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Proceeding

"Revitalizing Research And Education On Mathematics and Science for Innovations And Social Development"

5th ICRIEMS

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5th International Conference on Research, Implementation and Education of Mathematics and Sciences

"Revitalizing Research And Education On Mathematics and Science for Innovations and Social Development"

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PROCEEDINGS OF THE 5th INTERNATIONAL CONFERENCE ON RESEARCH, IMPLEMENTATION AND EDUCATION OF MATHEMATICS AND SCIENCES (5th ICRIEMS)

Revitalizing Research And Education
On Mathematics And Science For
Innovations And Social Development

Yogyakarta, 7 – 8 May 2018

FMIPA UNIVERSITAS NEGERI YOGYAKARTA

Proceedings of The 5th International Conference On Research, Implementation And Education Of Mathematics And Sciences (5th ICRIEMS): Revitalizing Research And Education On Mathematics And Science For Innovations And Social Development

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Preface

This proceedings is the regular edition (non-Scopus-indexed) of the conference proceedings of the 5th International Conference on Research, Implementation, and Education of Mathematics and Sciences (ICRIEMS) held by the Faculty of Mathematics and Science, Yogyakarta State University, Indonesia on 7 – 8 May 2017 at Eastparc Hotel Yogyakarta. All papers in this proceeding were obtained from a selection process by a team of reviewers and had already been presented in the conference. Some selected papers from the conference were compiled under separate proceedings and published by Institute of Physics (IoP) which is Scopus-indexed. This proceedings comprises 9 fields, they are mathematics, mathematics education, physics, physics education, chemistry, chemistry education, biology, biology education, and science education.

The theme of this 5th ICRIEMS is '*revitalizing research and education on mathematics and science for innovations and social development*'. This conference presented five keynote speakers, which were Prof. Dr. Fang-Ying Yang (Graduate Institute of Sciences Education, National Taiwan Normal University), Prof. Muammer Calik, Ph.D (Karadeniz Technical University, Turkey), Prof. Ferry Butar Butar, Ph.D. (Department of Mathematics and Statistics, Sam Houston State University, USA), and Prof. Dr. Eng Khairurrijal (Department of Physics, Bandung Institute Technology, Indonesia), and two invited speakers, which were Prof. (Assoc.) Dr. Azmi Mohamed (Department of Chemistry, Universiti Pendidikan Sultan Idris, Malaysia) and Dr. Lilla Adulyasas (Yala Rajabat University, Thailand). Besides the keynote and invited speakers, there were also parallel articles that present the latest research results in the field of mathematics, sciences, and education. These parallel session speakers came from researchers from Indonesia and abroad.

Hopefully, this proceeding may contribute in disseminating research results and studies in the field of mathematics, sciences and education such that they are accessible by many people and useful for the development of our civilization.

Yogyakarta, October 2018

Editorial Team

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Forewords From The Head of Committee 2018

Assalamu'alaikum warahmatullahi wabarakatuh.

On behalf of the organising committee of the 5th ICRIEMS, please let me welcome you to Yogyakarta, Indonesia. Nothing is more precious for us, besides enable to fete you all here, in the 5th of the International Conference on Research, Implementation, and Education of Mathematics and Science, that is organized by the Faculty of Mathematics and Science, Yogyakarta State University.

It is not only about the research as well as the papers that will be presented. But it is also about the academic networks, mutual cooperation, and meaningful communications amongst us – the researchers, academics, and educators – those which we are expecting to be built and established, in this conference. We believe that this occasion may lead our commitment to strength our roles together, particularly to achieve the innovation and social development through research and education on mathematics and science, as it is accentuated by the theme of this conference.

We are strongly considered that this conference would not be meaningful without other parties. Therefore, I would like to express my highest appreciation and gratitude to our keynote speakers and invited speakers. They are:

1. Prof. Ferry Butar Butar, Ph.D.,
2. Prof. Muammer Calik, Ph.D.,
3. Prof. Dr. Eng Khairurrijal, M.Si.
4. Prof. Dr. Fang-Ying Yang
5. Prof. Assoc. Dr. Azmi Mohamed
6. Dr. Lilla Adulyasas.

I also would like to address our big thank to our motivated and valuable participants. There are 570 papers will be presented and 2 posters displayed, out of 575 registered participants. A few selected papers would be published in the Scopus-indexed proceeding whilst others will be in either regular proceeding or journals.

We believe that there would be any shortcomings and inconveniences in this conference. Thus, we really apologize. We hope that this conference will be very succesful. Have a nice talk, discussion, and surely enjoy Yogyakarta. Thank you.

Wassalamu'alaikum warahmatullahi wabarakatuh.

Yogyakarta, May 2018

Agung W. Subiantoro

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Forewords From the Dean of Faculty of Mathematics and Sciences, Universitas Negeri Yogyakarta

Assalamu'alaikum warahmatullahi wabarakatuh. May peace and God's blessings be upon you all.

On behalf of the Committee, first of all allow me to extend my warmest greeting and welcome to the 5th International Conference on Research, Implementation, and Education of Mathematics and Sciences 2018, organized by Faculty of Mathematics and Natural Sciences (FMNS) Yogyakarta State University.

To celebrate the 54th Anniversary of Yogyakarta State University, our faculty has an opportunity to conduct the 5th ICRIEMS 2018 with the theme of Revitalizing Research and Education on Mathematics and Science for Innovations and Social Development. This conference proudly presents five keynote speeches by five fabulous speakers: Prof. Ferry Butar Butar, Ph.D., Prof. Muammer Calik, Ph.D., Prof. Dr. Eng Khairurrijal, M.Si., and Prof. Dr. Fang-Ying Yang and two invited speakers: Prof. Assoc. Dr. Azmi Mohamed and Dr. Lilla Adulyasas.

The independence of a country is impossible to gain if the education does not become the priority and it is not supported with the development of technology. We all know that the technology development could be achieved if it is supported by the improvement of firm fundamental knowledge. The empowerment of fundamental knowledge could not be separated from research which is related to the development of technology and the learning process in school and universities.

This conference is aimed to pull together researchers, educators, policy makers, and practitioners to share their critical thinking and research outcomes. Therefore, we are able to understand and examine the development of fundamental principle, knowledge, and technology. By perceiving the matters and condition in research and education field of mathematics and sciences, we could take a part in conducting qualified education to reach out the real independence of our nation.

This conference will be far from success and we could not accomplish what we do without the support from various parties. So let me extend my deepest gratitude and highest appreciation to all committee members. I would also like to thank each of participants for attending our conference and bringing your expertise to our gathering. Should you find any inconveniences and shortcomings, please accept my sincere apologies.

Wa'alaikumsalam warahmatullahi wabarakatuh.

Yogyakarta, May 2018

Dr. Hartono

Conference Program

THE 5th INTERNATIONAL CONFERENCE ON RESEARCH, IMPLEMENTATION & EDUCATION OF MATHEMATICS AND SCIENCES (ICRIEMS) 2018
7-8 MAY 2018, HOTEL EASTPARC, YOGYAKARTA, INDONESIA

#DAY 1: MONDAY, 7 MAY 2018

TIME	PROGRAM
07.00 – 08.00 AM	Registration
08.00 – 09.00 AM	Opening Ceremony 1. Opening 2. National Anthem: 3. Traditional Dance: 4. Welcome Speech: Chairman of ICRIEMS 2018 5. Opening Conference by Rector of YSU 6. Photo Session
09.00 – 09.30 AM	Tea/Coffee Break
09.30 – 12.00 PM	**Keynote Speech #1 :** **Prof. Ferry Butar Butar, Ph.D.** **Keynote Speech #2 :** **Prof. Dr. Eng Khairurrijal, M.Si**
12.00 – 01.00 PM	Lunch Break
01.00 – 05.00 PM	Parallel Sessions & Coffee Break

#DAY 2: TUESDAY, 8 MAY 2018

TIME	PROGRAM
07.00 – 08.00 AM	Registration
08.00 – 09.30 AM	**Keynote Speech #3:** **Prof. Muammer Calik, Ph.D**
09.30 – 10.00 AM	Tea/Coffee Break
10.00 – 11.30 AM	**Keynote Speech #4:** **Prof. Dr. Fang-Ying Yang**
11.30 AM – 00.30 PM	Lunch Break
00.30 – 04.00 PM	Parallel Sessions & Coffee Break
04.00 – 04.30 PM	Certificate Collection

#DAY 3: WEDNESDAY, 9 MAY 2018

TIME	PROGRAM
07.00 AM – 05.00 PM	City tour

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Analysis of the Problem Solving Ability of VIII-A Student on Linear Equation System of Two Variables (LESTV)

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Abstract. This study aims to determine the problem solving skills of VIII-A students in a private junior high school in Yogyakarta in LESTV material after they following the learning using RME approach. This research was conducted in a private junior high school in Yogyakarta in September until October 2017. The type of research was design research, because researchers designed the learning of LESTV material with stages are preparing for the experiment, implementation the design experiment, and the doing retrospective analysis using RME approaches. So the appropriate type of research is design research. The subjects of the study were 3 students, but in this paper the analysis of only one student will be discussed, that is student who answered using pictures and symbols (S3). Data analysis techniques of the research were data reduction, data display, and verification/conclusion. The result showed that S3 has problem solving ability in solving contextual problem related to LESTV after following the learning using RME approach. Problem solving skills possessed by S3 are understand the problem, make a plan, carried out the plan, and looked back at the completed solution.

Keywords: Realistic Mathematics Education, Problem Solving, Design Research, Linear Equation System of Two Variables.

INTRODUCTION

Mathematics is one of the lessons that are considered difficult by the students. Based on the results of interviews on teachers, in the teacher's learning is still using the lecture method. Passive students and active teachers. This causes students to feel bored with math. As a result student problem solving abilities are also very low. The results of the students' initial tests on the contextual problem related to Linear Equation System of Two Variables (LESTV), it turns out that the problem solving ability of students is still very low. Students have difficulty in modeling the problem and even solving it. Based on the results of student interviews, in the learning of teachers rarely provide a matter of story and train students to solve it. Therefore, students say that they are difficult to understand the problems given by researchers.

Realistic Mathematics Education (RME) is one of the learning method that begins with contextual problem related to student life. Therefore, students are trained to learn and construct directly from the problems that surround them into mathematical models. In addition, RME requires students to complete the model that has been made using the interrelationships between concepts that have been studied previously. The teacher is only a facilitator in guiding and the students themselves construct and solve problems.

RME Approach was first developed by the Freudenthal Institute in Holland. Based on the thought of Hans Freudenthal [1], in RME mathematics as human activites and must be associated with reality. According to Hadi [2], in the learning RME must start from something real so that students can be involved in the learning process

meaningfully. In the process of learning, the role of teachers only as a mentor and facilitator in guiding students to construct ideas and concepts of mathematics. According to Gravemeijer [3], RME approach has 5 characteristics, namely: (1) Phenomenological exploration, learning starts from real problem (real) close to the student or often encountered by students in everyday life. So that students can construct the problem into the mathematical model and solve it. (2) Bridging by vertical instruments, departing from contextual problems students use their own strategies to represent in the form of mathematical models. Mathematical models of mathematical symbols, schemes, graphs, and diagrams. The model is used by students as a bridge to deliver them from informal mathematics (horizontal mathematization) to formal mathematics (vertical mathematization). (3) Student contributions, students themselves using production and model construction. Thus, students are expected to be able to construct a formal model. Students play an active role in constructing their own knowledge, while the teacher is limited to the facilitator. (4) Interactivity, the interaction between students in the learning process. This form of interaction is used by students to improve or update constructed models. (5) Intertwining, students use an association of mathematical concepts to solve problems. Thus, the RME approach is expected to provide students with the maximum possible opportunity to make guesses, intuitions, and experiments on the problems presented by the teacher in the form of contextual problems. It aims to train students' skills in solving math problems.

According to Hudojo [4], a statement would be a problem only if a person does not have certain rules or laws that can immediately be used to find the answer to that question. Problems are subjective to everyone, meaning a statement can be a problem for a person, but not a problem for others. NCTM [5], argues that problem-solving is the process of applying the previously acquired knowledge to new and different situations. Explicitly, the steps of solution according to Polya [6], as follows: (1) understand the problem, at this stage students can retell by using their own language on the issue. In addition, students can write down what is known and asked questions. (2) make a plan, students are able to find related information, so it can be connected to get an initial concept to solve the problem. (3) carry out our plan, when the student is convinced of the plan made in the second stage, then the student will solve the problem using the plan. (4) looked back at the completed solution, after obtaining the answer the student checks the answer to confirm the truth.

Gravemeijer & Van Eerde [7], design research is a research method that aims to develop Local Instruction Theory (LIT) with the cooperation between researchers and educators to improve the quality of learning. Gravemeijer & Cobb [8], divides design research into three stages: (1) Preparing for the experiment, at this stage the researcher reviews the literature related to the research objectives and makes the initial design for use in the experimental stage of the research. (2) The Design Experiment, at this stage, the researchers conducted a design test on a non-subject class (pilot exsperiment). The results of the experiment were analyzed and then revised to conduct research on the class of research subjects (teaching experiment). (3) The Retrospective Analysis, this stage aims to evaluate the success of learning activities that have been implemented, observe the progress of learning from students and inform the progress of learning activities. In the data analysis phase, the researcher will analyze will analyze the learning flow hypothesis to answer the research problem formulation.

Relevant research with this research are: (1) research conducted by Triana [9], concluded that there are more than 85% of students whose level of problem solving ability is at least moderate category (score = 2.66) so it is said to have solved the problem and the result of observation the ability of teachers who obtained categorized very well. Therefore, PMR approach can improve students' mathematics problem solving abilities in class X IPA3 SMA Negeri 3 Pematang Siantar, (2) Krismiati [10], concludes that problem solving ability experience enhancement with shown more and more students reaching score more than 60% from maximum score at each cycle. Thus, learning with RME model gives students a more positive response and can develop problem solving creations.

Therefore, the researcher is interested to do research to aim to know the problem solving ability of VIII-A Student on Linear Equation System of Two Variables (LESTV) in one of private junior high school in Yogyakarta on contextual problem related to LESTV after applying RME approach.

RESEARCH METHOD

The type of research used in this study is a design research. The researcher designed the learning to know the problem solving ability of student on contextual problem related to Linear Equation System of Two Variables (LESTV) after applying Realistic Mathematics Education (RME) approach. So the appropriate type of research is design research. The subject of research are three students of class VIII-A one of junior high school in Yogyakarta. However, in this paper only discussed one student that is student who answered using pictures and symbols (S3), while the other students will be discussed in the next paper. The study was conducted in September until October 2017.

Methods of collecting data in the form of written tests and interviews are not structured. About written tests on contextual issues related to LESTV that have been designed in the learning path. In addition the researchers also conducted an unstructured interview to determine the problem solving ability of students in solving contextual problems provided by researchers. Thus, the data collection instrument is a written test sheet containing the contextual issues related to the LESTV and an outline interview guide. This means that the researcher only provides interview guides in outline and questions can develop in accordance with student answers and information that needs to be obtained by researchers.

Research using data analysis technique according to Miles & Heberman [11], namely: data Reduction, data display, and conclusion drawing/verification. Job results and student interviews will be reduced and presented in the form of data categories based on polya solving steps, namely: understand the problem, make a plan, carried out the plan, and look ed back at the completed solution.

RESULT AND DISCUSSION

Researchers conduct learning in class VIII-A as much as two meetings to learning on contextual material related to Linear Equation System of Two Variables (LSTV) by using Realistic Mathematics Education (RME) approach. The researchers formed 4 study groups in which each group consisted of 5 students at random. Early learning researchers give apperception to students to remind again about the material linear equations of one variable, understanding the variables and coefficients. Furthermore, researchers provide contextual problems to students related to LSTV. Researchers ask students to model and solve the problem using the way each student. In learning when there are students who have difficulty, then the researcher gives a student to the form of questions that are fishing students to find the answer it self. In this study, students are active while researchers are limited to facilitators. After working on the problem, the researcher asks each group representative to deliver the results of the discussion in front of the class while the other groups pay attention. If there are answers between different groups, then each student is free to give an opinion to perfect the answer. At the end of the lesson, the researcher asks the students to conclude the learning, then refined by the researcher.

After learning in the first and second meetings in the VIII-A student, the third meeting held a written test on contextual issues related to LSTV. The results of students written tests will be grouped based on the similarity of the students' answers into one group. Furthermore, the researcher chose the representative of each group for interview. Based on the students 'work, there are 3 (three) different groups of students' answers, that are students who answered using picture (S1), symbol (S2), picture and symbol (S3). However, this paper only discusses is student who answered using pictures (S3). Here is an analysis and discussion of student answers (S3):

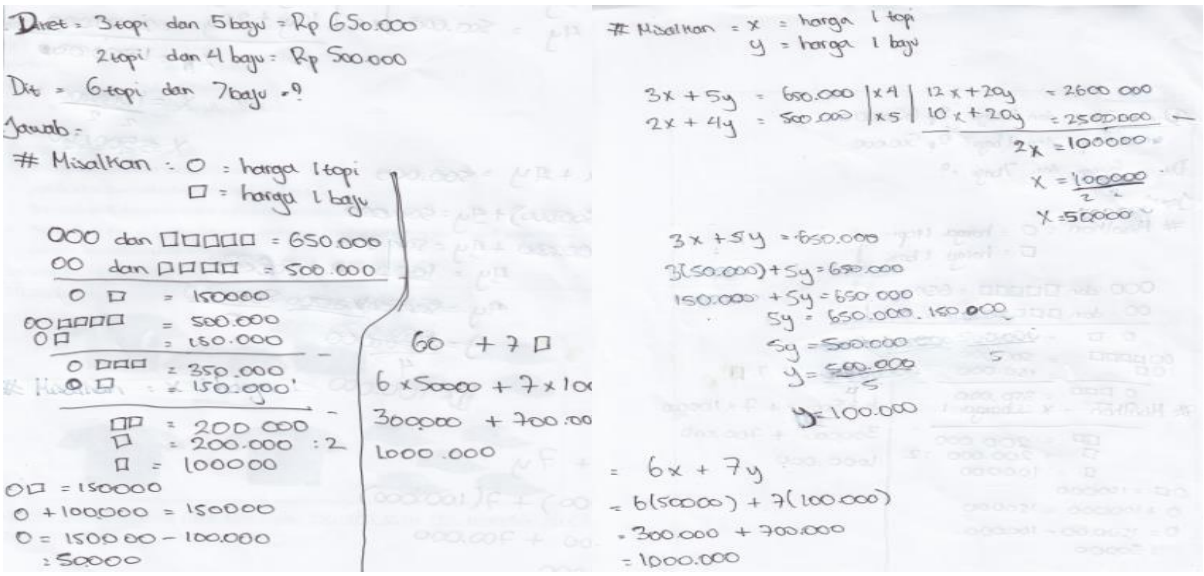

FIGURE 1. answer of student (S3)

Based on Figure 1, the researcher will analyze and discuss student answer 3 based on Polya step, that are: (1) understand the problem; (2) make a plan; (3) carry out our plan; (4) looked back at the completed solution.

Here is the analysis and discussion of the answer S3 in Figure 1 based on the polya step:

P : "What is known on the problem"?

S3: "The price of 3 hats and 5 shirts are 650.000 while the price of 2 hats and 4 shirts are 500.000."

P : "What's the question?"
S3: "Price 6 hats and 7 shirts."
P : " what is meant by word and in equation 1 and 2?"
S3: "That is **sum** sir ... hat and shirt, means hat plus shirt."

Based on the students' work, S3 has written down what is known and asked questions. While based on interview quotes, S3 can retell the problem using its own words. S3 is able to understand the problem well, so when writing what is known and asked the question using the word "and" which means the sum. Based on the results of work and interview students, it can be concluded that S3 is able to understand the problem well.

P : "Why in the first you are suppose with circle and rectangular images while the second with variable x and y?"
S3: " to make it easier to complete."
P : " Whether the split in both ways has the same meaning?"
S3: "Yes, actually it's just the same ... just a different symbol."

Based on the student's work, S3 creates a problem solving plan using two different events. S3 makes the first example, namely the formation of the image for the first way and the formation of the symbol for the second way. After that, S3 modeled the problem in the form of a mathematical model. In the first way, S3 plans a solution by subtracting the first equation by the second equation. While based on interview citations, S3 understands the problem well so plan the problem solving in two different ways. The purpose of S3 is to make the mathematical model and model easier to solve the problem. Based on the results of the work and interview students, it can be concluded that S3 can already plan problem solving with two different strategies, namely to create a mathematical model using images and symbols.

P : "Why the first way you subtract between equations 1 and 2?"
S3: "In order to be able to price 1 hat and 1 shirt."
P : "Why does the 2 equation minus the 3 equation you just got?"
S3: "In order to get the price of 1 rectangle, because it is reduced repeatedly then the circle is out."
P : "How do you means write 6 circles plus 7 rectangles?"
S3: "Because, question the problem are price 6 hats and 7 clothes ..."

Based on the results of the work and the student interview in the first way, S3 solves the problem by reducing first equation and second equation, then reducing equation 2 to third equation. S3 does the same thing repeatedly, resulting in 1 quadrilateral worth 100.000. Next S3 substituting the value of 1 rectangle to thethird equation obtained 1 circle worth 50.000. So S3 substitutes both values and obtains 100.000 results. S3 writes 6 circles plus 7 rectangles which means 6 multiplied by 50.000 while 7 multiplied by 100.000.

P : "Why are the second step, first equations multiplied by 4 and second equation multiplied by 5?"
S3: "to obtain the variable x then remove the y variable first "
P : " You know that way from where?"
S3: "Ever taught in a private place..."

Based on the results of the work and the student interview on the second way, S3 solve the problem using the method of elimination and substitution. The process of elimination is done if the variable coefficients of the two equations are equal. If the coefficients of the two variables are not the same, then it must be equated first. S3 understands problem and strategy in problem solving well. So S3 concluded that the price of 6 hats and 7 clothes is 1.000.000. Based on the results of the work and interview students, it can be concluded that S3 has a strategy in solving problems based on the two models of mathematics that have been modeled before by way of elimination and substitution.

P : "Are you sure about the answer in the first or second way?"
S3: " Sure, Sir. I checked back my answer...."
P : "How do you check back?"
S3: " The way is the value of the two picture or variables x and y are inserted into one equation and the answer is correct."

Based on the interview quote, S3 has checked back the answers that have been obtained to confirm the truth.

CONCLUSION

Based on the result of the research, it can be concluded that S3 has problem solving ability in solving contextual problem related to LESTV after following the learning using PMR approach. Problem solving skills possessed by S3 are understand the problem, make a plan, carried out the plan, and looked back at the completed solution.

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Certificate

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This is to certify that

Bernadus Bin Frans Resi

has participated in

The 5th International Conference on Research, Implementation and Education of Mathematics and Science

Organized by Faculty of Mathematics and Natural Science,
Yogyakarta State University, Indonesia
on May 7-8, 2018

as a

Presenter

with the paper entitled:

Analysis of the Problem Solving Ability of VIII-A Student on Linear Equation System of Two Variables (LESTV)

Yogyakarta, May 8, 2018
The Head of Commitee

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