Math Learning with Realistic Mathematics Education Approach (RME) Based On Open Source - Ended to Improve Mathematic Communication

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Article Info	Abstract
	This study aims to determine the feasibility and effectiveness of the application of learning using social arithmetic teaching books by Realistic Mathematics Education (RME) approach based on Open-Ended problem. The research design used in this research is Research and Development with Plomp model. Subjects in this study were students of class VIII SMP Askhabul Kahfi academic year 2017 / 2018. Design implementation is using Posttest Only Control-Group Design. The analysis technique used in the form of analysis of expert validation results and effectiveness test. Post test results on the class performed by the action are compared to the non-action class to ensure, it is done by (1) Complete Test, (2) Different Test, and (3) Simple Linear Regression Test. The results of this study obtained data that (a) the average value of evaluation of classroom communication skills using mathematics learning tools 73.42 ($\mu > 70$) and classical mastery of 76.6% ($\pi > 75\%$); (b) the average rate of classes using the application of mathematics learning tools with RME approach based on open-ended problem (73.42) is greater than the class that does not use the application of mathematics learning tool with RME approach based on open-ended problem (64.57) and (c) from the regression test obtained $t_{count} = 2.012$, t_{count} (2.012) $> t_{table}$ (1.99834). Based on the results of research and discussion, obtained the conclusion that (1) Arithmetic learning devices with RME approach developed valid is used based on the expert judgment. According to the results of small large class test, and (2) Arithmetic learning tools with RME approach developed effectively.

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INTRODUCTION

The fundamental problem faced government is how to improve the quality of education. The quality of education is always associated with the achievement of learning outcomes obtained by students who are identified with the test result score. In addition, the quality of education cannot be separated from the quality teaching process.

Mathematics is one of the subjects that occupy an important role in education. This is because mathematics is used in all areas of human life. Therefore, the mathematics lesson in the implementation of education is given to the level of education ranging from elementary school to university. The quality of mathematics education from 1975 up to now seems not to increase, It can be seen when the other countries that used to be relatively similar to Indonesia, such as Malaysia, Singapore, Philippines, and so on (Marpaung, 2003). In accordance with the fact that the average value of the National Exam of Mathematics SMP Askhabul Kahfi still showed low results.

In fact transfer of knowledge or teaching and learning process conducted by teachers today based on mastery of subject matter and do not pay attention to the meaning or value contained from the subject matter. Especially in the Mathematics at SMP Askhabul Kahfi on material of social arithmetic. Based on the observation of SMP Askhabul Kahfi and Mathematics teachers, some students still have difficulty understanding social arithmetic material.

Learning strategy is expected to swap the usage of learning in conventional model to be activate and creativity of students in a learning process, especially in learning mathematics such as through the approach of RME (Reliance Mathematics Education) (Latifah & Agoestanto, 2015). This learning approach is a new strategy that both invites students to be more active and creative in thinking and communicating ideas in solving a mathematical problem for students (Murniati, et al., 2013). The RME approach can be used at every level of education, so it is easy to

develop according to the conditions (Dickinson, et.al., 2010).

RME with open-ended problem as one of the new approach in mathematics learning, and supports students to contextualize the students' mindset that developed from concrete things to abstract things (Naibaho, 2016). Mathematics learning with RME model with open-ended problem is basically the utilization of reality and environment that is understood by students to expedite the process of mathematics learning so achieved the goal of mathematics education better than the past. The reality is the things that are real or concrete that can be observed and understood students by imagining, while the environment is where the students are (Soedjadi, 2000). Fauzan (2011) stated that RME provides an opportunity for students to act actively in searching the answers for problems encountered and seek to examine, seek and summarize itself logically, critically, analytically and systematically. This will encourage students to improve reasoning and think freely, openly and with pleasure, to deepen their knowledge independently.

Based on data at SMP Askhabul Kahfi some of the mathematics learning materials, social arithmetic material including difficult material. This is evident from the results of the National Examination statistics in SMP Askhabul Kahfi recorded the most error rate reside in the material, which means students are less understanding the concept of the material. Students are easy to do counting problems, but difficult to understand the concept of the material, generally students only memorize the formulas that have been taught. Therefore it is necessary for corrective actions to facilitate students in understanding these concepts by training students to have an understanding of the concept to understand the concepts in mathematics.

According Rahayu (2014), when students learn Math is separate from their daily experience it will easily to forget and can't apply mathematics. Based on the above opinion, mathematics learning in the class is emphasized on the interrelation between mathematical

concepts with the experience of everyday children. In addition, it is necessary to reapply the mathematical concepts that children have in daily life or in other areas. One method of mathematical learning that oriented to the mathematization of everyday experience and applying mathematics in everyday life is RME (Febrian,et al,2013). Mathematics learning basically sharpens the logical thinking of students through improving students' mathematical communication skills. So, RME learning is very suitable to improve students' mathematical communication skills.

Social learning process arithmetic approaching RME, need to be prepared first set of social arithmetic learning theory approaching RME that currently has not been published widely (Saputra, 2010). Therefore, it is necessary to develop a learning model of social arithmetic materials based on open-ended, open-ended methodology to be used in an effort to improve the students' understanding and communication ability in SMP. In addition to improving the understanding of mathematical concepts, problem-based learning can generate creative thinking, make critical decisions, and solve problems appropriately (Padmavathy & Mareesh, 2013). The development of a good learning model begins the development of quality learning devices. Learning tools to be developed include student learning materials in the form of a collection of syllabus, learning implementation plan, and student worksheet. The research will be conducted related to the development of learning tools of mathematics social arithmetic material. The importance of development research is put forward by Jong (2005) who says that development research is needed to improve collaboration between researchers and teachers. Jong further suggests a research method called development that involves repetitive cycle stages through a series of tests and revisions.

Through this research, it is expected that the teaching of social grade arithmetic materials VIII can achieve the development of basic competency indicator and basic competency that has been established and improve students' mathematical communication ability. Ultimately

expected to improve student learning outcomes on mathematical material. This research is a research of mathematics learning development with RME approach based on open-ended problem which is focused to improve students' mathematical communication ability on social arithmetic material.

METHODS

The form of research used in this research is Research and Development (R & D). In this study refers to the model of educational development Plomp, which is a model that is divided into 5 stages. These stages are (1) initial investigation stage, (2) design stage, (3) realization/construction stage, (4) test phase, evaluation and revision, and (5) implementation stage (Hobri, 2009). Subjects in this study were students of class VIII SMP Askhabul Kahfi Lesson Year 2017/2018. Design implentasi using Posttest Only Control-Group Design (Creswell, 2009). Instruments in this study include: (1) assessment instruments/tests of experts and students on developed products; (2) instruments about the test of the mathematical communication ability of social arithmetic material; and (3) observation sheet instrument of planting positive attitude of students.

The technique used in this research is measurement technique in the form of feasibility of learning device, test of math communication ability and positive attitude of student. The analysis used in the form of analysis of expert validation results and effectiveness test. Post test results on the class performed by the action are compared to the non-action class and to ensure it is done by (1) Complete Test, (2) Different Test, and (3) Simple Linear Regression Test.

Complete Test

Comprehension test of value data of class communication ability using application of mathematics learning tool with RME approach based on open-ended problem using hypothesis formulation as follows.

(1) Average Value

H_0 : $\mu \leq 70$ (average grade of classroom communication skills using the application of mathematics learning tools with RME approach based on open-ended problem less than or equal to 70)

H_a : $\mu > 70$ (average value of classroom communication skills using the application of mathematics learning tools with RME approach based on open-ended problem greater than 70)

(2) Classical Exhaustiveness

H_0 : $\pi \leq 75\%$ (classical classical completeness using the application of mathematics learning tool with RME approach based on open-ended problem less than or equal to 75%)

H_a : $\pi > 75\%$ (classical classical completeness using the application of mathematics learning tools with RME approach based on open-ended problem greater than 75%)

Different Test

Different test data value of communication ability using hypothesis formulation as follows.

H_0 : $\mu_1 \leq \mu_2$ (the average of classes using the application of mathematics learning tools with an RME approach based on open-ended problems is less than or equal to a class that does not use the application of mathematics learning tools with an open-ended based RME approach)

H_a : $\mu_1 > \mu_2$ (the mean of classes using the application of mathematics learning tools with an RME approach based on open-ended questions is greater than the class that does not use the application of mathematics learning tools with an open-ended based RME approach)

Regression Test

Regression test is used to show the influence of positive attitude of student to student communication ability. Model of simple linear regression equation as follows.

$\hat{Y} = a + Bx$

$\hat{Y}$ = Dependent variable

a = Constants

b = Coefficient of independent variable

x = Independent variable

The hypothesis to be tested is:

H_0 : There is no influence of students 'positive attitude toward students' mathematical communication skills.

H_a : There is influence of students 'positive attitude toward students' mathematical communication ability.

By testing criteria, if $t_{count} < t_{table}$, then H_a is rejected, but vice versa if $t_{count} > t_{table}$ or $t_{count} = t_{table}$ then H_a accepted.

RESULTS AND DISCUSSION

Expert Validation

Learning Tool (textbook) Arithmetic Social and Comparison that have been prepared, validation test by some experts. There are 3 experts who rate, namely 2 material expert validator and 1 expert media validator. Recapitulation of validation results is presented in Table 1.

Table 1. Expert Validation Results on Textbook

Validator	Score	criteria
Material Validator 1	141	Eligible
Material Validator 2	170	Very Eligible
Material Validator 3	107	Very Eligible

Based on Table 1 it can be seen that the developed textbook is feasible applied to the learning process. Suggestions from assessors or experts on textbooks developed, basically already meet the criteria of writing or preparation of a good textbook. Problems still have fundamental errors, such as the abuse of the term though it has a different meaning, the use of words or the selection of words in a sentence context becomes a reasonable mistake and is often done by other textbook writers. The design presented in the textbook of his hope is the result of his own creativity.

After the textbook is declared eligible to be used, then implemented in the process of learning class VIII. Implementation is done to know the effectiveness of the book on students' mathematical communication ability based on postes value. The data analysis of

communication evaluation test results are presented in Table 2.

Table 2. Recapitulation of Results of Communication Capacity

Class	Number of Students	Number of Students Completed	Number of Uncompleted Students	Average
With Learning Implementation RME	64	47	17	73,43
Without Learning Implementation RME	66	15	51	64.56

In addition to testing the differences in students 'communication skills in the experimental and control classes, observations were also made to the students' positive attitudes in the experimental class at each meeting. Observational data are used to see the extent to which developed textbooks are able to help the application of positive attitudes on students. Observation on student attitudes was done using peer assessment method, where 1 student was assessed by 2 other students. It aims to facilitate the writer to know his attitude and maintain objectivity assessment during learning (Chukwuyenum & Adeleye, 2013). The summary of observation result of students' positive attitude as shown in Table 3.

Table 3. Recapitulation of Positive Attitude Observation Results In the Experimental class

Meeting	Category	Number of students	
		VIII A	VIII B
Meeting 1	Less	-	2 students
	Enough	17 students	10 students
	Good	14 students	19 students
	Very Good	2 students	-
Meeting 2	Less	-	2 students
	Enough	17 students	8 students
	Good	14 students	21 students
	Very Good	2 students	-
Meeting 3	Less	-	2 students
	Enough	14 students	6 students
	Good	17 students	23 students
	Very Good	2 students	-
Meeting 4	Less	-	-
	Enough	10 students	5 students
	Good	21 students	26 students
	Very Good	2 students	-
Meeting 5	Less	-	-
	Enough	2 students	4 students
	Good	29 students	27 students
	Very Good	2 students	-
Meeting 6	Less	-	-
	Enough	2 students	4 students
	Good	29 students	27 students
	Very Good	2 students	-

Completeness Test

Average Value

The average grade hypothesis using the application of mathematics learning tool with RME approach based on open-ended problem as follows.

H_0: $\mu \leq 70$ (average grade of classroom communication skills using the application of mathematics learning tools with RME approach based on open-ended problem less than or equal to 70)

H_a: $\mu > 70$ (average value of classroom communication skills using the application of mathematics learning tools with RME approach based on open-ended problem greater than 70)

Based on Table 2, the class rates using the application of mathematics learning tools with RME approach based on open-ended problem is 73.43 ($\mu > 70$), so H_0 is rejected. It can be concluded that the learning tool of mathematics with RME approach based on open-ended problem has a positive (effective) effect on students' mathematical communication ability.

(2) Classical Exhaustiveness

Classical classical mastery hypothesis using application of mathematics learning tool with RME approach based on open-ended problem as follows.

H_0 : $\pi \leq 75\%$ (classical classical completeness using the application of mathematics learning tool with RME approach based on open-ended problem less than or equal to 75%)

H_a : $\pi > 75\%$ (classical classical completeness using the application of mathematics learning tools with RME approach based on open-ended problem greater than 75%).

Based on Table 2 that students who complete the class using the application of learning tools mathematics with RME approach based on open-ended problem of 47 students, which means classical classical completeness using the application of mathematics learning tool with RME approach based on open-ended problem of 76.6 %. Because classical completeness is greater than 75% ($\pi > 75\%$), it can be concluded that mathematics learning tool with RME approach based on open-ended problem has positive effect on student's mathematical communication ability.

Different Test

Test different data value of communication ability using hypothesis formulation as follows.
$H_0 : \mu_1 \leq \mu_2$ (the average of classes using the application of mathematics learning tools with an RME approach based on open-ended problems is less than or equal to a class that does not use the application of mathematics learning tools with an open-ended based RME approach)
$H_a : \mu_1 > \mu_2$ (the mean of classes using the application of mathematics learning tools with an RME approach based on open-ended questions is greater than the class that does not use the application of mathematics learning tools with an open-ended based RME approach)

Based on Table 2, the mean of classes using the application of mathematics learning tools with RME approach based on open-ended problem is 73.43, whereas the class rate that does not use mathematics learning tool with RME approach based on open-ended problem is 64.56. Because $\mu_1 > \mu_2$, H_0 is rejected and it can be concluded that mathematics learning tool with RME approach based on open-ended problem has a positive (effective) effect on students' mathematical communication ability.

Regression Test

Regression test is used to show the influence of positive attitude of student to students communication ability. This simple linear regression test uses SPSS 17 for windows. The results of linear regression test are presented in Table 4.

Table 4. Simple Linear Regression Test

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (Constant)	53.052	10.197		5.203	.000
Positive attitude	507	.252	.248	2.012	.049

a. Dependent Variable: Communication Capabilities

Before performing hypothesis testing in the research first done simple linear regression analysis to know the functional relationship. The regression equation is $\hat{Y} = 53.052 + 0.507x$. Based on the equation, the regression coefficient of each independent variable is positive, meaning that positive attitude of students has a positive effect on students' mathematical communication ability. Value 53.052, which means if the student's positive attitude is equal to zero (no change), then the student's mathematical communication ability will be equal to 53.052. In accordance Value of 0.507, it means if the student's positive attitude is equal to one, then the student's mathematical communication ability will be equal to 0.507.

The hypothesis to be tested as follows.
H_0 : There is no influence of students 'positive attitude toward students' mathematical communication skills.
H_a : There is influence of students 'positive attitude toward students' mathematical communication ability.

Based on Table 4 it can be seen that $t_{count} = 2.012$. Because $t_{count} > t_{table}$ (1.99834), then H_0 is rejected. So it can be concluded that the positive attitude of students positively affect the ability of students' mathematical communication.

During the use of textbooks, students practice solving contextual problems on Arithmetic and Comparative Arithmetic materials. The problems presented relate to the context that students can easily encounter in everyday life. The use of textbooks through learning with RME approach allows students to find the mathematical concepts contained in each issue presented in the textbook. Indirectly,

students have been practicing in improving their mathematical communication skills (Suyitno & Suyitno, 2015). This has an impact on student achievement on the evaluation test of students' mathematical communication skills at the end of the implementation stage. The result of posttical literacy mathematics shows that the average student has reached the mathematical communication ability with the average value of 73.42. These results show that effective textbooks are used in facilitating the achievement of students' mathematical communication skills. It also shows that such a contextual learning can improve students' mathematical communication skills (Hidayati, et al., 2014).

The effectiveness of textbooks is largely determined by good learning activities and proper use of textbooks. The ability of the mathematics teacher in managing the learning activities become the key of the success of the students using textbooks so that they influence the students achievement in the evaluation of the mathematical communication ability. In addition, teachers have knowledge and skills about mathematics and RME and can apply it in learning mathematics. Teachers are able to facilitate students in thinking, discussing, and negotiating. During the lesson, the teacher accompanies and encourages students to express their ideas and find their own problem-solving strategies. Teachers are also able to manage the class in such a way that encourages students to work together and discuss in order to construct student knowledge. At the end of each lesson, the teacher invites students to summarize facts, concepts, and mathematical principles that have been learned through the process of reflection and confirmation. The ability of teachers to make the learning process using RME approach goes well and the use of textbooks because more effective and had to appropriate goals.

CONCLUSION

Based on the results of research and discussion, obtained the conclusion that (1) Arithmetic learning tools with RME approach developed is valid to used based on the expert judgment. And according to the results of small and large class test, and (2) Arithmetic learning tools with RME approach developed effectively. This is indicated by (a) the average value of evaluation of classroom communication skills using 73. 42 ($\mu > 70$) and 76.6% ($\pi > 75$%) classical completeness; (b) the average rate of classes using the application of mathematics learning tools with RME approach based on open-ended problem (73.42) is greater than the class that does not use the application of mathematics learning tool with RME approach based on open-ended problem (64.57) and (c) from the regression test obtained $t_{count} = 2.012$, t_{count} (2.012)$> t_{table}$ (1.99834).

REFERENCES

Chukwuyenum, AN. & Adeleye BA. 2013. Impact of Peer Assessment on Performance in Mathematics among Senior Secondary School Students in Delta State, Nigeria. *Journal of Emerging Trends in Educational Research and Policy Studies (JETERAPS).* 4(5): 719-725

Creswell, J. 2009. *Research Desaign; Qualitative, Quantitative, and Mix Methods Approaches.* California: SAGA.

Dickinson, P., Eade, F. & Hough, S.. 2010. Using Realistic Mathematics Education with Low to Middle Attaining Pupils in Secondary Schools. *Proceedings of the British Congress for Mathematics Education.* 5(1): 34-46.

Fauzan, A. 2002. *Applying Realistic Mathematics Education (RME) in Teaching Geometry In Indonesian Primary Schools.* ISBN 90-365-18-43-1.

Fauzan, A.2011. Pendidikan Matematika Realistik: Suatu Tantangan dan Harapan. *Jurnal Matematka USD.* 3(2): 10-20.

Febrian, DW., Wardono & Supriyono. 2013. Pembelajaran TGT Melalui Pendekatan PMRI Berbantuan Permainan Tradisional terhadap Kemampuan Berpikir Kreatif. *Unnes Journal of Mathematics Education.* 2(2): 87-95.

Hidayati, I., Asikin, M. & Sugiman. 2014. Keefektifan Model-FSLC Dengan pendekatan Kontekstual Terhadap Kemampuan Komunikasi Matematis Siswa. Unnes Journal of Mathematics Education. 3(2): 87-92.

Hobri. 2009. *Metode Penelitian Pengembangan (Aplikasi Pada Penelitian Pendidikan Matematika).* Jember: FKIP Universitas Jember Press.

Jong, O. 2005. Research and Teaching Practice in Mathematics Education: Living Apart or Together?. *Mathematics Education International*. 6(1): 23-31.

Latifah, NU. & Agoestanto, A. 2015. Keefektifan Model Pembelajaran AIR dengan Pendekatan RME terhadap Kemampuan Komunikasi Matematik Materi Geometri Kelas VII. *Unnes Journal of Mathematics Education*. 4(1): 36-44

Marpaung, Y. 2001. Prospek RME Untuk Pembelajaran Matematika Di Indonesia. *Makalah*, disampaikan pada Seminar Nasional tentang Realistic Mathematic Education Universitas Negeri Surabaya.

Murniati, L.D, Candiasa, I. M & Kirna, I. M.. 2013. Pengembangan Perangkat Pembelajaran Matematika Realistik Untuk Meningkatkan Kemampuan Pemecahan Masalah Siswa SMP. *Jurnal Pendidikan dan Pengajaran*. 46(2): 23-30.

Naibaho, A. J.. 2016. Perbedaan Sikap Positif Dan Kemampuan Berpikir Kreatif Siswa Dengan Menggunakan Pendekatan Pembelajaran Matematika Realistik Dan Pembelajaran Langsung Di Kelas VIII SMP. *Jurnal Ilmiah "DUNIA ILMU"*. 2(1): 28-36.

Padmavathy, R.D. & Mareesh, K.. 2013. Effectiveness of Problem Based Learning In Mathematics. *International Multidisciplinary e-Journal*. 2(1): 13-24.

Rahayu, I, Suyitno, H. & Wardono. 2014. Pembelajaran Matematika Model Double Loop Problem Solving dengan Pendekatan PMRI Bermuatan Karakter Untuk Meningkatkan Kemampuan Pemecahan Masalah. *Unnes Journal of Mathematics Education Research*. 3(1): 62-70.

Saputra, T.A.D. 2010. Pengembangan Perangkat Pembelajaran Matematika Model Quantum Teaching dengan Pendekatan Realistik Berbantuan CD Interaktif untuk Meningkatkan Aktivitas Dan Motivasi Belajar Matematika Siswa kelas VIII. *Jurnal Elektronik Pembelajaran Matematika*. 4(9): 23-30.

Soedjadi, R. 2000. *Kita Pendidikan Matematika di Indonesia (Konstatasi Keadaan Masa Kini Menuju Harapan Masa Depan)*. Jakarta: Direktorat Jenderal Pendidikan Tinggi, Departemen Pendidikan Nasional.

Suyitno, A. & Suyitno, H. 2015. Learning Therapy for Students in Mathematics Communication Correctly Based-On Application of Newman Procedure (a Case of Indonesian Student). *International Journal of Education and Research*. 3(1): 529-538.