THE EFFECTS OF REALISTIC MATHEMATICS EDUCATION ON STUDENTS' MATHEMATICS BELIEF AND PROBLEM SOLVING ABILITY AT FIRST GRADE OF JUNIOR HIGH SCHOOL PEKANBARU

Putri Yuanita
Universitas Riau, Pekanbaru,Indonesia

EffandiZakaria
UniversitiKebangsaan Malaysia, Bangi, Selangor

Abstract

This study is an experimental study that examines the effects of realistic mathematics education approach on mathematics belief and problem solving ability of Junior High School students in Pekanbaru. Using a quasi-experimental pretest-postest non equivalent group design, the study was carried out on 85 first grade students of Junior High School in Pekanbaru. Instruments used in this study were mathematics problem solving test, Mathematics Belief Questionnaire, and open-ended survey about students' perception on realistics mathematics education approach. The data were analyzed by descriptive statistics and inferential statistics using t-test. The components of mathematics belief were divided into belief in the nature of mathematics and belief in teaching and learning mathematics.The instruments to measure students'mathematics problem solving consisted of 10 questions.The results of this study indicated that there were significant differences in problem solving and mathematics belief between the realistics mathematics educations group (experimental group) and the control group. Content analysis of the data revealed that students had positive attitude towards realistics mathematics teaching.

Keywords:*Realistics Mathematics Education, Mathematics Belief, Problem Solving Ability*

Introduction

Education is the principal element in preparing competent students. Education is believed to lead students to think critically, logically, and innovatively to solve every problems that they face. It is also in lined with Sumarmo's (2004) who explains that math education contribute to students behaviors in elaborating reasonable, logical thinking, sistematic, critical and accurate, and behave objectively in confronting problems. Mathematics is a compulsory subject that must be mastered by students since primary school until college. Junior High School plays significant role in strengthening basic competence of mathematics. Related to mathematics role, the mastery of all mathematics matter for Junior High School students must be a priority.

In mathematics learning, knowledge construction, mathematics problems solving, and doing tasks actively are very important to students. These three aspects influenced mathematic's reliance and student's problem solving ability. The mathematics lesson are often considered to be difficult subject by students. Based on the observation result and interview with mathematics teacher at Junior High School in Pekanbaru, many problems were found in learning mathematics, especially in social arithmetic and ratio.Most students were waiting for smart students to answer and didn't want to think for themselves on the

questions while practice. The homeworks given by the teacher were done at school before the lesson started. In addition, students always confused in every question about where they must start to solve the questionbecause students didn't know the step in solving question and they preferred asking their friend rather than their teacher.

Researches have done many studies by applying the model and the approach of innovative learning but not many are focusing on Realistic Mathematics Education (RME) approach. RME approach for mathematics lesson at school are widely known as the best and the most detail and extensively build around problem (Hadi, 2002). This approach developed by*Freudenthal Institute*of the Netherlands in 1971. In Indonesia this learning has been started in 2001 by the name of Pendidikan Matematik Realistik Indonesia (PMRI). This organization has constantly made innovationsin mathematics education to improve the quality of mathematics education and this efforts has progressively improvesthe mathematics education in Indonesia (Sembiring, 2002).

There are five principal characteristics of RME's approach: (1) to utilize student's experience in daily live, (2)to modify reality into model, then to modify model by vertical mathematics process before getting formal form, (3)to engage student's activity, (4)to bring mathematics into student's self needed discussion, question-answer and (5)mathematics learning will be more holistic than partial (Ruseffendi, 2003). With this approach, problemsolving ability is presumed to increase and the students activitiesarecreatedaround their daily life. Freudenthal (1991) asserts that mathematics must relate to reality and human activity. It means mathematics must be relevant with their daily life. Mathematics students must be given a chance to reinvent idea and concept of mathematics which can be inspired by the procedures of informal solution. That efforts were applied by exploring many "realistic"situations and problems. Realistic means not only refer to reality but also the things that can be reflected by students (Slettenhaar, 2000). Realistic mathematics learning in class orient at using contextual problem, model, students' contribution, interactive teaching process, and integrate with other topics (Gravemeijer, 1994; de Lange, 1996). Students have a chance to reinvent mathematics concept or formal mathematics knowledge. Also, students apply the mathematics concept to solve daily problems or problems in other field.Therefore, RME is different with mathematics learning which tends to give information and utilize mathematics that ready to be used in solving problems.

De Corte and Opt Eynde (2002) explain that student's confidence in mathematics can influence the behavior of students in studying mathematics and solving mathematics problems. Confidence is an important element in the cognitiveprocess especially in mathematics learning. Mathematics belief is stable and personal that influence the view of student about mathematics related to mathematic's teaching and learning (Malmivouri, 2001) and another opinion explains that students who have negative belief to mathematics learning will be a passive students and tend to memorize in order to understand the topic (Pehkonen,&Torner 1996). Some research findings show that mathematics is a difficult subject and for only who want to be mathematician or technician (Malmivuouri, 2001) and mathematics needs to learn by memorizing facts and formula, not comprehension (Schoenfeld, 1985). Mason (2003) states that students beliefs that they needs time to get the answer. Believing in mathematics in daily activity and the understanding of math concept are useful for the students' quality of work. The problem solving ability is the students' skill to use the math activity on solving their problem in their daily activity (Soedjadi, 1994). The problem solving ability in math is very important for the students since this can also be applied in the other subjects and in their daily life as well. (Russeffendi, 1991).

The mathematics problem solving ability can be taught to the students in various approaches. Taking a look at how the process of learning or subjects are managed. The approach is a method which is done by lecturer or students in achieving the purpose of learning (Russeffendi, 1991). The importance of mathematics problem solving ability learned by students is also proposed by *National Council of Teachers of Mathematics* (NCTM). NCTM documented that the ability of mathematics problem solving as one of five general goals in mathematics learning.

Based on the above literature, RME is suitable to be applied at Junior High School level in Indonesia. RME is expected to enhance the quality of learning, problem solving ability and mathematics belief. The study was designed to find the effects of Realistics Mathematics Education on mathematics belief and problem solving ability. The specific objectives of this study were:

1. To determine whether there is difference in mathematic problem solving ability between RME compared to traditional learning.
2. To determine whether there is a difference in mathematics belief between RME compared to traditional learning.
3. To determine students' perception about learning with realistics mathematics approach.

Methodology

This study used *quasi-experimentalpretest-postest non equivalent control group design.*The experimental design is explained by using this diagram :

Experimental Group	O	X1	O
Control Group	O	X2	O

Notes :

X1 = Realistic Mathematic Education (RME)
X2 = Traditional Learning
O = The measurement of mathematics Problem Solving Ability.
and Mathematics Belief on before and after learning.

2.1 Sample

The sample of this research consisted of 85 students on class VII-8 and VII-9 Junior High School 21 Pekanbaru. They learnt the Social Arithmetic and Ratio in second semester 2010/2011. Forty-three students (43) are in the experimental group and 42 students on control group.

2.2 Instrumentation

This study used Mathematics Belief Questionnaire (MBQ) (Roslina, 2006). The cronbach alpha of the instrument is 0.78. This questionnaire consists of four dimensions; a) self-confident, b) mathematics belief, c) the belief on math learning, and d) teaching belief. This questionnaire uses Likert scale.The instrument of Mathematics Problem Solving Ability consisted of 10 questions. These questions were the questions on social arithmetic and ratio.

Findings

3.1 Profiles

This study involved 85 students of mathematics education program who took mathematics in Semester II, 2010/2011 (Table 1).

Table 1: The Profile

Group	Frequency	Percent (%)
Experimental	43	50.59
Control	42	49.41
Total	85	100

There were 19 (44.19%) female students and24 (55.81%)male students for the experimental group. There were 20 (47.62%) female students and 22 (52.38%) male students for the control group. Comparison of mathematical problem-solving ability of students is shown in Table2.

Table 2: Comparison of Mean and Standard Deviation of Mathematical Problem SolvingAbility

Group	mean	Standard deviation
Experimental group	77.00	10.37
Control group	71.79	8.36

As shown in Table 2, the mathematics problem solving ability of experimental group is higher than the control group.

Table 3:Mean Score and Standard Deviation of Mathematical Belief

Belief Indicator	Experimental Group		Control Group	
	Mean Score	SD	Mean score	SD
Self Confidence	73.44	7.21.	70.00	8.01
Belief Mathematics	77.90	12.24	74.02	10.15
Belief Learning Mathematics	78.36	13.23	72.00	10.73
Belief Teaching mathematics	76.81	11.16	69.81	9.00

Overall, the experimental group had a much higher score in mathematical belief than the control group.

A. Analysis of RME in Enhancing The Ability of Solving Mathematic's Problem

Table 4. Result of Normality Test of Problem Solving Ability

Group	Kolmogorov- Smirnov		
	Statistic	Df	Sig.
Experimental	0.150	43	0.056
Control	0.126	42	0.09

In table 4, students in experimental group have Kolmogorov-Smirnoz value of 0.150, Sig. = 0.056. Control group has K-S valueof 0.126, Sig. = 0.09. Levene Statistics shows that these two groups are homogen, Sig. 0.212 ($p > 0.05$)

Table 5. ANOVA test for ability problem solving

	Total square	Degree of freedom	Mean square	F	Sig.
Between Groups	1050.221	1	1050.221	7.191	0.009
Within groups	12121.166	83	146.038		
Total	13171.387	84			

Table 5 indicates that there are significant differences ($p<0.05$) of mean score of problem solving mathematics, $F(1,83)= 7.191$, $p = 0.009$, on all two groups. Based on the finding above, it shows that problem solving ability of students using realistics mathematics learning is higher than students who used conventional learning. This finding is supported by Treffer and Streefland who conclude that using realistic mathematics learning are more successful in solving higher problems than students with conventional learning. Lester (1980) states that students' ability in problem solving is better when they solve real problems more frequently. It is in line with one of characteristics of realistics mathematics learning that is using real context as a learning trigger.

B. Analysis of RME regarding Mathematical Belief

C.

Table 6. Result of Normality Test of Mathematics Belief

Belief Components	Group	Kolmogorov- Smirnov		
		Statistic	df	Sig.
Mathematics Belief	Experimental	0.168	43	0.004
	Control.	0.222	42	0.000
Learning Belief	Experimental	0.143	43	0.028
	Control	0.140	42	0.038
Teaching Belief	Experimental	0.169	43	0.003
	Control	0.111	42	200*
Self belief	Experimental	0.118	43	0.144
	Control	0.096	42	200*

All students from the experimental group are distributed normally. Homogenity test using Levene Statistics shows that these two groups are homogen, Sig. 0.181 ($p > 0.05$). Table 7 below shows the result of the *Anova* test for Mathematical belief which is based on experiment group and control group. The result are as follows.

Table 7. ANOVA Test for Mathematics Belief

Belief		Total square	Degree of freedom	Mean square	F	Sig.
Mathematic Belief	Between Groups	320.38	1	320.38	2,53	0.116
	Within groups	10518.60	83	126.73		
	Total	10838.988	84			
Belief in Learning	Between Groups	858.513	1	858.513	5.898	0.017
	Within groups	12081.199	83	145.567		
	Total	12939.712	84			
Teaching in Belief	Between Groups	1040.118	1	1040.118	10.092	0.002
	Within groups	8554.528	83	103.067		
	Total	9594.646	84			
Self Belief	Between Groups	261.701	1	251.701	4.336	0.040
	Within groups	4818.605	83	58.065		
	Total	5070.306	84			

Table 7 indicates that there are significant differences ($p<0.05$) of the mean score of belief in learning, $F(1,83) = 5.898$, $p = 0.017$, teaching belief, $F(1,83)=10.092$, $p=0.002$ and self belief, $F(1,83)= 4.336$, $p = 0.04$, on all two groups. So that, it was found that the students who learnt Mathematics by RME approach was higher than the students who learnt by traditional approach. However, there's no significant differences in mathematics belief between experimental group and control group ($p = 0.116 > 0.05$).

The small increase in mathematics belief as a result of the implementation of realistic mathematics learning is not surprising. Goldin (2002) states that mathematics belief is formed through a long process because it firstly faces emotional stage and attitude before the formation of belief and value. As the result of the RME implementation on this short period of study, it causes the improvement of mathematics belief has not achieved maximally.

Corte, Depaepe, and Vershaffel (2006) also found lack of satisfaction on the achievement of mathematics belief. They conducted a study by implementing problem solving word problems approach. After the lesson was completed, students were asked to fill in belief scale containing statements about students' persistence and view related to the learning process through problem solving word problems approach. They concluded that students' belief about teaching and learning mathematics was not as expected. Therefore, it can be concluded that it's not easy to impove students' mathematics belief.

3. Student perceptions of teaching and learning using RME

Table 8. Percentage of Students' Mathematics Attitude in Elementary Statistics Learning

No	Statement	Total	SS	S	TS	STS
1	I like studying Mathematics.	Total	4	34	5	0
		Percentage	9.3%	79.1%	11.6%	0%
			88.4%		11.6%	
2	I don't like Arithmatics and RatioSubject	Total	0	0	36	7
		Percentage	0%	0%	83.7%	16.3%
			0%		100%	
3	Discussion about Arithmatics and Ratiomaterials are exciting	Total	5	18	15	5
		Percentage	11.6%	41.9%	34.9%	11.6%
			53.5%		46.5%	
4	I have problems in	Total	4	0	8	31

	understanding Arithmetics and Ratio	Percentage	9.30%	0%	18.6%	72.1%
			9.30%		90.7%	
5	I follow the Arithmetics and Ratio learning seriously	Total	20	12	3	8
		Percentage	46.51%	27.91%	6.98%	18.6%
			74.42%		15.58%	
6	Arithmatics and Ratio are useful and related to the other subjects.	Total	15	28	0	0
		Percentage	34.9%	65.1%	0%	0%
			100%		0%	
7	Arithmatics and Ratio are not useful in daily life.	Total	0	13	30	0
		Percentage	0%	30.2%	69.8%	0%
			30.2%		69.8%	
8	I have a lot of difficulties to study through the *RME*	Total	0	5	30	8
		Percentage	0%	11.6%	69.8%	18.6%
			10%		90%	
9	Studying Arithmatics and Ratio with *RME approach* which I recently followed is interesting.	Total	7	36	0	0
		Percentage	16.3%	83.7%	0%	0%
			100%		0%	
10	I prefer to study with teacher domination in explaining the material while I just listen and note it.	Total	9	32	2	0
		Percentage	20.9%	74.4%	4.7%	0%
			95.3%		4.7%	

Overall, students acted positively towards Mathematics and *realistics Mathematics education approach*. This is in accordance with result showed in table 8 above.

Conclusion

Mason (2003) stated that *doing a test of beliefs for students is important,* because he believes that students who are at the low level of belief, will face the negative beliefs. Then, Kloosterman (2002) stated that students' belief in mathematics and learning would affect their comfort and motivation in Mathematics. In order to increase the students' ability in mathematics problem-solving which affects the learning outcomes standard curiculum with minimum Standard of *Kurikulum Tingkat Satuan Pendidikan (KTSP),*innovative learning is needed. One way to reach the goal is by implement of RME learning approach. Further research and study can be done in other fields by monitoring other demography factors, such as students belief based on their backgrounds, their social-economy level, environmental factors, and all of the other factors which are given the contribution in improving problem-solving abilities.

References

Chua Yan Piaw. 2008. AsasStatistikPenyelidikan. Buku 3.Mic.Graw Hill. Malaysia

Corte, E.D., Depaepe, F. dan Verschaffel, L. 2006. Investigating Social and Individual Aspects in Teachers' Approaches to Mathematical Problem Solving. [Online]. Tersedia: http://math.unipa.it/ [2 Maret 2012].

Fauzan, Ahmad .2002. Applying Realistics Mathematics Education in teaching Geometry in Indonesian Primary Schools. *Doctoral Dissertation*. University of Twente Enschede. The Netherlands

Field, Andy & Hole, Graham. 2003. How to Design and Report Experiments. SAGE Publication. London Thousand Oaks. New Delhi.

Garofalo, J. 1989. Beliefs and their influence on mathematical performance.*Mathematics Teacher, 82*, 502–505.

Goldin, G.A. 2002. "Affect, Meta-Affect, and Mathematical Beliefs Structures". *Beliefs: A Hidden Variable in Mathematics Education?* Editor: Leder, G.C., Pehkonen, W., dan Torner, G. London: Kluwer Academics Publisher.

Gravemeijer, K.P.E. 1994. Developing Realistic Mathematics Education. Freudenthal Institute Utrecht. Nederlands

Hadi, Sutarto. 2002. Effective Teacher Profesional development for The Implementation of realistic Mathematics education in Indonesia. DisertasiDoktor. University of Twenty

Kloosterman, P. 2002. Mathematics Teacher Change and Development. In Gilah C. Leder, ErkkiPehkonen& Gunter Torner. 2002. Beliefs: A hidden variable in mathematics education. Dordrecht: Kluwer Academic Publishers.

Mac Leod, D.B. (1992). Research on affect in mathematics education: A reconceptualization, in D.A. Grouws (Ed.), Handbook of Research on mathematics teaching and learning, New York Macmillan, pp. 575-596.

Malmivouri, M. 2001. The dynamics of affect, cognition and social environment in the regulation of personal learning processes: the case of mathematics. *Research Report* Department of Education, University of Helsinki. http://ethesis.helsinki.fi/julkaisut/kas/kasva/vk/malmivouri/ [20Juli 2009]

Mason, L. 2003. High School Students' Beliefs About Maths, Mathematical Problem Solving, and Their Achievement in Maths: A cross-sectional study. Educational Psychology,23(1),73 -85

Op'tEynde, P. & De Corte, E. 2003. Junior high school students' mathematics-related belief systems: their internal structure and external relations. Paper presented at Annual Meeting of the American Educational Research Association, Chicago, April 21-25. Washington, DC: AERA.

Pallant, J. 2001. SPSS Survival Manual : A step by step guide to data analysis using SPSS for Windows (Version 10). Illinois: Allen &Unwin.

Pehkonen, E., &Torner, G.1998. *The state-of-art in mathematics-related belief research: Results of the MAVI activities* (Research Report 195). Helsinki, Finland: Department of Teacher Education, University of Helsinki.*Personal epistemology. The psychology of beliefs about knowledge and knowing* (pp. 297–320). Mahwah, NJ: Lawrence Erlbaum Associates.

Schoenfeld, A.H.1985. Explorations of students' mathematical beliefs and behavior. *Journal for Research in Mathematics Education* 20(4), 338-355.

Sleftenhaar. 2000. "Adapting Realistic Mathematics Education in the Indonesian Context". *Dalam majalah ilmiah Himpunan Mahasiswa Indonesia (Proseding Konperensi Nasional Matematika X ITB, 17-20 Juli 2000 Strefland L. 1991. Realistic Mathematics Education in Primary School.* Freudenthal Institude. Utrecht.

Sembiring, R.K. 2002. Reformasi pendidikan Matematika di Indonesia. *Kompas* (16 September 2002).