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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"

7-8 May 2018
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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

Table of Content

MATHEMATICS EDUCATION

PHYSICS

PHYSICS EDUCATION

BIOLOGY

BIOLOGY EDUCATION

SCIENCE EDUCATION

5th ICRIEMS Proceedings
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Analysis of the Mathematical Communication Ability of Grade X Student on the Logarithmic Functions

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Abstract. This research aimed was describing the mathematical communication skills of the grade X Science students in Yogyakarta after following the process learning and using Problem Based Learning on the logarithmic functions material. This research was conducted in one of the high schools in Yogyakarta at October 2017. The type of this research was the design research. The subjects of this research were grade X Science students in Yogyakarta. The steps undertaken in this research were initial design, test and implementation of learning. Data analysis used in this research were data reduction, data presentation and conclusion or verification. In this research, there were 5 students as subjects, but the researcher will only describe 1 subject. The results are analyzed based on students' performance indicators set by the NCTM. The results showed that (1) The student was able to use the ability in using the terms, mathematical notations and structures to present the idea by using the definition of logarithm, (2) The student was also able to understand, interpret both orally, and writing, or in another visual form, (3) The student was able to use the ability to demonstrate and describe through oral and written.

Keywords: PBL, Mathematical Communication, Logarithmic Functions.

INTRODUCTION

The process standards, which is the ability that students must possess to achieved are: (1) mathematical problem solving, (2) mathematical reasoning, (3) mathematical communication, (4) mathematical connections, and (5) mathematical representations [1]. Based on this, mathematical communication couldn't be separated from mathematics learning. According to Baroody there were two reasons why mathematical communication is important, that were: (1) mathematics is a language, mathematics is not just a tools. Mathematics helps to find patterns, solve the problem, but also (2) mathematics as a social activity in learning mathematics [2]. Based on the results of interview with teacher of mathematics subjects related to the logarithmic functions material, students still have difficulty in transforming the shape of exponents into logarithms, especially if the questions of the problem was rather complex. Students were also accustomed to solving problems that weren't in the questions of a story problem. When students were given a story problem, students couldn't prove it. This students cannot do because students weren't guided by the previously taught concept. In mathematical communication skills, teacher said that students who have higher ability were able to communicate mathematically because at the time of group discussion, students with higher ability were responsible for teaching their friends and when presenting the results of the discussion to in front of the class, the teacher will surely appoint the lower ability student so that the student was able to communicate what they were studying. Based on the background, the research question in this research was how the mathematical communication skills of the grade X Science students in Yogyakarta after following the process learning and using Problem Based Learning on the logarithmic functions material?

THE COMMUNICATION MATHEMATICS, PROBLEM BASED LEARNING, DESIGN RESEARCH

Communication is an activity where students can express mathematical ideas and assess their accuracy using language. Students are given the widest opportunity to speak, write, read, and listen [1]. On the other hand Clark stated that "*Math is communication. You have to be able to communicate the concepts. You have to be able to communicate your thinking. Numbers are not enough for any good mathematician. You have to prove. You have to convince*" [3]. This indicated that the students must be able to convey the contents of their thoughts on math problems, not only in terms of counting but also how to communicate the mathematics both orally and in writing.

Opinions about mathematical communication is also expressed by Schoen, Bean and Ziebarth [2]. They argued that mathematical communication is the students (1) ability to explain an algorithm and a unique way of solving problems, (2) ability to construct and explain real-world phenomena in graphs, sentences, equations, and tables or other physical form of presentation, and (3) ability to give conjecture about the pictures of geometry. Furthermore, NCTM suggests that indicators of mathematical communication competency in mathematics learning comprises of: (1) ability in using the terms, mathematical notations and structures to present the idea by using the definition, (2) able to understand, interpret both orally, and in writing, or in another visual form, (3) able to use the ability to demonstrate and describe through oral and written [1].

Therefore, the suitable learning model for this research is the Problem Based Learning model. Boud & Feletti on 1991 stated that Problem Based Learning model, is a learning model that makes the problem as a basis for students to learn. The basic principle supporting the concept of PBL is older than formal education itself, namely that learning is initiated by a posed problems, query, or puzzles that the learner wants to solve [4].

According to Gravemeijer & Van Erde on 2006, design research is a research method that aims to develop Local Instrument Theory (LIT) with cooperation between researchers and educators to improve the quality of learning. Design research can be characterized as: (1) intervetionist: the research leading to the design of an intervention in the real world, (2) iterative: the research incorporates a cyclic approach to the design, evaluation, and revision, (3) process-oriented: a model of research that avoids the measurement of inputs and outputs, focus on understanding and improving interventions, (4) oriented to usability: the benefits of design were measured by looking at the practicality of the design for the user in reality, and (5) oriented to the theory: design (at least partially) made by theories that already exist, and field testing of the design contribute to the development of the theory [5, 6].

METHOD

The type of research used in this research was the design research developed by Gravemeijer and Cobb. According Gravemeijer and Cobb, the design research was divided into three stages: (1) preparing for the experiment, (2) design experiments, and (3) retrospective analysis [5].

The subjects of this research were grade X Science students in Yogyakarta. Research was carried out at the first semester of 2017/2018 school year. In this research, data was collected by documentation method. Data from the study were recorded learning video and documentation of the students working results.

In planning learning design, researchers also make a conjecture students reaction during learning and the strategies which would be used by students. Gravemeijer stated that the learning hypothesis is activity hypothesis everyday in the designed learning [7].

Data analysis technique in this research was conducted in a qualitative descriptive. In this research, data reliability was measured through a description of the learning process which is carried out by the researchers. The used steps in data analysis were: 1) data reduction which means to summarize, choose things, focus on the important things, look for themes and pattern and discard unnecessary information; 2) data presentation which is a set of well-structured information giving the possibility of withdrawal of conclusions; and 3) conclusion or verification which is intended to find the meaning of the data collected by finding relationships, similarities, or differences.

RESULTS AND DISCUSSION

Problems test was given to students after applied PBL, then the test results will be analyzed based on 3 indicators of communication mathematics ability. The PBL problems which was given in applying PBL were the problem of compound interest and the number of times the ball falls to construct the ability to define a logarithmic function. In this research, there were 5 students as subjects, but the researcher will only describe 1 subject. The following is an analysis of student's mathematical communication ability after PBL applied:

1. **Ability in using the terms, mathematical notations and structures to present the idea**
   Q1

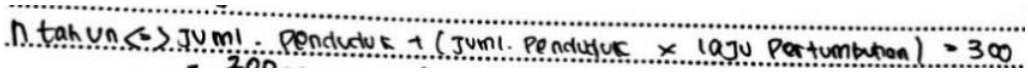

Figure 1. first part of student's answer for Q1

In question number 1, the student has been able to use the terms, mathematical notations and structures to present his ideas. This is seen in student assignment. For using the terms, student has been able to write n years to state after how many years the population will increase. But, even though the student can express his idea explicitly, the idea of the student in solving the problem was still incorrect because $(population \times growth\ rate)$ should be on the power of n. For the use of notation, the student used if and only if notation in expressing formulas using words, and "=", "()", "+", etc. It's also seen when researchers interviewed the student, and the student can explain it. Researchers ask:

R: "What did notation you use?
S: "I used notation plus, equals, in parentheses, if and only if, and so on".

Q2

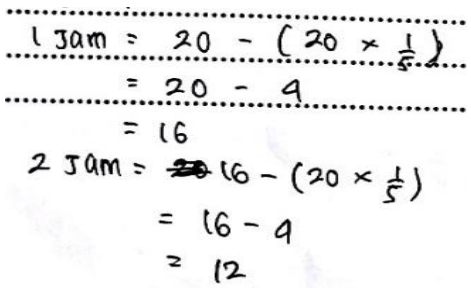

Figure 2. first part of student's answer for Q2

In question number 2, the student has been able to use the terms, mathematical notations and structures to present the ideas. This is seen in student assignment. For using the terms, this student has been able to write 1 hour to state the length of the brownies after the first piece, etc., but the student doesn't stated the idea explicitly as he did for question number 1. The student can use mathematical notation well like "=", "()", etc. It's also seen when researchers interviewed the student, and the student can explain it. Researchers ask:

R: "What did notation you use?
S: "I used notation multiplied by, equals, in parentheses, minus, over, and so on".

2. **Ability to understand, interpret both orally, and in writing, or in another visual form**
   Q1

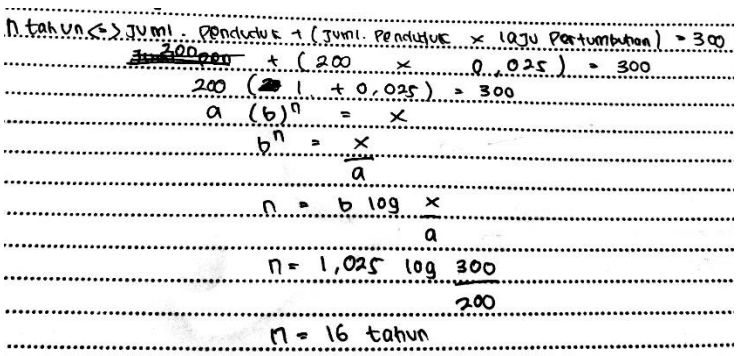

Figure 3. second part of student's answer for Q1

In question number 1, the student has been able to understand, interpret both orally, and in writing, or in another visual form. This is seen in student assignment which is student was able to understand by writing what was known and his answer is correct. It's also seen when researchers interviewed the student, and the student can explain it. Researchers ask:

R: "How did you do to solve the problem?"
S: "The equation asked how many years if the population reaches 300, so I immediately solve it using the logarithmic formula. So the population plus the population multiplied by the growth rate is equal to three hundred. Then, since there is the same factor of multiplication, and because of the power of n, by logarithm I get 16, 4 but I rounded it to 16 years.

From the answer, the student has been able to interpret the problem into a mathematical form, such as writing the problem into the form of logarithm that is $a.b^n = x$, and orally as seen in the above interview.

Q2

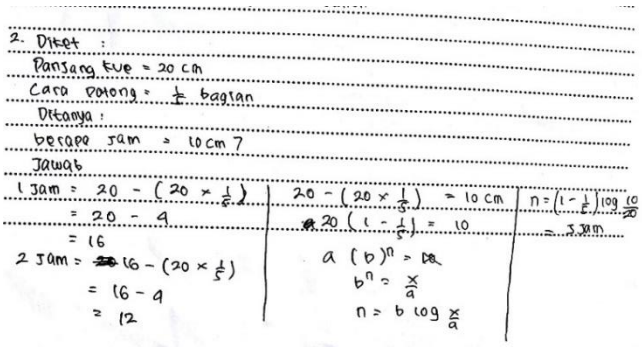

Figure 4. second part of student's answer for Q2

In question number 2, the student has also been able to understand, interpret both orally, and in writing, or in another visual form. This is seen in student assignment which is student was able to understand by writing what was known and asked and his answer is correct. It's also seen when researchers interviewed the student, and the student can explain it. Researchers ask:

R: "How did you do to solve the problem?"
S: "We know that the length of the cake is 20 cm, we cut it on 1/5 parts. The question asked how many hours for the cake to become 10 cm long. Well, at first I initially I count one by one but because I am lazy, I immediately solve it using the pattern. So the length of the cake is reduced by the length of the cake multiplied by 1/5 which is to equals 10 cm. By using factorizing, I continue to use the pattern, and I got that's n is equals to 3 hours.

From his answer, the student has been able to interpret the problem into a mathematical form, such as writing the problem into the form of logarithm that is $a.b^n = x$, and orally seen as in the above interview.

3. **Ability to demonstrate and describe through oral and written**

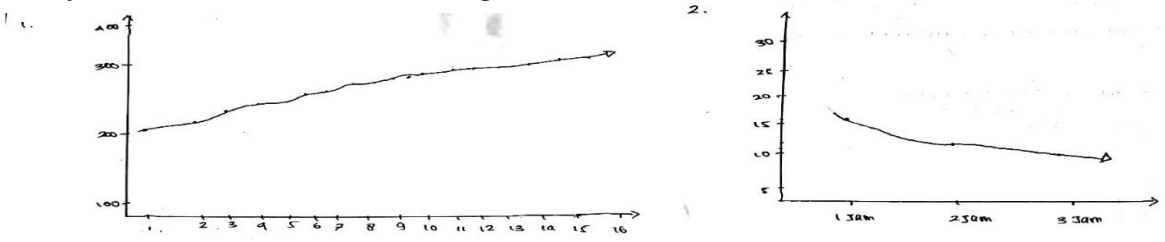

Figure. 5 graphs made by the student for Q1 (a) and Q2 (b)

The student has been able to demonstrate and illustrate in written. This is seen in the graphs made by the student for answer numbers 1&2. The student can draw a graph of upward function for question number 1 which means the number of population increases each years and decreases for problem number 2 because the brownies length will be reduced on each cuts. The student can explain orally as shown in interview below:

R: "Do you understand the graphics you made?"
S: "Yes. The graph on number 1 goes up, and on number 2 it goes down. So going up it means the base a is big, and if it goes down it's small.

Based on all the results it can be explained that student have been able to use mathematical communication skills well and meet the three indicators according to NCTM [1], although there is little error in writing, but in orally the student can already explain it. So, it can be said that the student has been able to use his communication skills both orally and in writing. The research by Fachrurazi conclude that there is an increase in mathematical communication, students who learn to use PBL model. Students using PBL experience improved mathematical communication than students using conventional learning [8]. Meanwhile, according to Hastuti the application of PBL can improve the communication skills of students of class VII. The improvement of mathematical communication ability can be seen from the percentage of improvement of the indicators. This means the PBL model works to improve students' mathematical communication [9].

CONCLUSION

The student has meet the three indicators of mathematical communication skills both orally and in writing although there is still a little mistake in writing.

ACKNOWLEGMENTS

The authors thank the Magister of Mathematics Education and Department of Mathematics Education Sanata Dharma University for the funding of this work.

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Certificate

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This is to certify that

Archangelia Maria Lelu

has participated in

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

Organized by Faculty of Mathematics and Natural Science,
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on May 7-8, 2018

as a

Presenter

with the paper entitled:

Analysis of The Mathematical Communication Ability of Grade X Student on The Logarithmic Functions

Dean,

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Yogyakarta, May 8, 2018
The Head of Commitee

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