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The Differences of Mathematical Problem Solving Ability and Motivation of Learning Mathematics Between Students are Given PBL and RME Model Assisted by Geogebra

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Abstract
The purpose of this research to analyze: (1) the difference of problem solving ability of mathematics between students who are given problem based learning (PBL) model with students who are given realistic mathematics education (RME) assisted by Geogebra, (2) the difference of learning motivation of mathematics between students who are given PBL with students who are given RME assisted by Geogebra. Subjects in this research were students of class XI MIPA II and XI MIPA III at SMAN 18 Medan. The result of the research shows that: (1) there is a difference of mathematical problem solving ability between the students who are given PBL with the students who are given RME assisted by Geogebra; (2) there is a difference of motivation to learn mathematics between the students who are given PBL with the students who are given RME assisted by Geogebra.
Keywords: Problem Based Learning, Realistic Mathematics Education, Geogebra Software, Problem Solving, Motivation of Learning.

1. Introduction

The ability to solve problems in mathematics learning is very important to have students. By solving problems, students will build their own knowledge by linking the concept or principle they already have (Lenchner, 1983). Through problem solving students are required to be able to choose or find appropriate strategies and then apply them to solve problems (Napitupulu & Mansyur, 2011). In other words, when students are trained to solve problems, students are accustomed to digging information, trying to plan, execute completion and end by communicating their ideas (Illingworth, 1996).

If problem solving is a general purpose of learning mathematics, then the motivation becomes very important to have students in order to exert all the ability it has in solving the problem. Sardiman (2014) states that "motivation is the overall driving force within the student that raises the learning activities so that the goals desired by the learning subject can be achieved". This is confirmed by Uno (2016) that "knowledge and understanding of learning motivation in students is very beneficial for teachers to awaken, improve, and nourish the spirit of students to learn to succeed". Because with the provision of positive motivation will add to the spirit of student learning (Schaefer, 2000).

Based on the above description seems to solve problems and motivation to learn are two things that should be achieved by students in learning mathematics in school. However, based on preliminary observations at SMAN 18 Medan, the facts show that students' problem solving and motivation skills are still low. The low ability of problem solving and student learning motivation is seen from the result of diagnostic test in the form of problem-solving test for prerequisite materials and learning motivation scale given to 36 students. The results of the test show: (1) the lack of students 'understanding of the given problem so as not to be able to change the problem into the mathematical model correctly, (2) the lack of students' understanding of the prerequisite concept, (3) the students have not yet been able to relate or interpret the calculation result to in the context of the problem. The result of the motivation scale shows that in the aspect of responsibility, trying to excel, likes challenges, independence, fortitude, and tenacity each get a low score on both positive and negative items.

The low of problem solving ability and motivation to learn the mathematics of students can not be separated from the role of math teachers in managing learning. Student involvement in learning is still minimal, where teachers still use the knowledge transfer system so that the student activity is very passive (Turmudi, 2008). The lack of student activity in mathematics learning is caused by the inappropriateness and lack of variation in the use of learning models by teachers in the classroom (Wahyudin, 1999; Pomalato, 2005; Ersoy, 2016). Therefore, a learning model is needed that involves more student activities and can create a pleasant learning environment, thereby developing students' problem solving skills and motivation to learn mathematics (Frederiksen, 1984; Napitupulu, 2011; Jariswandana, et al, 2012; Islim & Karatas, 2016). Among them are problem-based learning model (PBL) and realistic mathematics education model (RME).

PBL and RME are student-centered and teacher-centered learning as facilitators, using real-world problems as a context for students to learn to think critically and acquire knowledge and concepts that are essentially from the subject matter (Chakrabarty, et al, 2013; Fahrudin, 2017). Contextual issues provided aim to motivate students, arouse students' learning arousal, and improve student learning activities (Kolmos, et al, 2007). One of the teacher's efforts to involve active students in PBL and RME by utilizing instructional media. Asra & Sumiati (2013) stated that "learning media is everything that can be used to channel the message, stimulate the thoughts, feelings, attention and willingness of students so as to encourage the learning process".Math learning media that can be used is Geogebra software. Hohenwarter & Fuchs (2004) states that teachers can utilize the use of Geogebra software to demonstrate and visualize certain mathematical concepts and as a tool for students to find a mathematical concept.

Based on the problems that have been described above, the purpose of this research are: (1) to analyze the difference of mathematical problem solving ability between the students taught by PBL with students taught by RME assisted by Geogebra software, (2) to analyze the difference of motivation to learn mathematics between students taught with software-assisted PBL with students taught by RME assisted by Geogebra software.

2. Literature

2.1. Problem Solving Ability of Mathematics

The problems encountered in everyday life are not all that can be said to be a problem. Clement & Ramirez (2008) states "the problem is unstructured that can not be solved directly by applying a particular formula or strategy, but needs more information to understand and need to combine several strategies or even create one's own strategies to solve them." While the problem in mathematics is said when a student can not immediately find a solution, but students need to reason, guess or predict, look for a simple formula and prove it (Van De Walle, 2008). The process of how to solve this problem is called the process of solving the problem (Polya, 1973).

Joyce, et al (2009) states "problem solving is done by the students themselves where this phase can be facilitated by providing a unit of problem that can be solved, especially when the teacher knows that the student has obtained the rules needed to solve the problem". The steps of problem solving according to Polya (1973) is to understand the problem, plan the settlement, solve the problem according to plan, and re-examine.

Based on the above description, it can be concluded that the indicators of problem solving abilities in this study are: (1) understanding the problem, (2) plan the solution, (3) solve the problem, and (4) interpret the results.

2.2. Motivation of Learning Mathematics

Motivation comes from the word "motive" which is defined as the effort that forces someone to do something. Similarly Sardiman (2014) states "motive is the driving force from within and within the subject to perform certain activities to achieve a goal". Mc. Donald (in Hamalik, 2010) states "motivation is a change of energy in a person characterized by the appearance of feeling". For a student, learning motivation generally arises because of the stimulation that comes from within himself and from outside himself (Dimyati & Mudjiono, 2013).

Uno (2016) states that the indicators of learning motivation can be classified as follows: (1) the desire and desire succeed, (2) the encouragement and the need to learn, (3) the expectation and future aspirations, (4) learning, (5) the existence of interesting activities in learning and (6) the existence of a conducive learning environment. Asra & Sumiati (2013) suggests factors that influence students' motivation to learn, (1) interest in subjects, (2) perception of learning benefits, (3) willingness to perform, (4) confidence and (5) patience and persistence in learning.

From the above description it can be concluded that the motivation to learn mathematics in this research is based on: (1) responsibility, (2) tenacity, (3) independence, (4) like challenge, (5) fortitude, (6) and (7) curiosity.

2.3. Problem Based Learning Model

According to Arends (2012) the problem-based learning model is a learning model in which students work on authentic issues with the intent to structure their own knowledge, develop inquiry and higher-order thinking, develop self-reliance and self-confidence.The selection or determination of this real problem can be done by teachers and students who are adapted to certain basic competencies (Amir, 2009). The problem is open, that is, the problem that has many answers or settlement strategies (Ceker, et al, 2016). The problem is also unstructured that can not be solved directly by applying a specific formula or strategy (Clement & Ramirez, 2008).

Based on the above description, in this study, problem-based learning is based on five main steps, namely: (1) orientate students to the problem, (2) organize students to learn, (3) guide individual and group investigation, (4) develop and present the work and (5) analyze and evaluate the problem-solving process.

2.4. Realistic Mathematics Education Model

Realistic mathematics education was first introduced by mathematicians from Utrecht University Netherlands, Prof. Hans Freudenthal in 1973. The word "realistic" is derived from the classification proposed by Treffers

(1991) which distinguishes four learning approaches in mathematics namely mechanistic, empiristic, structuralist, and realistic. Van den Heuvel - Panhuizen (2003) argues that the use of the word "realistic" comes from the Dutch zichrealiseren meaning to imagine. This understanding of the real world is influenced by students' mathematical ability (de Lange, 1987). There are two types of mathematization formulated by Treffers (1991), namely horizontal mathematization and vertical mathematization. The process of horizontal mathematization moves from the real world to the world of symbols. This process involves an informal process that the students do in solving a problem. Vertical mathematization is the process of re-organization of acquired knowledge into more abstract mathematical symbols.

Gravemeijer (1994) suggests three principles in the RME, namely: (1) rediscovering, where students are given equal opportunities to build and rediscover mathematical ideas and concepts; (2) Didactic phenomena, in which problems are conveyed to students derived from the phenomenon of everyday life, (3) the development of its own model, which serves as a "bridge" between informal knowledge (model of) and formal mathematics (model for). Gravemeijer also suggests five characteristics that are the operationalization of RME principles: (1) using contextual problems, (2) using models, (3) using student contributions, (4) interactivity, and (5) related to other topics.

Based on all the above descriptions, the research is realistic learning of mathematics is learning by referring to four main steps: (1) understanding the contextual problem, (2) solving contextual problems, (3) comparing or discussing answers, and (4) conclude.

2.5. Media of Geogebra Software

The word "media" comes from the Latin medius which literally means "middle", "introduction" or "intermediary". If the media carries instructional messages or information aimed at instructionally or contains instructional purposes, the media is called learning media (Arsyad, 2013).In mathematics learning, computer-based media greatly helps students in bridging the real world and mathematical abilities (Van De Walle, 2008). One of the abstract mathematical material is geometry. Rusman (2012) stated that the computer-based learning media used in the learning process of mathematics is the existing mathematical software. One of them Geogebra software.

Hohenwarter, et al (2008) states that Geogebra is a dynamic software that combines geometry, algebra and calculus. Geogebra is able to construct dots, vectors, segments, lines, conic sections, even functions and dynamically alter them. Hohenwarter & Fuchs (2004) suggests three benefits of Geogebra software as a media of mathematics learning with the following activities: (1) as a media of demonstration and visualization; (2) as a construction tool; and (3) as a tool of the discovery process. In this study used Geogebra software version 5.0.311.0 and work on two-dimensional field.

3. Research Methods

This research uses quantitative research approach with experimental method in the form of quasi experiment. The population in this study were all students of class XI SMA Negeri 18 Medan consisting of 4 parallel classes with total students 144 students. The sample in this research is the students of class XI MIPA II and XI MIPA III with total of 71 students.

The instruments used in this research are test and non-test. The test type instrument involves initial capability test and problem solving postes compiled in the form of each description of 4 questions, whereas the non-test type instrument is a mathematics learning motivation scale of 40 items of statement in multiple choice form where each item contains five alternative answers according to Likert scale. The statistical analysis used was covariance analysis (ANACOVA) in which the students' initial ability as the accompanying variable. The research design is illustrated in Table 1 below:

Table 1. Research Design

Class	Initial Ability Test	Treatment	Postest / Motivation of Learning Scale
Experiment I	A_1	X_1	A_2
Experiment II	A_1	X_2	A_2

Explanations: X_1 : Treatment with PBL model assisted by Geogebra software
X_2 : Treatment with RME model assisted by Geogebra software

4. Result

4.1 Research Results Problem Solving Abilities of Mathematics

The data of initial and posttest test results have met the normality test, homogeneity test, linear regression model, independence test, linearity test of regression model, equality test of two regression models and equilibrium test of two regression models. Therefore ANACOVA can be used to test the difference of mathematical problem solving ability with SPSS 20.0 program, which can be seen in Table 2 below:

Table 2. Tests of Between-Subjects Effects

Dependent Variable: *Postest*

Source	Type II Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1199,115[a]	2	599,558	28,908	,000
Intercept	27483,125	1	27483,125	1325,125	,000
Class	277,910	1	277,910	13,400	,000
Initial Ability	1015,222	1	1015,222	48,950	,000
Error	1410,321	68	20,740		
Total	144769,000	71			
Corrected Total	2609,437	70			

a. R Squared = ,460 (Adjusted R Squared = ,444)

Based on the results of the analysis of covariance for the class obtained F_{count} = 13,400>F_{table} = 3,980 and with sig = 0,000. Because the sig level is less than 0,05, so Ha is accepted. So it can be concluded there are differences in the ability of problem solving mathematically between students who are given problem-based learning aid Geogebra with students who are given realistic mathematical learning assisted Geogebra.

Furthermore, if seen from corrected model value, obtained value F_{count} = 28,908 and valueF_{table} = 3,980 with sig. (0,000) <α = 0,05, it can be concluded that the initial ability and the learning model simultaneously affect the students' mathematical problem solving abilities.

Furthermore, further test with t-test using SPSS 20.0 program which the result is shown in Table 3 below:

Table 3. Parameter Estimates

Dependent Variable: *Postest*

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	36,303	1,241	29,250	,000	33,826	38,779
[Class=I]	3,977	1,086	3,661	,000	1,809	6,145
[Class=II]	0[a]					
Initial Ability	,386	,055	6,996	,000	,276	,497

a. This parameter is set to zero because it is redundant.

Based on Table 3 above, it can be seen that for class I the value of sig. (0,000) < α = 0.05 thus H_0 is rejected. This means that there is an average difference in mathematical problem solving ability between students who are given PBL with the students who are given RME assisted by Geogebra.

The regression model that has been obtained for the previous mathematical problem solving ability for the PBL class assisted by Geogebra is Y_{E1} = 41,65 + 0.30 X_{E1} and the equation for the RME class assisted by Geogebra is Y_{E2} = 34,74 + 0.47 Y_{E2}.. Because both regression for both homogeneous class and constant equation of linear regression line for mathematical problem-solving ability of PBL class assisted by Geogebra that is 41,65 is more than equation of constant equation of linear regression line of RME class assisted by Geogebra that is 34,74. Hence geometrically regression line for the PBL class assisted by Geogebra is above the regression line of the RME class assisted by Geogebra.

This indicates that there are significant differences and hypotheses above the difference in altitude of the two regression lines that are influenced by regression constants. The regression line height describes the student's learning result, that is when X = 0, the regression equation for solving the mathematical problem of PBL class assisted by Geogebra is obtained Y = 41.65 and the regression equation of RME class assisted by Geogebra obtained Y = 34,74. Means it can be concluded that there is a significant difference in mathematical problem solving ability between students who are given PBL with students who are given RME assisted by Geogebra. In this case the mathematical problem-solving ability of students who are given PBL assisted by Geogebra better than the students who were given RME assisted by Geogebra.

4.2 Research ResultMotivation of Learning Mathematics

Data of motivation scale of learning mathematics have fulfilled normality test, homogeneity test, linear regression model, independence test, linearity regression model test, equality test of two regression model and alignment test of two regression models. Therefore ANACOVA can be used to test the difference of motivation to learn mathematics with the help of SPSS 20.0 program which can be seen in Table 4 below:

Table 4. Tests of Between-Subjects Effects

Dependent Variable: Motivation of Learning Scale

Source	Type II Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	11709,734[a]	2	5854,867	41,993	,000
Intercept	304715,801	1	304715,801	2185,527	,000
Class	607,752	1	607,752	4,359	,041
Initial Ability Test	11513,114	1	11513,114	82,576	,000
Error	9480,857	68	139,424		
Total	1615692,000	71			
Corrected Total	21190,592	70			

a. R Squared = ,553 (Adjusted R Squared = ,539)

Based on the results of covariance analysis for the class obtained $F_{count} > F_{table}$ (4,359 > 3,980) and with sig = 0,041. Because the sig level is less than 0,05, then Ha is accepted. So it can be concluded there are differences in the scale of motivation to learn mathematics between students are given PBL with students are given RME assisted by Geogebra.

Furthermore, if viewed from corrected model value, obtained value F_{count} = 41,993 and value F_{table} = 3,980 with sig. (0,000) < α = 0,05. It can be concluded that the initial ability and the learning model simultaneously affect the motivation of learning mathematics students.

Furthermore, further test with t-test using SPSS 20.0 program which the result is shown in Table 5 below:

Table 5. Parameter Estimates

Dependent Variable: Motivation of Learning Scale

Parameter	B	Std. Error	T	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	125,234	3,218	38,917	,000	118,812	131,655
[Class=1]	5,881	2,817	2,088	,041	,260	11,503
[Class=2]	0[a]					
Initial Ability Test	1,301	,143	9,087	,000	1,015	1,587

a. This parameter is set to zero because it is redundant.

Based on Table 5 above, it can be seen that for class I the value of sig. (0,041) < α = 0,05 thus H0 is rejected. This means that there is an average difference in the scale of motivation of learning mathematics between students are given PBL with students are given RME assisted by Geogebra.

The regression model that has been obtained for the previous mathematics learning motivation scale for the PBL class assisted by Geogebra is = 133,03 + 1,18 and the equation for RME class assisted by Geogebra is = 123,05 + 1,43. Further calculation because both regression for both homogeneous class and constant of equation of linear regression line for learning motivation scale of mathematics in PBL class assisted by Geogebra that is 133,03 more than equation of constant of equation of linear regression line of RME class assisted by Geogebra that is 123,05. Geometrically line the regression for the PBL class lies above the regression line of the RME class assisted by Geogebra.

This indicates that there are significant differences and hypotheses above the difference in altitude of the two regression lines that are influenced by regression constants. The regression line height describes the student's learning result, that is when X = 0, the regression equation for solving the mathematical problem of PBL class assisted by Geogebra is obtained Y = 133,03 and the regression equation of RME class assisted by Geogebra obtained Y = 123,05. It can be concluded that there is a significant difference in motivation of learning mathematics between students who are given PBL class with students are given RME class assisted by Geogebra on linear program material. In this case the motivation to learn mathematics students are given PBL assisted by Geogebra better than the motivation to learn mathematics students are given RME assisted by Geogebra.

5. Discussion

Based on the results of research and statistical tests showed that there is a significant difference in mathematical problem solving ability between students who received problem based learning (PBL) with Geogebra software with students who received realistic mathematics education (RME) with Geogebra software and there were also significant differences in learning motivation mathematics between students who received PBL assisted by Geogebra with students who received RME assisted by Geogebra.

Ability of problem solving and motivation to learn mathematics of students who get PBL assisted by Geogebra better than students who got RME assisted by Geogebra. This is evident from the position of the regression line of each learning model, where the regression line for the PBL model assisted by Geogebra is above the regression line for the RME model assisted by Geogebra. This advantage is because the PBL model has different characteristics significantly different when compared with the characteristics of RME model in its use for high school students especially class XI. The significant characteristic difference lies in the intellectual development of Piaget, where the class XI (age > 12 years old). In general, can already think abstractly (Aqeel, 2013). While the RME model in its use is highly emphasized for students who have not been able to think abstractly / formally (Uzel, 2006). While the model of PBL in its use is very stressed for students who can already think in the abstract.

PBL and RME are essentially constructivist learning where students are given the opportunity to build their own mathematical knowledge so as to reinvent mathematical ideas and concepts through the exploration of problems in real contexts. The problem given to the RME should be a simple problem identified by the student and can't solve it by applying the formula or the theorem directly, but must use "model of" and "model for" (Gravemeijer, 1994), while the PBL problem is not structured and open-minded and can apply formulas directly according to the level of intellectual development of students (Padmavathy, 2013).

In PBL and RME teachers only act as facilitators but always monitor the development of student interactivity and encourage students to achieve the targets to be achieved. Interactivity of students in these two lessons can be either negotiation, explanation, justification, approval, question or reflection through small group discussions. Student interactivity at RME is used to achieve a form of formal mathematical knowledge of informal mathematical knowledge forms that students themselves find themselves, whereas PBL is used to perform authentic investigations to solve a given problem. In practice, PBL and RME can use a holistic approach in which learning topics can be linked and integrated across disciplines so that an integrated concept or operation is developed.

If we note the main difference characteristics of the two lessons, then no wonder the occurrence of such differences. Theoretically PBL has certain advantages when compared with RME when applied to class XI students where if these advantages are maximized in the implementation in the classroom enables the learning process to be better.

6. Conclussion

Based on the results of data analysis and discussion in this study, presented several conclusions as follows:

1) There is a difference of problem solving ability of mathematics between students who are given problem based learning (PBL) assisted by Geogebra software with students who are given realistic mathematics education (RME) assisted by Geogebra software. It can be seen from the constant of regression line equation for PBL assisted by Geogebra software is 41,65 more than RME assisted by Geogebra software that is 34,74. Which resulted geometrically regression line for PBL assisted by Geogebra software is above the regression line of RME assisted by Geogebra software.
2) There is a difference of motivation to learn math between students are given problem based learning (PBL) with students are given realistic mathematics education (RME) assisted by Geogebra software. It can be seen from the constant of regression line equation for PBL assisted by Geogebra software is 105,35 more than RME assisted by Geogebra software that is 91,92. Which resulted geometrically regression line for software-assisted PBL Geogebra is above the regression line assisted by Geogebra software.

References

Amir, M. T. (2009). *Inovasi Pendidikan Melalui Problem Based Learning. Bagaimana Pendidik Memberdayakan Pemelajar di Era Pengetahuan*. Jakarta : Kencana Prenada Media Group.

Aqeel, A. (2013). Piaget's Theory of Learning. *Interdisciplinary Journal of Contemporary Research In Businnes Vol. 4 No. 9*, Januari 2013.

Arends, R. I. (2012). *Learning to Teach ninth edition.* New York : McGraw – Hill.

Arsyad, A. (2013). *Media Pembelajaran(Edisi Revisi)*. Jakarta : PT Rajagrafindo Persada.

Asra & Sumiati. (2013). *Metode Pembelajaran*. Bandung : CV Wacana Prima.

Ceker, E., *et al*. (2016). Features and characteristics of problem based learning. *Cypriot Journal of Educational Sciences Volume 11, Issue 4, (2016) 195-202.*

Chakrabarty, *et al*. (2013). Problem Based Learning : Cultural Diverse Students Engagement, Learning, and Contextualized Problem Solving in a Mathematics Class. *Wcik e – Journal of Integration Knowledge 2013.*

Clement, J. J., Ramirez, M. A. R. (2008). *Models Based Learning and Instruction in Science*. New York : Springer.

de Lange, J. (1987). *Mathematics Insight and Meaning.* Ultrecht:OW&OC.

Dimyati & Mudjiono. (2013). *Belajar & Pembelajaran*. Jakarta : Rineka Cipta.

Ersoy, E. (2016). Problem Solving and Its Teaching in Mathematics. *The Online Journal of New Horizons in Education Volume 6, Issue 2 April 2016.*

Fahrudin. (2017).Effect of Realistic Mathematics Education (RME) Approach and Initial Ability of Students to the Problem Solving Ability of Class 4^{th} Student. *American Journal of Educational Research, 2017, Vol. 5, No. 3, 246-250.*

Frederiksen, N. (1984). Implications of Cognitive Theory for Instruction in Problem Solving. *Review of Educational Research Fall, 1984, Vol. 54, No. 3, Pp. 363 – 407*.
Gravemeijer, K. (1994). *Developing Realistic Mathematics Education.* Utrecht : Freudenthal Institute.
Hamalik, O. (2010). *Proses Belajar Mengajar*. Jakarta : Bumi Aksara.
Hohenwarter, M. & Fuchs, K. (2004). *Combination of Dynamic Geometry, Algebra, andCalculus in the Software System Geogebra*.[Online] Tersedia www.geogebra.org/publications/pecs_2004.pdf.
Hohenwarter, M., *et al*. (2008). *Teaching and Learning Calculus with Free DynamicMatematics Software GeoGebra*. [Online] Tersedia http : // www.*publications.uni.lu/record/2718/files/ICME11-TSG16.pdf.*
Islim, O. F., Karatas, S. (2016). Using The Scamper Technique In An Ict Course To Enhance Creative Problem Solving Skills : An Experimental Study. *The Turkish Online Journal of Educational Technology Special Issue for INTE 2016,*
Illingwoth, M. (1996). *Real Life Math Problem Solving.* Sidney Wright.
Jariswandana, *dkk*. (2012). Meningkatkan Motivasi Belajar Matematika Siswa Dengan Penerapan Model Pembelajaran Kooperatif Tipe Think Talk Write. *Jurnal Pendidikan Matematika Hal. 81-86 Vol. 1 No. 1*, *2012*.
Joice, B., *dkk*. (2009). *Model – Model Pengajaran.* Edisi Delapan. Yogyakarta : Pustaka Pelajar.
Kolmos, *et al*. (2007). Problem-Based Learning. *Teaching and Research in Engineering in Europe* (TREE). [Online]. Tersedia http://www.unifi.it/tree/dl/oc/b5.pdf
Lenchner, G. (1983). *Creative Problem Solving in School Mathematics*. New York : Glenwood Publication Inc.
Napitupulu, E. E & Mansyur, A. (2011). Kemampuan Pemecahan Masalah Matematika Siswa (Studi Kasus di SMA Negeri Parongpong KabupatenBandung Barat). *Jurnal Generasi Kampus Vol. 4 No. 1*, ISSN 1978-869X, April2011.
Napitupulu, E.E. (2011). *Pengaruh Pembelajaran Berbasis Masalah Atas Kemampuan Penalaran dan Pemecahan Masalah Matematis Serta Sikap Terhadap Matematika Siswa Sekolah Menengah Atas.* Disertasi pada SPS UPI Bandung. Tidak Diterbitkan.
Padmavathy, R. D., Maressh, K. (2013). Effectiveness of Problem Based Learning In Mathematics. *International Multidisciplinary e-journal vol II issue 1 jan 2013*, ISSN 2277 - 4262.
Polya, G. (1973). *How to Solve it. A New Aspect of Mathematical Method.* Princeton, NJ : Princeton University Press.
Pomalato,S.W.Dj. (2005). *Pengaruh Penerapan Model Treffinger dalam Mengembangkan Kemampuan Kreatif dan Pemecahan Masalah Matematika Siswa Kelas 2 Sekolah Menengah Pertama*. Disertasi pada PPS UPI. Tidak diterbitkan.
Rusman. (2012). *Model – Model Pembelajaran. Mengembangkan Profesionalisme Guru.* Edisi Kedua. Jakarta : PT Rajagrafindo Persada.
Sardiman, A.M. (2014). *Interaksi & Motivasi Belajar Mengajar*. Jakarta : Rajawali Pers.
Schaefer. (2000). *Rewards and Motivation.* USA: Irwin-McGraw Hill.
Treffers, A. (1991). Didactical background of a mathematics program for primary education. In L. Streefland (Eds.), *Realistic mathematics education in primary school*. (pp. 21-57). Utrecht : CD Beta Press.
Turmudi. (2008). *Landasan Filsafat dan Teori Pembelajaran Matematika*. Jakarta: Leuser Cita Pustaka.
Uno, H. B. (2016). *Teori Motivasi & Pengukurannya*. Jakarta : Bumi Aksara.
Uzel, D., Uyangor, S. M. (2006). Attitudes of 7th Class Student Toward Mathematics in Realistic Mathematics Education. *International Mathematical Forum, 1, 2006, no. 39, pp. 1951-1959*.
Van den Heuvel - Panhuizen, M. (2003). The Didactical Use of Models in Realistic Mathematics Education : an Example from a Longitudinal Trajectory on Percentage. *Educational Studies*. Netherlands : Kluwe Academic Publishers.
Van de Walle, J. A. (2008). *Matematika Sekolah Dasar dan Menengah. Pengembangan Pengajaran. Jilid 1. Edisi Keenam.* Jakarta : Erlangga.
Wahyudin, (1999). *Kemampuan Guru Matematika, Calon Guru Matematika, dan Siswa dalam Mata Pelajaran Matematika*. Disertasi pada FPS IKIP Bandung:Tidak diterbitkan.