5. Results of the Validity Assessment of the Digital Pocket Book

Assessment by validator	Percentage of validity	Criteria
Material expert	85%	Valid
Design expert	87,5%	Valid
Average percentage of validity	86,25%	Valid

Based on table 5, it can be concluded that the average percentage of the validity of digital pocketbooks from material expert validators and design experts is 86.25% which fulfils the valid criteria. In addition to scoring in the form of scores, material expert validators and design experts also provide written suggestions and input on the mathematics pocketbook.

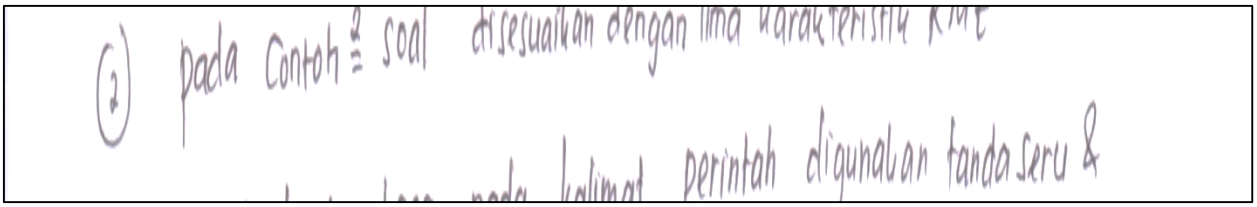


Figure 3. Comments and Advice from Material Expert Validators on Mathematics Pocket Book

The material expert validator provided input in slides of RME learning steps in the RME menu but was not used in a pocket book, so it was better removed. The revision made is to delete the RME learning steps slide menu on the RME menu. The material expert validator also suggested that the five RME characteristics appear in the sample questions because, in some sample questions, only a few characteristics appeared. The revision made is to use the five characteristics of the RME in the sample questions. In practice questions, the material validator suggested the need to use appropriate question marks. The revision made was to fix the question marks in practice questions. The expert validator also suggested that level 3 literacy questions need to be adjusted to the literacy indicator level 3. The revision made was to change the practice questions by designing level 3 literacy questions according to the problem indicators.

Design expert validators also provide written advice and input on the math pocketbook. Based on Figure 4 below, the design expert validator suggests revising mathematical literacy problems in a pocket book. It is because some questions are not visible indicators of mathematical literacy. The revision made was to improve several questions according to the suggestions of the design validator.

Figure 4. Comments and suggestions from the design expert validator on the mathematics pocket book

A draft two mathematics pocket book is obtained after validation by material experts and design experts, as shown in figure 5.

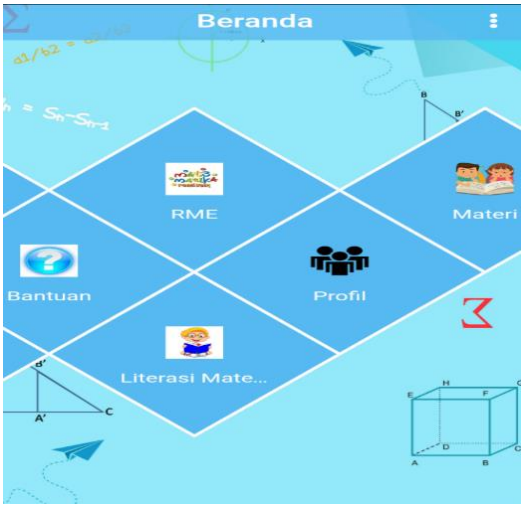
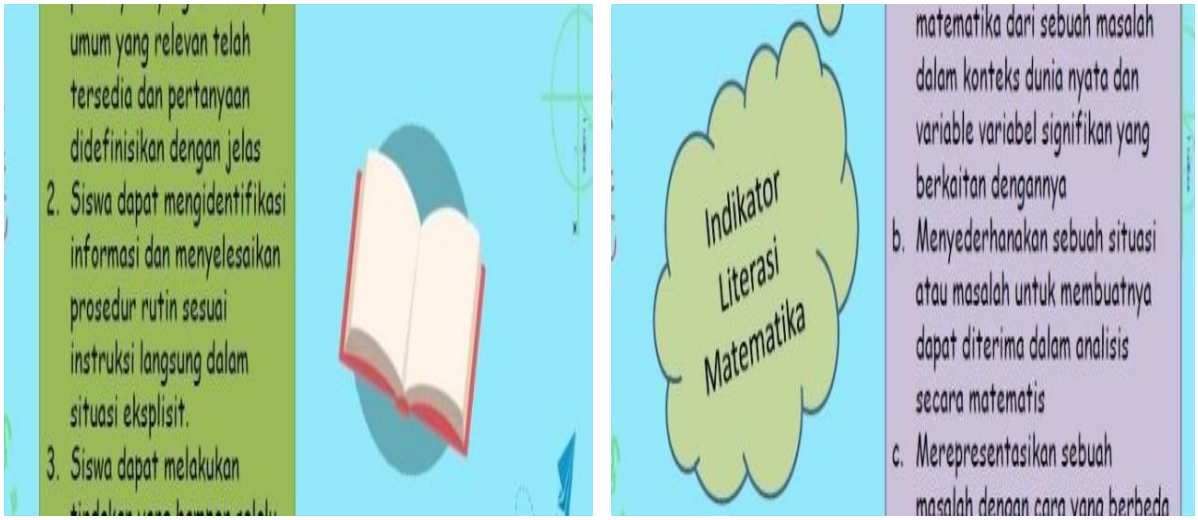


Figure 5. Display Home Menu

The homepage display, as shown in figure 5, consists of several menus, namely (1) the RME menu, (2) mathematical literacy, (3) material, (4) help, and (5) profiles. The display on the RME menu is, as shown in figure 6.

Figure 6. Display RME Menu

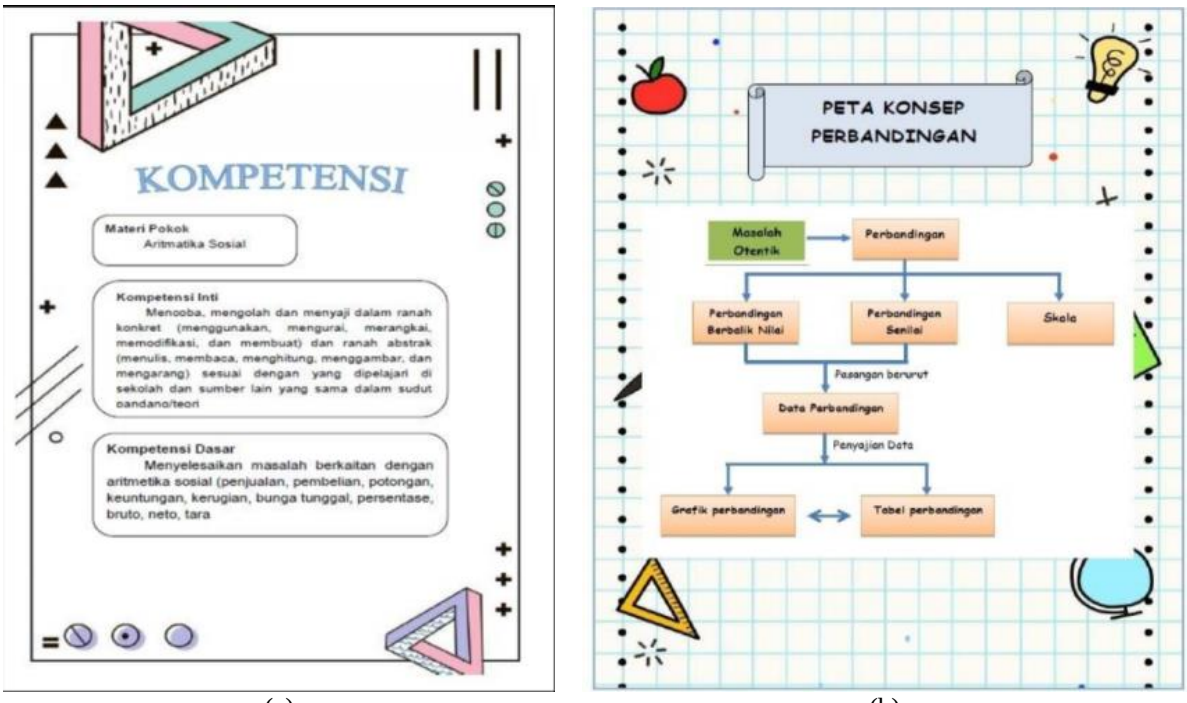
In the RME menu, there are two displays, namely a display of explanations about the characteristics of RME and a display of RME learning steps. The mathematics literacy menu consists of several explanations about mathematical literacy indicators in general and indicators of mathematical literacy per level. The following is the display of the mathematical literacy menu.



(a) (b)

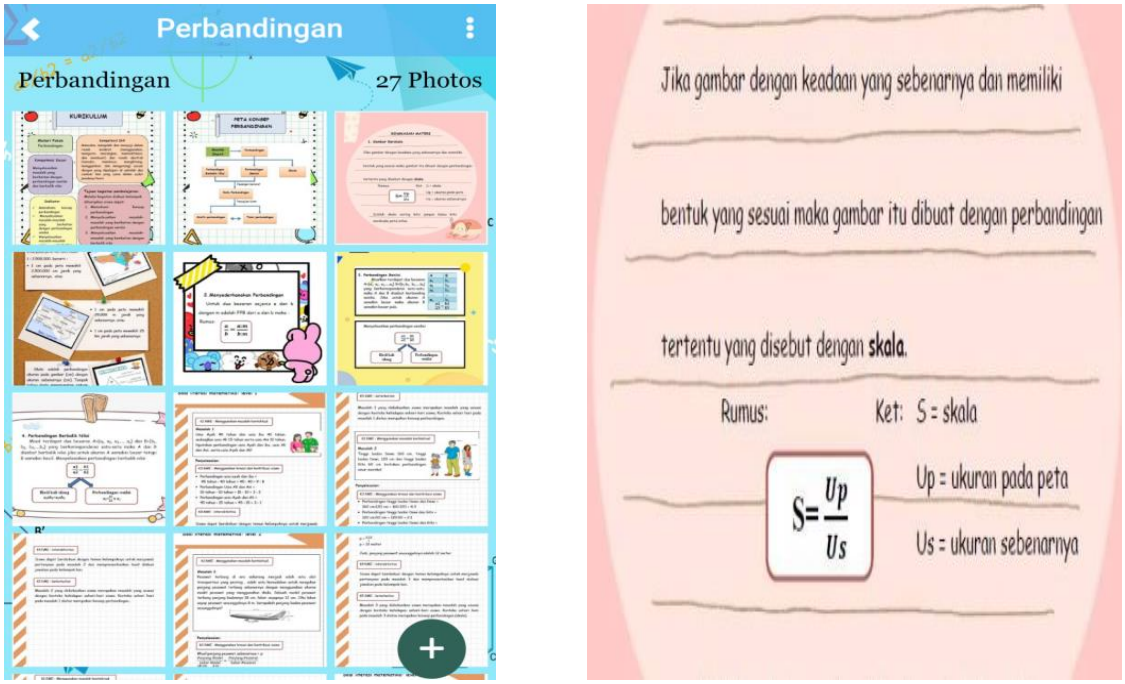
Figure 6. (a) Display of the Mathematical Literacy Indicator Menu in General, (b) Display of the Mathematical Literacy Indicator Menu by Level

The material menu consists of several explanations, namely an explanation of competencies (KI, KD, indicators and learning objectives), concept maps, material summaries, sample questions and question exercises, as shown in figure 7. There is a summary of the material per chapter in the material menu with the following display in figure 8.



(a) (b)

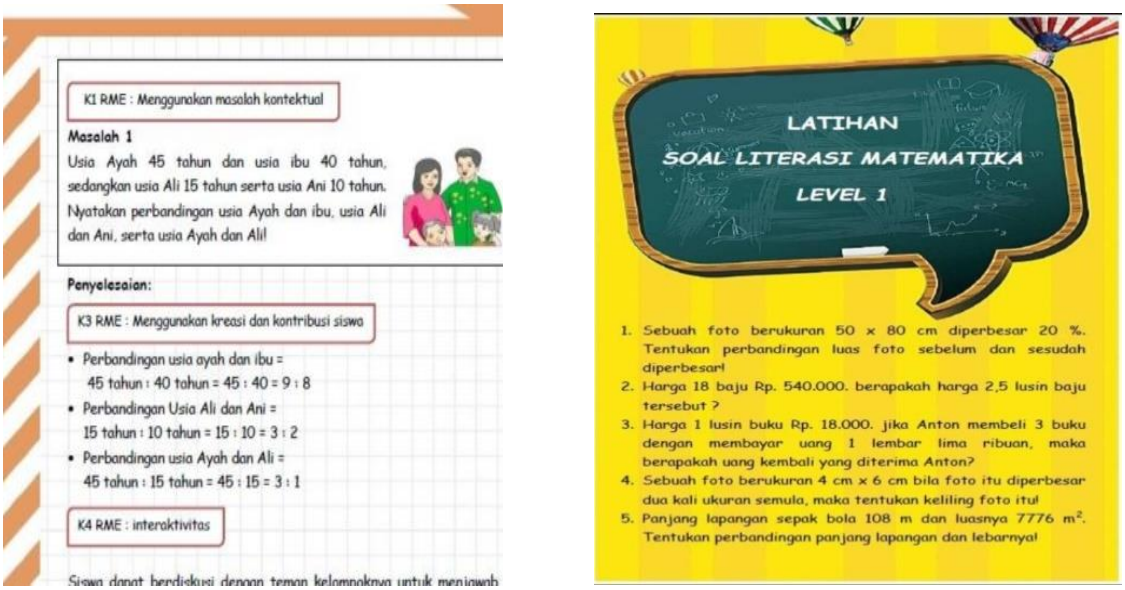
Figure 7. (a) Display of competence on the material menu, (b) display of concept maps



(a) **(b)**

Figure 8. (a) Overall View of Comparative Material, (b) Initial View of Material Summary

Figure 9 is a display of examples and practice questions on the material menu. The examples and exercises are designed based on RME by highlighting the characteristics of RME. Problems also designed to help students develop mathematical literacy skills. It is designed based on the levels according to the indicators at each level, as in figure 9.



(a) (b)

Figure 9. Display sample questions, (b) display practice questions

Analysis of the digital pocket book's practicality was carried out by asking for practicality assessments by teachers and students, carried out in a field trial on August 28, 2020, at SMP Negeri 7 Muaro Jambi. There were five teachers and 30 students who gave a practical assessment of pocket books. The teacher's assessment of the digital pocket book can be seen in the following table.

Table 6. Results of Teacher Assessment of Mathematics Pocket Book in Field Trials

No	Descriptors	Score	Maximum score
1	The material in the mathematics pocketbook is coherent and clear	23	25
2.	The pocketbook of mathematics is practical and easy to use.	23	25
3.	Math pocketbook is designed according to the 2013 curriculum	22	25
4.	The sentences used in the math pocketbook are easy to understand	21	25
5.	Text/writing is easy to read	23	25
6.	Math pocketbook uses visible typeface and font	22	25
7.	The language/sentence used is under the thinking level of SMP / MTs students.	22	25
8.	The language used is following EYD rules	20	25
9.	The cover of the pocket math book is attractive, using suitable colour combinations	21	25
10.	The background colour of each slide on the pocket math book is attractive	21	25
11.	Math pocketbook can increase students' interest in learning.	22	25
Total		240	275
Percentage of practicality (P)			87,27%

Based on the teacher's practicality assessment, it was found that the percentage of the practicality of the digital pocket book was 87.27%, which met the practical criteria. The results of student assessments of digital pocket books can be seen in table 7.

Table 7.Student Assessment Results Against the Mathematics Pocket Book in Field Trials

No	Descriptors	Score	Maximum score
1	The material in the mathematics pocketbook is coherent and clear.	140	150
2.	The pocketbook of mathematics is practical and easy to use.	138	150
3.	Math pocketbook is designed according to the 2013 curriculum	140	150
4.	The sentences used in the math pocketbook are easy to understand	131	150
5.	Text/writing is easy to read.	142	150
6.	Math pocketbook uses visible typeface and font.	130	150
7.	The language/sentence used is following the thinking level of SMP / MTs students.	148	150
8.	The language used is following EYD rules.	142	150
9.	The cover of the pocket math book is attractive, using suitable colour combinations.	120	150
10.	The background colour of each slide on the pocket math book is attractive.	125	150
11.	Math pocketbook can increase students' interest in learning.	128	150
Total		1484	1650
Percentage of practicality (P)			89,93%

While the percentage of the assessment results of 30 students on the practicality of the digital pocketbook was 89.93%, which met the practical criteria, the mathematics pocket book that was designed met the practical criteria based on teacher and student assessments.

The digital pocketbook's effectiveness is obtained from the teacher and student activity observation sheets and students' literacy tests. There are 20 teacher and student activities observed in the teacher and student activity sheets. Based on the results of the calculation of the teacher and student activity observation sheets, the results are shown in Table 8.

Based on the table, it is found that the average effectiveness of the teacher activity observation sheet is obtained a percentage of 87%, which meets the effective criteria. Simultaneously, the student activity observation sheet's average effectiveness amounted to 80.5%, which also met the effectiveness criteria. The digital pocketbook has met the criteria for effectiveness based on the teacher and student activity observation sheets from these results.

Table 8. The results of the calculation of the Teacher and Student Activity Observation Sheet

Observed Observation Sheet	1st meeting			2nd meeting			The average percentage of effectiveness
	Score ($\sum X$)	Maximum score (SMI)	Percentage of effectiveness (P)	Score ($\sum X$)	Maximum score (SMI)	Percentage of effectiveness (P)	
Teacher activity	86	100	86%	88	100	88%	87%
Student activities	80	100	80%	81	100	81%	80,5%

The effectiveness of the digital pocketbook is also based on the results of students' literacy tests. The student literacy test was conducted at SMP Negeri 7 Muaro Jambi with 30 students of class VII G, who took the test. There are 3 test questions given to measure students' literacy skills. Student answers are assessed based on student literacy indicators per level. There are three levels of student literacy skills assessed according to the student literacy indicators in table 3. The assessment of the students' literacy test answers indicated that the average test score of 30 students was 83.27. Twenty-six students fulfilled the KKM, and four students did not fulfil the KKM. The percentage of the digital pocketbook's effectiveness based on the students' literacy tests' results is 90.08%, which means it meets the "very effective" criteria. Based on the test results, it can also be seen that most students can answer literacy questions per level well. It can be seen from the average score of students for question no.1 (level 1 literacy questions) of 89.80. For question no.2 (level 2 literacy questions), the student's average score was 86.66. Meanwhile, question no 3 (level 3 literacy questions) obtained an average student score of 73.33. The average literacy test results per level can be seen in figure 10.

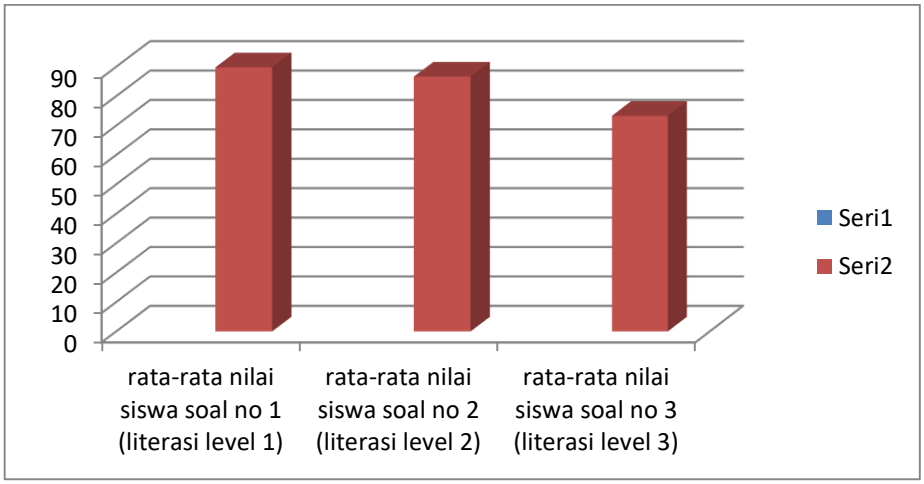


Figure 10. Average Student Scores Per Literacy Level

Based on the results described above, SMP Negeri 7 Muaro Jambi's seventh-grade students have solved literacy test questions well. Based on the research results, it was also found that the digital pocketbook developed had met the valid, practical, and effective criteria. It is also hoped that the developed digital pocketbook will help develop students' literacy skills.

DISCUSSION

According to the research findings, the RME-based digital pocketbook produced fits the criteria for being valid, practical, and effective. The findings of this study corroborate those of (Utami & Sunaryo, 2018) who prepared a pocketbook on triangles and quadrilaterals for students in grade VII SMP. Numerous academics in domains other than mathematics conduct research on the development of pocketbooks to learn and improve specific abilities (Abdullah, Khaldun, & Musman, 2021; Alif Yanuar Zukmadini, Kasrina, Jumiarni, & Rochman, 2020; Apriliyani & Hidayati, 2020; Cahyono, Tsani, & Rahma, 2018; Friansah, Adha, & Refianti, 2018; T. . Handayani & Suharyanto, 2016; Nuzula & As'ari, 2013; Saputra, Abidin, Ansari, & Hidayat, 2018a; Sholeh, Supriadi, & Suherman, 2021; Studi, Matematika, Mahaputra, & Yamin, 2018; Sulistri, Sunarsih, Utama, & Moseki, 2020; Sulistyowati, 2019; Suprapto, Ibisono, & Mubarok, 2021).. The abilities developed are problem-solving ability, conceptual understanding, higher order thinking abilities, and student learning interests. Additionally, (Apriliyani & Hidayati, 2020; Sulistri et al., 2020) advised developing a pocketbook to aid literacy development.

The material in a pocketbook is a valuable instructional tool that students can utilize (Febriyanti et al., 2019; Herawati et al., 2020; Irawan, 2015; Saputra et al., 2018b; Sulistyani et al., 2013). Pocketbooks are a print medium with several pros and downsides. The advantages of pocketbooks include the following: (1) They can present messages or information in large quantities; (2) Students can study them according to their interests and speeds; (3) They can be studied anytime and anywhere due to their portability; (4) They will be more interesting if they include pictures and colours, and (5) Repairs/revisions are simple. While pocketbooks have numerous advantages, they do have some drawbacks. The disadvantages of pocketbooks include the following: (1) The manufacturing process is lengthy; (2) Dense printed materials are boring and will quickly lose students' attention who read them; (3) If the volume and paper quality is inadequate, the printed material will be easily damaged and torn.

The critical aspect of producing educational materials, particularly pocketbooks, is to pay close attention to their appearance and content. Pocketbooks must adhere to reasonable, practical, and adequate standards to be used by students as a form of instruction (Abdullah et al., 2021; Choir & Fitri, 2021; Husna & Yazidah, n.d.; Nurmala R, Izzatin, & Mucti, 2019; Pramika, 2018; Pratama, Iswari, & Ngabekti, 2019; Puma, Fadillah, & Haryadi, 2020; Rizdani et al., 2013). Additionally, it is

intended that by designing a pocketbook, teachers will have innovative ideas for developing instructional resources that enhance reading skills and other talents associated with 21st century capabilities.

CONCLUSION

Based on the results of field trials, it was found that the digital pocketbook had met the criteria of being valid, practical and effective. The developed digital pocketbook can be used as a learning medium to help teachers understand social arithmetic concepts and comparisons. Some suggestions that can be given in the development of pocketbooks are that it is hoped that digital pocketbooks can be made more interactive and attractive to increase students' enthusiasm and enthusiasm in learning mathematics. This digital pocketbook can also be developed on various mathematical materials to be an alternative learning media used by students in online learning, such as during the Covid-19 pandemic.

Based on the research findings and conclusions above, several suggestions can be made (1) for students, an RME-based mathematics pocketbook can be used as a learning medium produced during and outside of school hours to boost learning results, mainly information on comparisons; (2) for teachers, as a medium of instruction and a source of knowledge to improve student learning outcomes and literacy abilities.

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