ISBN: 978 – 602 – 1180 – 91 – 4

DESIGN OF DEVELOPMENT OF REALISTIC MATHEMATIC EDUCATION MODEL (RME) BASED ON LITERATION AND PROBLEM SOLVING IN MATHEMATICS LEARNING

Dhina Cahya Rohim

FKIP Universitas Muria Kudus, Jl. Lingkar Utara UMK, Gondangmanis, Bae, Kabupaten Kudus, Jawa Tengah 59327, e-mail: dhinacahya@gmail.com

Abstract. This study aims to produce the design of the development of RME model based on literacy and problem solving in fourth grade elementary school mathematics learning. This type of research is research and development. The stages of this research are: (1) preliminary study, (2) development, and (3) testing. Subjects in this study were fourth grade elementary school students in Pati Regency. The preliminary study phase is carried out through literature studies, observations, and interviews in the field. In the development stage, the design of the model is carried out. Then the validation of the learning model expert was carried out. From the expert test results, it was found that the design of the RME model based on literacy and problem solving was valid so that it was feasible to be tested in the field.

Keywords: RME, Literation, Problem Solving

INTRODUCTION

Mathematics is one of the basic sciences that has a very important role in mastering science and technology (Ningsih, 2014: 2). In line with this opinion, Firdaus (2015: 81) states that Mathematics is a universal science that underlies the development of modern technology, has an important role in various disciplines and advances the power of human thought. Indications of the importance of mathematics can be seen from the learning of mathematics as one of the subjects that must be given at every level of education

Anisa (2014: 2) states that mathematics learning if successful, among others, will produce students who have problem-solving skills, communication skills, reasoning abilities, ability to understand and other abilities well and able to utilize mathematical usefulness in life. The National Council of Teachers of Mathematics (NCTM) states that mathematics learning should be carried out in an effort to develop problem solving skills, reasoning and verification, mathematical connections, mathematical communication, and representation (NCTM in Hadi & Radiyatul, 2014: 53). In line with this statement, Fathani (2016: 137) states that the demands of students' abilities in mathematics are not just about having the ability to count, but also about reasoning skills that are logical and critical in problem solving. From this statement, it can be interpreted that problem solving is one of the objectives in mathematics learning.

According to Dahar (in Fadillah, 2009: M.554), problem solving is a human activity that combines concepts and rules that have been obtained previously, and not as a generic skill. Krulik and Rudnick (in Carson, 2007: 7) define problem solving as follows:

> *"the means by which an individual uses previously acquired knowledge, skills, and understanding to satisfy the demands of an unfamiliar situation. The student must synthesize what he or she has learned, and apply it to a new and different situation."*

Based on these quotations, problem solving is a process by which students can use

previously acquired knowledge, skills, and understanding to meet the demands of an unusual condition.

From some of the opinions above, it can be interpreted that problem-solving ability is the ability to be able to use prior knowledge to solve problems in different situations. Problem solving skills are strongly related to students' ability to read and understand the language of story problems, present them in mathematical models, plan calculations from mathematical models, and complete calculations from non-routine questions (Anisa, 2014: 3). Thus, a high level of literary awareness and motivation, skill, and passion are needed.

Suyono (2009: 204) states that other activities that usually accompany the core activities are literacy, such as observing, discussing, and presenting the results which are an extension of the practice of litigation. Activities which are an extension of the practice of liturgy will be needed by almost everyone in the 21st century, in a knowledge-based society and technology in the broadest sense.

To overcome the factors causing low problem-solving ability, especially in elementary schools, it can be done by creating meaningful learning activities, one of which is by applying the Realistic Mathematics Education (RME) learning model.

Realistic Mathematics Education (RME) is a theory of mathematics learning which one of the approaches to learning uses real-world context (Fathurrohman, 2015: 185). RME has long been developed in the Netherlands. RME refers to Freundenhal's opinion which states that mathematics must be associated with reality and mathematics is a human activity meaning that humans are given the opportunity to rediscover mathematical ideas and concepts (Shoimin, 2014: 142).

The philosophy underlying the Realistic Mathematics Education (RME) is that students must develop their mathematical understanding by working from contextual problems. Initially, students design their own methods for working on problems but, by using a set of examples that the teacher carefully and accurately chooses, they then generalize and develop their understanding into a more formal understanding.

But in practice there are still some weaknesses in its application. One of them is that it is not easy for teachers to encourage students to find solutions to mathematical problems. In general, students' motivation to read and understand problems is still lacking. This results in a lack of students' understanding of the problems (story problems) presented.

From these reviews, to improve students' ability to understand problems to be able to solve problems, a Realistic Mathematics Education (RME) learning model based on literacy and problem solving was developed.

Literacy in this case is the habit of carrying out mathematical literacy activities and increasing the ability to understand story problems from reading results. This is in accordance with Fuentes's statement (in Hite, 2009: 59), which says that "need to improve educators 'educators' reading in order to improve their mathematics because it is so much of our math today involves reading". The statement means that every educator must develop students' reading interest to improve their mathematical abilities because at this time more mathematical problems involve reading in the form of story questions (RME) based on literacy and problem solving.

Abidin (2017: 108) describes the components of mathematical literacy activities, including:

1) Communication, both orally and in writing to show how the problem can be resolved.
2) Mathematization is an activity to change problems in a context of the real world or interpret mathematical models into real-world context problems.
3) Representation, for example using media in the form of graphics, diagrams, pictures, or concrete objects to help solve problems.
4) The reasoning is a mathematical literacy activity rooted in the ability to think.
5) Problem solving strategies, namely the ability to choose strategies to solve problems.
6) Use symbol language, to interpret and interpret symbolic expressions in the context of mathematics.
7) Use of mathematical tools, as a help or bridge to solve problems.

In the development of this model will also be presented learning tools in the form of Learning Implementation Plans (RPP), teaching materials, Student Worksheets (LKS), and Problem Solving Test questions that are associated with realistic problems. Teaching materials are inserted several stories

so that it is expected to increase students' reading interest. Through reading habits, students are expected to be able to understand the problems presented in the story problem. This is very important because understanding the problem is the first step in the problem-solving process before students plan their completion techniques.

METHOD

The type of research that will be conducted is research and development. Sources of data in this study include students, teachers and learning model experts. This research and development use several types of techniques for collecting data, namely interviews, questionnaires, observations. The instrument used for collecting data including interview guidelines, questionnaires, and observation sheets.

RESULT AND DISCUSSION

Result

The development of RME models based on literacy and problem solving includes several components including (1) syntax, (2) social systems, (3) reaction principles, (4) supporting facilities, and (5) instructional impacts described as follows.

1. Syntax
   RME learning syntax based on literacy and problem solving is explained as follows.
   a. Phase 1: Student orientation on the problem
      The process of understanding the problem begins with the way the teacher gives a story/picture to bring up the problem. The purpose of this phase is to increase curiosity in finding something and students are more enthusiastic about learning mathematics. Next, the teacher presents several questions related to the story or picture presented and the student answers the question and gives reasons related to the picture/story presented
   b. Phase 2: Organize students to learn
      Activities that can be carried out in this phase include teachers dividing students into groups and distributing student worksheets, tools, and materials used to solve problems. The teacher gives a brief explanation of the instructions for working on the worksheet and the use of the tools/materials provided
   c. Phase 3: Understanding contextual problems
      Activities in this phase students carry out activities such as reading and understanding the contextual problems in the worksheet before working on them. Students write down what is known and asked about the contextual problems provided in the worksheet.
   d. Phase 4: Prepare a completion plan
      Activities in this phase students are guided to use media in the form of drawings/sketches according to the problems provided. Students make modeling from ordinary sentences to mathematical sentences. The teacher guides the discussion by giving guiding questions to direct students to solve problems. Then students develop problem solving strategies.
   e. Phase 5: Resolve contextual problems
      Activities in this phase students solve contextual problems in their own way. Different ways of solving problems for each student are preferred. Students ask questions if there are things that are lacking. The teacher describes students' motivation to solve the problem by giving guiding questions to direct students to solve problems.
   f. Phase 6: Check again
      Students re-examine the answers that have been obtained and write answers from mathematical sentences into ordinary sentences.
   g. Phase 7: Compare and discuss answers
      The activities carried out by the teacher in this phase are to motivate students to interact in their respective groups such as asking questions, expressing opinions, giving explanations to friends so that they can solve problems in the worksheet. Students discuss to compare their answers in each group. One group was assigned to present their work. Students from other groups listen and write if there are important things that have not been understood to ask. Other groups provide responses or questions related to the explanation.
   h. Phase 8: Draw conclusions
      At this stage teachers together with students reflect or evaluate their investigations and the process of solving the problems they are taking or using. This stage helps students to reflect on the knowledge and skills they have acquired, the learning strategies

students use, and students' contributions to group learning. Based on the results of group discussions and class discussions conducted, the teacher directs students to draw conclusions. Students are encouraged to make a summary that includes important things related to the material being studied.

Teacher and student activities in this model in detail are presented in the following table.

Table 1. RME steps based on Literacy and problem solving

Process Components of Mathematical Literacy	RME steps based on Literacy and problem solving
• Communication • Mathematization (from concrete to abstract)	1. Student orientation on problems a. the teacher gives a story/picture to bring up the problem (literacy) b. the teacher presents several questions related to the story or picture presented (communication) c. students answer questions and provide reasons related to the pictures/stories presented (communication) d. The teacher provides explanations and responses to student answers 2. Organize students to learn a. The teacher divides students into groups consisting of 4 students b. The teacher distributes student worksheets, tools and materials used to solve problems c. The teacher gives a brief explanation of the instructions for working on the worksheet and the use of the tools/materials provided 3. Understanding contextual problems a. Students read and understand the contextual problems that exist in the worksheet before working on it (literacy) b. Students write down what is known and asked about the contextual problems provided in the worksheet (Matematization)
• Reasoning • Problem solving strategies • Use of symbol language • Use of mathematical tools (pictures/tables) • Matematization (from abstract to concrete)	4. Prepare a settlement plan a. Students make drawings/sketches according to the problems provided (use of mathematical tools) b. Students make modeling from ordinary sentences to mathematical sentences (symbolic language use) c. The teacher guides the discussion by giving guiding questions to direct students to solve problems d. Students develop problem solving strategies 5. Resolve contextual problems a. Students in groups solve problems according to plans that have been prepared (reasoning) 6. Check again a. Students review the answers that have been obtained b. Students write answers from math sentences to ordinary sentence *(Matematization)*
• Communication	7. Compare and discuss answers a. Students discuss to compare their answers in each group b. The teacher gives an opportunity to one group to present their work (communication) c. Students from other groups listen and write if there are important things that are not understood to be asked (literacy) d. Other groups provide responses or questions related to the explanation (communication)

• Communication	8. Draw conclusions a. Based on the results of class discussions conducted, the teacher gives direction to students to be able to draw conclusions on the material that has been learned (communication)

2. Social System
   The social system of the RME model based on literacy and problem solving is student-centered learning where students play a major role in learning activities in both individual activities and in groups. Natawijaya in Antika (2014: 253) states that active learning is a teaching and learning system that emphasizes students' active physical, intellectual and emotional mentality in order to obtain learning outcomes in the form of a combination of cognitive, affective and psychomotor aspects.
3. Reaction Principle
   The principle of reaction is the principle of management or the teacher's reaction to students. In this model the teacher acts as a mentor and facilitator. In accordance with the statement of Antika (2014: 253) that good learning is student-centered learning where the teacher must be able to carry out his role well that is not only as a teacher, but also as a motivator, facilitator, and innovator. Teachers are not only required to teach in front of the class but also play a role in helping students to solve problems when experiencing difficulties in the learning process.
4. Support System
   The support systems needed to be able to implement this model are Learning Implementation Plans (RPP), Syllabus, teaching materials, and Student Worksheets (LKS). The Learning Implementation Plan (RPP) is prepared as a teacher's guide to implementing learning. Student Worksheets (LKS) are organized as activity sheets containing mathematical problems that are done in groups. Student Worksheet (LKS) functions to guide students in the construction of new knowledge in each meeting. In addition, to support the process of learning mathematics is also provided teaching materials. Instructional Impact
5. Instructional impact
   The instructional impact in question is learning outcomes that are achieved directly by directing students to the expected learning objectives/formulated (Sugiono et al, 2016: 28). Furthermore, Sugiono, et al (2016: 28) stated that the effects of accompaniment are other learning outcomes resulting from a learning process, as a result of the creation of a learning atmosphere experienced directly by students without direct guidance from the teacher. The instructional impact achieved in this study is the achievement of learning objectives. Whereas the accompanying impact is an increase in students' mathematics learning outcomes in terms of problem solving abilities.

Validation Results

Expert validation data is data obtained based on the assessment of the learning model experts through an assessment sheet. The prototype-1 model that has been designed and developed is then validated by an expert team (expert judgment). In this study consisted of three validators namely Dr. Murtono, M.Pd. (A1), Dr. Widiyanto, M.BA., M.M. (A2), and Dr. Suad, M.Pd. (A3). The assessment results from each expert can be seen in the attachment. The following are the results of the appraisal recapitulation from experts presented in table 4.5.

Table 2. Recapitulation of Expert Validation Results on Model Design

No.	Nama Instrumen	Hasil Telaah			Rata – Rata	Kategori
		V1	V2	V3		
1	Model book validation sheet	93	79	98	90	Amat Baik
2	Validation sheet of Learning Implementation Plan (RPP)	97	98	98	98	Amat Baik
3	Syllabus validation sheet	95	98	97	97	Amat Baik
4	Validation sheet for teaching materials	89	100	88	92	Amat Baik

5	LKS validation sheet	92	94	98	95	Amat Baik
6	Problem solving test validation sheet	100	92	92	95	Amat Baik
	Average				94,5	Amat Baik

Note:
V1: Validator 1, V2: Validator 2,
V3: Validator 3

Discussion

The RME model based on literacy and problem solving is the development of the RME model. In the learning process is carried out by implementing literacy activities especially mathematical literacy. Through mathematical literacy activities it is expected to help improve students' mathematical problem solving abilities. This is reinforced by the opinion of Fathani (2016: 137) which states that the demand for students' abilities in mathematics is not just the ability to count, but the ability to reason is logical and critical in problem solving. The solution to this problem is not merely a problem in the form of routine questions but rather the problems faced daily. Such mathematical abilities are known as mathematical literacy abilities.

Through this model, the teacher creates a learning process that involves real-world contexts that can help students improve their ability to solve mathematical problems. In this model, students are trained to develop their mathematical understanding by working from contextual problems. Initially, students are given a problem and then design their own method to solve it.

This is consistent with the concept of constructivism learning in Sumarsih (2009: 55) which states that constructivism is one of the schools of philosophy of knowledge that emphasizes that knowledge is the result of construction (formation). Knowledge is always the result of a cognitive construction from the reality that occurs through one's activities. Thus in the implementation of this model students are asked to be active in learning.

The principle of RME model learning is based on literacy and problem solving similar to the RME principles in learning, namely (1) constructing and concretizing, (2) levels and models, (3) reflection and special assignments, (4) social context and interaction, and (5) structuring and interweaving (Streefland in Shoimin, 2014: 148)

This constructing and concretizing principle states that learning mathematics is a construction activity. This is evident in learning that students find themselves procedures for themselves when solving problems. Levels and models are principles in which learning mathematical concepts or skills is a long and varied process. Reflection and special assignments are principles that state that an assessment of a person is not only based on results but also understands how a person's thinking process. Social context and interaction is the principle that learning is not only an individual activity but something that happens in society and is directly related to the sociocultural context. Therefore in learning, students must be given the opportunity to exchange ideas, argument arguments and so on. Structuring and Interweaving is the principle that learning mathematics does not only consist of absorbing elements of knowledge and elements of unrelated skills but is a structured construction of knowledge and skills. In learning, efforts are made so that there is a connection between one another.

In this literacy-based RME model and problem solving students are trained to be able to solve problems through group activities. Students are trained to work with other students in the group to solve routine questions and non-routine questions (story problems). Besides that, the teacher also familiarizes students in terms of independence. Passive students are trained not only to wait for explanations from their friends but actively to establish communication, express their thoughts to find solutions, express opinions, express ideas so that they can create a work in the student community in learning.

The RME model is based on literacy and problem solving according to the current era because this model stimulates students to be able to think and solve problems according to their own abilities. This is in accordance with the expected human characteristics of the future as stated in Sumarsih's research, (2009: 55) that humans are able to collaborate in solving broad and complex problems for the preservation and glory of their nation, have sensitivity, independence, responsibility for

risk in taking decision, develop all aspects of potential through a continuous learning process to find yourself or the process to learn to be.

CONCLUSION

The design of the development of the RME model based on literacy and problem solving includes several components, namely:

1. Sintak, consisting of 8 phases, namely (1) student orientation to the problem, (2) organizing students to learn, (3) understanding contextual problems, (4) preparing completion plans, (5) solving contextual problems, (6) checking return, (7) compare and discuss answers, and (8) draw conclusions.
2. Social systems, namely student-centered learning where students play a major role in learning activities both individual activities and in groups.
3. The principle of reaction in this model the teacher acts as a mentor and facilitator.
4. The support system in the form of learning devices consisting of RPP, syllabus, LKS, and teaching materials.
5. Instructional and accompanying Dampmak, namely the achievement of learning objectives and improvement of mathematics learning outcomes in terms of problem solving.

ACKNOWLEDGMENTS

Based on the conclusions stated above, the suggestions that need to be considered to improve the quality of learning are that teachers should use the mathematics learning products developed, namely the RME model based on literacy and problem solving as one of the innovative mathematics learning and able to stimulate mathematical problem solving processes.

REFERENCES

Abidin, Yunus dkk. 2017. *Pembelajaran Literasi (Strategi meningkatkan kemampuan literasi matematis, sains, membaca dan menulis).* Jakarta:Bumi Aksara

Anisa, Witri N. 2014. *Peningkatan Kemampuan Pemecahan Masalah Dan Komunikasi Matematik Melalui Pembelajaran Pendidikan Matematika Realistik Untuk Siswa SMP Negeri Di Kabupaten Garut.* Jurnal Pendidikan dan Keguruan Vol. 1 No. 1, 2014, artikel 8

Antika, Reza Rindy. 2014. *Proses Pembelajaran Berbasis Student Centered Learning (Studi Deskriptif di Sekolah Menengah Pertama Islam Baitul 'Izzah, Nganjuk).* Jurnal BioKultur, Vol.III/No.1/Januari-Juni 2014, hal. 251

Carson, Jamim. 2007. *A Problem With Problem Solving: Teaching Thinking Without Teaching Knowledge*. The Mathematics Educator 2007, Vol. 17, No. 2, 7–14

Fadillah, Syarifah. 2009. *Kemampuan Pemecahan Masalah Matematis Dalam Pembelajaran Matematika.* Fakultas MIPA, Universitas Negeri Yogyakarta: Prosiding Seminar Nasional Penelitian, Pendidikan dan Penerapan MIPA

Fathani, Abdul H. 2016. *Pengembangan Literasi Matematika Sekolah Dalam Perspektif Multiple Intelligences.* Edu Sains Volume 4 Nomor 2; 2016 ISSN 2338-4387

Fathurrohman, *Muhammad. 2015. Model – Model Pembelajaran Inovatif*. Jakarta: Ar – Ruzz Media

Firdaus, Fery M. 2015. *Pembelajaran Matematika Realistik untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Siswa Sekolah Dasar.* Jurnal Pedagogik Vol. III, No. 1, Februari 2015

Hadi, Sutarto & Radiyatul. 2014. *Metode Pemecahan Masalah Menurut Polya Untuk Mengembangkan Kemampuan Siswa Dalam Pemecahan Masalah Matematis Di Sekolah Menengah Pertama.* EDU-MAT Jurnal Pendidikan Matematika, Volume 2, Nomor 1, Pebruari 2014, hlm 53 – 61

Hite, Shayne. 2009. *Improving Problem Solving by Improving Reading Skills*. Nebraska: Department of Teaching, Learning, and Teacher Education University of Nebraska-Lincoln

Ningsih, Seri. 2014. Realistic Mathematics Education: *Model Alternatif Pembelajaran Matematika Sekolah.* JPM IAIN Antasari Vol. 01 No. 2 Januari – Juni 2014, h. 73-94

Shoimin, Aris.2014. 68 *Model Pembelajaran Inovatif dalam Kurikulum 2013*. Jakarta: Ar – Ruzz Media

Sugiyono, dkk. 2016. *Validitas Logis Model Pembelajaran Eskalasi Untuk Pembelajaran Fisika di SMA*. Jurnal

Pembelajaran dan Pendidikan Sains, Vol. 1 No. 1 September 2016, hal. 23-30

Sumarsih. 2009. Implementasi Teori Pembelajaran Konstruktivistik dalam Pembelajaran Mata Kuliah Dasar-Dasar Bisnis. Jurnal Pendidikan Akuntansi Indonesia Vol. VIII. No. 1 – Tahun 2009 Hal 54 – 62

Suyono. 2009. *Pembelajaran Efektif Dan Produktif Berbasis LiterasI : Analisis Konteks, Prinsip, dan Wujud Alternatif Strategi Implementasinya di Sekolah*. Jurnal Bahasa dan Seni, Tahun 37, Nomor 2, Agustus 2009