

INCREASED CAPACITY OF THE UNDERSTANDING OF THE CONCEPT AND THE ABILITY TO SOLVE PROBLEMS THROUGH THE IMPLEMENTATION OF THE MODEL OF TEACHING MATHEMATICS REALISTIC BASED ON COGNITIVE CONFLICT STUDENTS

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Abstract

This research aims at: 1) the influence of the implementation of the model of teaching mathematics realistic based on cognitive conflict students to the ability to understanding the concept and troubleshooting capabilities; 2) determine the larger capacity of the understanding of the concept through the implementation of the model of teaching mathematics realistic based on cognitive conflict junior secondary school students the City of Bengkulu. 3) determine the great improvement of the ability to solve problems through the implementation of the model of teaching mathematics realistic based on cognitive conflict SMP students Bengkulu City. To achieve the goal of this research is to apply Research Design pseudo experiments with research design *Pretest-Posttest Nonequivalent Control Group Design*, with the test instrument the ability to understanding the concept and test the troubleshooting capabilities. The data has been analyzed using the test gains. The results of this research is 1) the ability of understanding the concept and troubleshooting class experiment the given learning with PMR is better than with the ability to understanding the concept and troubleshooting control classes assigned to conventional mathematics lesson; 2) increase the ability of the understanding of the concept through the implementation of the model of teaching mathematics based on cognitive conflict SMP students Bengkulu City is significant with the index gain of 0,755 (high-level); 3) increase the ability to solve problems through the implementation of the model of teaching mathematics based on cognitive conflict SMP students Bengkulu City is significant with the index gain of 0,500 level (is).

Keywords: model of teaching, conceptual understanding, troubleshooting, cognitive conflict

Abstrak

Penelitian ini bertujuan: 1) Pengaruh Penerapan Model Pembelajaran Matematika Realistik Berdasarkan Konflik Kognitif Siswa terhadap Kemampuan Pemahaman Konsep dan Kemampuan Pemecahan Masalah; 2) menentukan besar peningkatan kemampuan pemahaman konsep melalui penerapan model pembelajaran matematika realistik berdasarkan konflik kognitif siswa SMP Kota Bengkulu. 3) menentukan besar peningkatan kemampuan pemecahan masalah melalui penerapan model pembelajaran matematika realistik berdasarkan konflik kognitif siswa SMP Kota Bengkulu. Untuk mencapai tujuan penelitian ini menerapkan Desain Penelitian eksperimen semu dengan desain penelitian *Pretest-Posttest Nonequivalent Control Group Design*, dengan instrumen tes kemampuan pemahaman konsep dan tes kemampuan pemecahan masalah. Data dianalisis dengan menggunakan uji-gain. Hasil penelitian ini adalah 1) Kemampuan pemahaman konsep dan pemecahan masalah kelas eksperimen yang diberi pembelajaran dengan PMR adalah lebih baik dibandingkan dengan kemampuan pemahaman konsep dan pemecahan masalah kelas kontrol yang diberi pembelajaran matematika konvensional; 2) peningkatan kemampuan pemahaman konsep melalui

penerapan model pembelajaran matematika berdasarkan konflik kognitif siswa SMP Kota Bengkulu adalah signifikan dengan indeks gain sebesar 0,755 (level tinggi); 3) peningkatan kemampuan pemecahan masalah melalui penerapan model pembelajaran matematika berdasarkan konflik kognitif siswa SMP Kota Bengkulu adalah signifikan dengan indeks gain sebesar 0,500 (level sedang).

Kata Kunci: Model Pembelajaran, Pemahaman Konsep, Pemecahan Masalah, Konflik Kognitif

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INTRODUCTION

Various government efforts, school principals and teachers in improving the quality of mathematics teaching is continuing. But the fact that found in schools, learning materials Mathematics SMP is still not meaningful for students. This is as a result of the learning process where the SMP mathematics materials delivered very theoretic and the students are learning in mekanistik (Wahyu Widada, 2005). The students that will be experiencing cognitive conflict between the conception that he had with the strukturalistik mathematics materials and very theoretic.

The difference is too far between the conception of students called from the long term memory and the concept of/principles of mathematics received in working memory students, resulting in imbalance in this leads to cognitive conflict for students in mathematics teaching. In addition, as part of the effort to accelerate the change in the understanding of the concept on the students then diterapkan a strategy that can cause an imbalance in (*disequilibrium*) in the mind of the students or cognitive conflict (Al-Arief, 2012). According to Asdar (2012) that cognitive conflict is a condition of awareness of the individual who is experiencing the imbalance.

Based on the initial survey conducted researchers against the students SMP N 3 and Junior Secondary School Students N 18 Bengkulu City, obtained cognitive conflicts students in mathematics teaching. Cognitive conflict between the students is as follows.

- 1) How $\frac{2}{5} + \frac{1}{3}$? Students answer $\frac{3}{8}$, cognitive conflict occurs when the students give reasons $(2+1)/(5+3)$.
- 2) Simplify $3x - 7y - 6x + 3y - 8$? The students answered $3x - 7y - 6x + 3y - 8 = 3x - 6x - 7y + 3y - 8 = -3x - 10y - 8$. Cognitive conflict occurs when the students complete that $-7y+3y = -10y$.
- 3) Simplify $(15x3y + 5x)/5x$. Students answer $15x3y + 1$. Cognitive conflict experienced by students as follows $(15x3y + 5x)/5x = 15x3y + 1$.

In addition, Widada (2013) find a cognitive conflict in the form of overgeneralisasi done junior secondary school students in memfaktorkan square equation. A student Overgeneralisasi revealed as in the interview footage as follows.

- Interviewer* : *Mas try whether you know how to complete the following equation $x^2 - 3x + 2 = 0$?*
- Students* : *... from my teacher Pak... similarities compute square roots can be resolved with memfaktorkannya...
..... [students' can memfaktorkan square equation correctly].....*
- Interviewer* : *... Okay ... well. If so try try you complete the Square Equation*

$$x^2 - 3x + 2 = 20?$$

..... [students working on paper in a specific time].....

Interviewer : ... how the result?

Students : Well Pak.... Square equation $x^2 - 3x + 2 = 20$, can be completed with memfaktorkan that the left so obtained: $(x-2)(x-1) = 20$, means equivalent with $x^2 = 20$ or $x-1 = 20$, means the solution is $x = 22$ or $x = 21$ and finished Pak.

Interviewer : ... well, ... if so do you know what is common square?

Students : I ca bu teacher writes $ax^2 + bx + c = 0$ are equivalent square, so Pak definition.

Widada (2013) analyzing the preview above that overgeneralisasi occurs when the students asked to complete the square equation $x^2 - 3x + 2 = 20$, without using the concept of the square students directly memfaktorkan equation the equation. The students only memorized the definition of square equation, but an understanding of the definitions are only as deklaratif sentences that less meaningful for students. So that the students said that: "square equation $x^2 - 3x + 2 = 20$, can be completed with memfaktorkan that the left so obtained: $(x-2)(x-1) = 20$, means equivalent with $x^2 = 20$ or $x-1 = 20$, means the solution is $x = 22$ or $x = 21$ and finished Pak." If the students really understand the concept of the square equation, then the students will restore it in accordance with the definition of square equation, so that the equation $x^2 - 3x + 2 = 20$ can be formed in the square equation becomes $x^2 - 3x - 18 = 0$. Square equation $x^2 - 3x - 18 = 0$ this can be accomplished with memfaktorkan become $(x-6)(x+3) = 0$, so obtained $x - 6 = 0$ or $x+3 = 0$ and the solution is $x = 6$ or $x = \text{minus } 3$.

In mathematics teaching the students are seen as active information processing, so that students are able to perform the adaptation to school environment. Adapatasi as intended by Piaget, include assimilation, accommodation, disekuilibrasi, and ekuilibrasi/re-ekuilibrasi. Students who experience disekuilibrasi which duration long possible cognitive conflict occurs. Therefore teachers should provide assistance in the form of *scaffolding* zone based on the development of undistributed (as Vygotsky theory (Arends, 1997; Arends, 2001; Slavin, 1994)).

Mathematics Teaching is the process of manipulating the condition that allows learners to do a logical activities in an effort to the discovery or the discovery of the principle of/mathematical concepts. For mathematics is a human activity (*U.S. mathematics s human activity*, Freudenthal (in Gravemeijer, 1995). Therefore required a conscious effort that can condition the interactive activities between the components of the lesson the students of teachers learning resources), so make it easy for students to complete the task. Furthermore it is expected that each student is able to perform internalisasi in processing system information.

There are four teaching approaches in mathematics education based on the horizontal and vertical components matematisasi namely mekanistik, empiristik, strukturalistik and realistic (Treffers, 1991). Based on the opinion, realistic approach to approaches that can help SMP students (which the majority are in the stage of development of concrete operational intelektual) in developing the ability to understand the concept and Solve Mathematics Problems with easy. For according to Gravemeijer (1994) in mathematics teaching realistic, there are three main principles namely, find back and progressive matematisasi, the phenomenon of Journalists teamt, and build your own model.

To take advantage of the real problem with mathematics teaching realistic based on cognitive conflict encourage the students are able to solve the problem with his own way. The ability to Solve Mathematics Problems is the ability to search for and resulted in the settlement of a Mathematics Problem with various activities: 1) understand the problem that is given, 2) model the mathematics, 3) solving problems in accordance with the model of mathematics made, 3) interpret the settlement (Hamalik, 2001).

Mathematics Teaching realistic based on cognitive conflict encourage students to mengkonstruk a concept or find the concept of mathematics (Treffers, 1991). Therefore, learning outcomes can improve the ability of students in mmahami mathematical concepts. The ability of understanding the concept covers several indicators that are able to claim the concept that has been studied, able to classify objects based on met or whether or not the requirements that form the concept, able to apply the concepts in the algorithm, is able to give an example and non-examples from the concept that has been studied, able to present the concept in various forms of representation is able to associate the concept of internal and external mathematics), and able to develop the necessary conditions and the condition is quite a concept (Kilpatrick, Swafford, & Findell (2001).

In efforts to achieve the purpose of mathematics teaching and take advantage of cognitive conflict as a *starting point* mathematics teaching mathematics teaching realistic approach is needed (PMR). Mathematics Teaching realistic is basically the utilization of the reality and the environment is understood learners to facilitate the process of mathematics teaching to achieve the goal of mathematics education is better than in the past. According to Soedjadi (2001) also explain what is with *reality*, and the things that real or concrete steps that can be observed or understood learners through imagine, while is with the environment is an environment where learners are good school environment, families and communities can be understood learners. The environment is also called the daily life, and Glasersfeld (1992), said mathematics is "" reflects the real world through the process of empirical abstraction.

Mathematics Teaching should be done with attention to all parts of the development of psychology students, and done with the humanist. According to the Hendriana (2012), create mathematics that humanists in the learning is the initial capital to provide a stimulus early to the students so that the negative responses toward mathematics decreases. With enjoying the mathematics learning mathematics become a pride for the students so that it is expected that the habit of creative thinking become trained. One of the alternative learning approach that is expected to support the huanis mathematics and creativity of the students are *Metaphorical Approach Thinking*. The writer is trying to examine about the implementation of the approach *metaphorical thinking* is on the power increase student creativity.

Based on the explanation above, the process of mathematics teaching realistic use contextual problems (*contextual problems*) as a starting point in learning mathematics. By applying the PMR, it is hoped that students have troubleshooting capabilities and have the ability to understanding the concept. To achieve this, then dotted with the reject mathematics problem realistic, students can easily complete tasks/questions about mathematics.

Based on the explanation above, the process of mathematics teaching realistic use contextual problems (*contextual problems*) as a starting point in learning mathematics. The characters in mathematics teaching realistic and take advantage of cognitive conflict (Asdar, 2012; Muhammad, 2012), the students are able to perform cognitive process to achieve the ability of understanding the concept and troubleshooting issues with good.

In this article discussed about the influence of the implementation of the model of teaching mathematics realistic based on cognitive conflict against the ability of understanding the concept and troubleshooting capabilities junior high students.

METHOD

To achieve the goal of this research is conducted research experiment facades with research design *Pretest-Postest Nonequivalent Control Group Design*, with the test instrument the ability to understanding the concept and test the troubleshooting capabilities. A sample of this research is 80 junior secondary school students in Bengkulu City which is selected by the technique of *cluster random sampling*. This research instrument in the form of the test the ability of understanding the concept and test the troubleshooting capabilities. The data has been analyzed using kovarians multivariat analysis. The results of the test data capabilities of the understanding of the concept of the test and troubleshooting capabilities, analyzed by using the index score gains (g). If $g \geq 0.7$ then N-gain is categorized as high; if $0.7 > g \geq 0.3$, then N-gain is categorized as being; and if $0.7 > g < 0.3$, then N-gain categorized low (Hake, 1999).

RESULTS AND DISCUSSION

The results of research and this discussion is the analysis of the data has been seminar in activities Semirata VETERINARY (BKS West in Unsri 22-24 May 2016 (Dewi Herawaty & Rusdi, 2016). Observation of the students during the learning process is done by the two observers for each time the meeting. The observation data obtained using a sheet of observation of 6 students as the sample observation. The students who made samples of observation randomly selected from 25 students in each school that made the research. The results of these observations Data two teachers dirata averaged, then calculated with the presentage. There is 89,01% time used students to perform activity: 1) Observe and understand contextual problem is given in the book the students; 2) working together to resolve the issue in the book the students/WORKSHEETS in Iranian groups (pairs); 3) Pour answers permasalahan into WORKSHEETS individually; 4) asked the teacher or a group of friends/another friend; 5) Appreciate ideas friends; and 6) Membandingkan results of the solution to the problems with the results of the work of a friend. This shows that the average every aspect/category that is observed on the activity of the students during the learning process to four the RPP imposed including effective category. Thus the activity of the students in the learning process with the implementation of the model of *teaching mathematics realistic* is effective.

Furthermore based on the results of the test data capabilities of the understanding of the concept of the test and troubleshooting capabilities, analyzed with kovarian analysis.

Kovariat variable in this research is the ability to start the students who obtained from the value of the pretes students whereas bound variable is the ability to understanding the concept and problem solving the students who obtained from the value of the postes. Inferential analysis using kovarians analysis (ANAKOVA) with the steps as follows:

Regression Model $Y = a + bX$, with a and b is estimatasi for θ_1 and θ_2 from the equation

$Y = \theta_1 + \theta_2 X$ based on the results of the calculation of the class regression model experiment obtained similarities following regersi model.

$$Y = 75,59 + 0,34X$$

Based on the results of the calculation of the control class regression model regression model equation is obtained as follows.

$$Y = 51,23 + 0,45X$$

The analysis to test the independency of the class regression model experiment is as follows, with significant rank $\alpha = 5\%$ diproleh $F(0.95; 1; 43) = 4.08$ which means $F^* > (0.95; 1; 43)$ then regression model coefficient is equal to zero. This means that the ability of the beginning students (X) has a significant impact on the ability of understanding the concept and problem solving students (Y).

To test the inpedensi analysis class regression model control, namely with significant ttaraf $\alpha = 5\%$ diproleh $F(0.95; 1; 43) = 4.8$ which means $F^* > (0.95; 1; 43)$ then regression model coefficient is equal to zero. This means that the ability of the beginning students (X) has a significant impact on the ability of understanding the concept and problem solving students (Y).

Test the linieritas Regression Model

Based on the analysis of the class regression model lineritas experiment obtained that, with significant rank $\alpha = 5\%$ diproleh $F(0.95; 4; 39) = 2,61$ which means $F^* > F(0.95; 4; 39)$ then class regression model coefficient experiment is linier. This means that the relationship between the ability of the beginning students with the ability to understanding the concept and problem solving students peda class experiment is linier. Based on the analysis of the class regression model linieritas control that with significant rank $\alpha = 5\%$ diproleh $F(0.95; 4; 39) = 2,61$ which means $F^* > F(0.95; 4; 39)$ then control class regression model coefficient is linier. This means that the relationship between the ability of the beginning students with the ability to understanding the concept and problem solving students peda control classes are linier. Because the data on the class of experiments and control classes are linier then continued with the next test.

Test the similarity of two Regression Model

Based on the results of the test calculations common two class regression model experiment and control classes obtained regression model linier aggregated data as follows.

$$Y = 14,29 + 3,45X$$

$$F^* = 158,05$$

Using the rank of significant $\alpha = 5\%$ diproleh $F(0.95; 2; 86) = 3,15$ which means $F^* > F(0.95; 2; 86)$, then the H_0 was rejected. This means that the regression model class linier experiment and control classes are not the same.

Test the equality of two Regression Model

Because the two regression model is not the same, then will continue with the test regression coefficient consistency. Based on the results of the test calculations parallel class regression model experiment and control classes obtained the results of the analysis as follows.

A = 2662,45
 B = 2346,42
 F* = 5.46

Using the rank of significant $\alpha = 5 \%$ diproleh $F(0.95; 1 ; 86) = 4.00$ which means $F^* > F(0.95 ; 1 ; 86)$, then the H_0 was rejected. This means that the regression model class linier experiment and control classes aligned.

Because all varians analysis are met and both the regression model is aligned it can be concluded that there is a difference between the ability of understanding the concept and problem solving the students in the classroom experiment the given learning with PMR, with the ability to understanding the concept and troubleshooting control classes assigned to conventional mathematics lesson for the subject of the same.

Class regression lines of the experiment and control classes aligned and planck regression line for the class experiment is greater than planck regression lines to control classes shows that there is a significant difference between the two regression model. Regression lines are geometrically to the classroom experiments on the control class regression lines, which means that the ability of understanding the concept and troubleshooting class experiment the given learning with PMR is better than with the ability to understanding the concept and troubleshooting control classes assigned to conventional mathematics lesson.

The result of the study of the capacity of the understanding of the concept and the ability to Solve Mathematics Problems SMP students Bengkulu City 2016 (has been disseminated in Jambi International Seminar on Education, 3-5 April 2016 by Herawaty, dkk., 2016), which can be served one by one in the ability test score statistics diagram understanding the concept and test scores troubleshooting capabilities as follows.

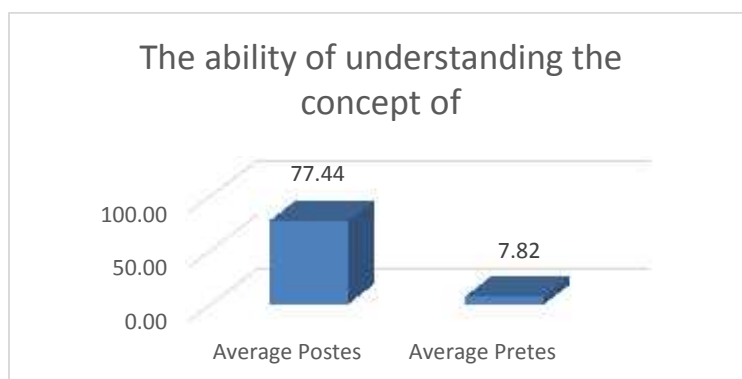


Figure 1. Average Postes Pretes Score and the ability of understanding the concept

Based on the Figure 1, average pretes score the ability of understanding the concept is of 7.82, and average scores postes the ability of understanding the concept is 77,44. This may indicate that the difference in average scores pretes and postes is 69,62, which means that the increase

in the ability of understanding the concept of very high. Furthermore can be served the graph Average Postes Pretes Score and troubleshooting capabilities in the picture below.

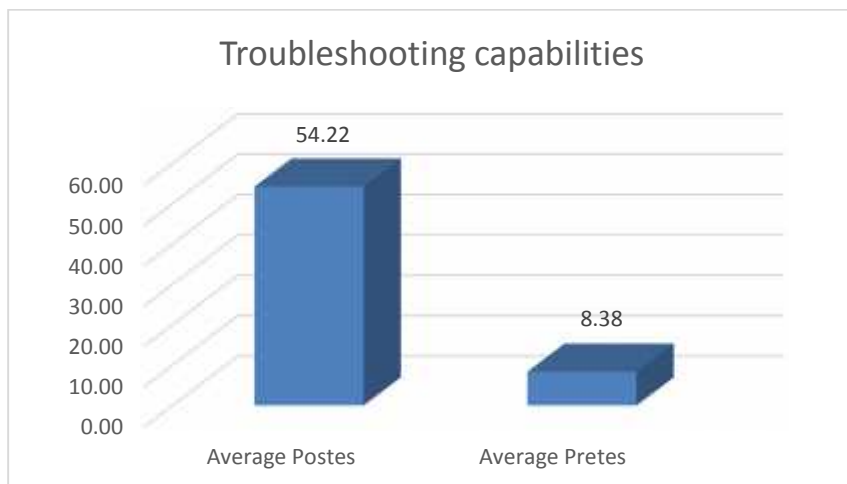


Figure 2. Average Postes Pretes Score and troubleshooting capabilities

Based on the Figure 2, average scores pretes troubleshooting capabilities are 8,38, and average scores postes troubleshooting capabilities is 54,22. This may indicate that the difference in average scores pretes and postes is 45.84, which means that the increase in troubleshooting capabilities is very high. Furthermore can be served the graph average gains the ability to score on the concept of understanding the picture below.

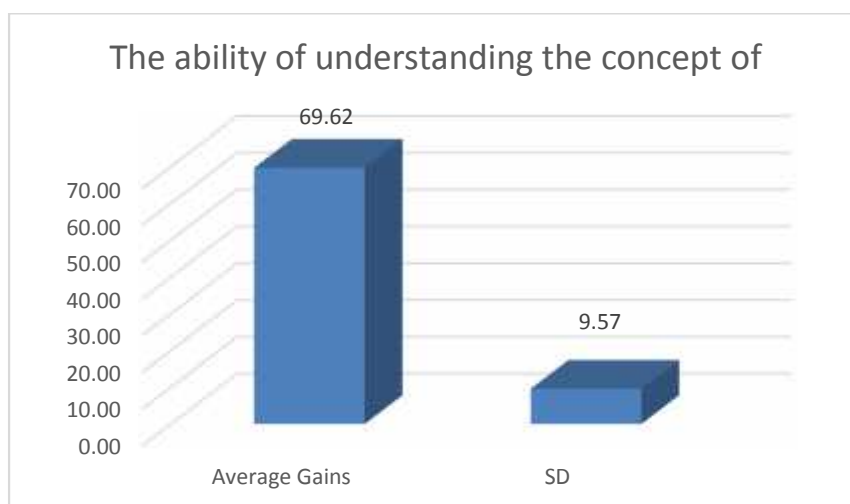


Figure 3. Average and deviation Stadart Score gains the ability of conceptual understanding

Based on the Figure 3, average gains pretes score the ability of understanding the concept is of 69,62, and Standard deviation score postes the ability of understanding the concept is 9,57. This may indicate that the average capacity of the understanding of the concept of the students is very high. Furthermore can be served the graph average and Standard deviation Score Gains Troubleshooting capabilities in the picture below.

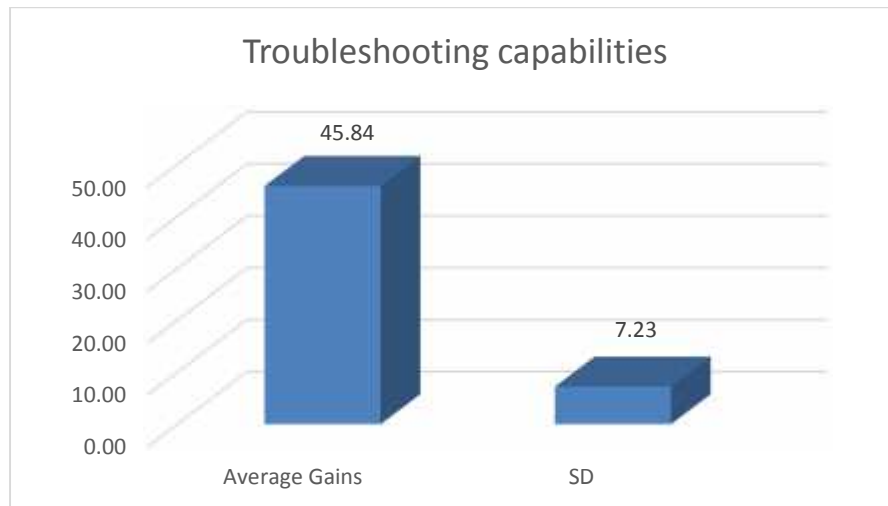


Figure 4. Average and Standard Deviation Gain Troubleshooting Capabilities Score

Based on the Figure 4, average gain score postes troubleshooting capabilities is 45,84, and Standard deviation score postes troubleshooting capabilities is 7,23. This may indicate that the average increase in the ability of understanding the concept of problem solving the students is high enough.

Based on the Figure 1 until with Figure 4, can be calculated the index score gains as follows:

- (1) The index score gains the ability to understanding the concept of (gpk) = 0,755;
- (2) The index score Gains Troubleshooting Capabilities (gpm) = 0,500.

With the index score gains the ability to understanding the concept is the gpk = 0,755, N-Score gains the ability to understanding the concept is categorized as high. Means that the ability of understanding the concept of mathematics SMP students N 10 Bengkulu City after being taught by applying the model of teaching mathematics realistic based on cognitive conflict students have increased high. The contribution of the implementation of the learning model are able to perform the horizontal matematisasi easily and to take advantage of the realistic approach, the students were able to achieve the concept and understand with both through the vertical matematisasi (as revealed by Treffers, 1995).

So also based on the index score Gains Troubleshooting Capabilities (gpm) = 0,500, then N-Score Gains Troubleshooting capabilities are categorized as being. Means that the ability to Solve Mathematics Problems SMP students N 10 Bengkulu City after being taught by applying the model of teaching mathematics realistic based on cognitive conflict students have increased high enough. With pemerapan mathematics teaching realistic based on cognitive conflict students, making it easier for students to understand contextual problems that was given to make it easy for students to make up the model of mathematical prowess, and make it easy for students to solve the problem are given by using a model that he had made. As the results of research Wahyu Widada (2013), in learning equation system linier two variables (SPLDV) in junior high school teachers often told with strukturalistik approach. Teachers give definitions of SPLDV then gives an example and continued with the exercise. But there are some teachers who presents SPLDV through learning that more closely with the basic scheme students. Based on this second teachers, obtained decompositions of genetic in memory system students is as follows.

Teachers : [students without giving the concept of] try you complete the questions about "Eat in the canteen" following.
 [teachers give Activity Sheet Students (LAS) the contents as follows.]



Figure 5. Problem eat in the canteen in LAS I

[... around 15 minutes the students are given time menyelesaikan questions LAS I...]

Students : Pak i will try to answer ... is jawaba i Pak... [students providing answers in LAS I as Figure 5]



Figure 6. One Of Model answers the students from the problem of food in the school canteen in LAS I

Students : my answer in LAS I [as picture 5 above] two items namely one meatball and one ice valuable intervention the same 13 thousand rupiah... I can scrub and the result as follows. [students pointed toward the settlement of such as Figure 6 below) means one sliced meatballs price Rp 8,000.

Rp 8,000,-



Figure 7. answers the students after the same removal

Students : ... Sir, then i can replace the price of the bowl meatballs into one of the picture... [students point in the answer in LAS I as Figure 7]



Figure 8. Students replaced the Rp 8,000 to Meatballs

Students : Because 1 bowl meatballs i replace with Rp 8,000 and whole Rp Negara which means one glass of ice him five thousand rupiah Sir.

Based on the genetic decompositions students about SPLDV above shows that the students are given LAS based on issues that near with his thoughts very well and very good to take advantage of *previous schema*-him in processing system information. *Short-term Memory* as *working memory* works so good as do the process based on the procedures that he had.

Widada (2013) stated that based on the above quotation, the activities of the action against the objects of the physical and metal can dienkapsulasi, processed through ditematisasi interiorisasi and be mature about eleminasi scheme and substitution SPLDV without must be delivered down the facts about eleminasi, and substitution and principles. But in the genetic decompositions thus students find themselves eleminasi principles in accordance with expressions: "*.... my answer in LAS I [as Figure 5 above] two items namely one meatball and one ice valuable intervention the same 13 thousand rupiah... I can scrub and the result as follows. [students pointed toward the settlement of such as picture 6 below) means one sliced meatballs price Rp 8,000.*" Said "...removes ..." in the phrase kebermaknaan eleminasi principles. In this case the students have the understanding of the concept of/principles that are stored in the scheme of eleminasi good in the system memory although the name of the principle of ("eleminasi") is not yet he know, as well as the principle of substitution of our have students understand with both in the system memory.

CONCLUSION

Based on explanation of research results in the conclusions of this research is 1a) the activity of the students in the learning process with the implementation of the model of teaching mathematics realistic is effective. 1b) the ability of understanding the concept and troubleshooting class experiment the given learning with PMR is better than with the ability to understanding the concept and troubleshooting control classes assigned to conventional mathematics lesson. 2) the index score gains the ability to understanding the concept is the $gpk = 0,755$, N- Score gains the ability to understanding the concept is categorized as high. Means that the ability of understanding the concept of mathematics SMP students N 10 Bengkulu City after being taught by applying the model of teaching mathematics realistic

based on cognitive conflict students have increased high. 3) the index score Gains Troubleshooting Capabilities (gpm) = 0,500, then N-Score Gains Troubleshooting capabilities are categorized as being. Means that the ability to Solve Mathematics Problems SMP students Bengkulu City after being taught by applying the model of teaching mathematics realistic based on cognitive conflict students have increased high enough.

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