

Proceeding

5th ICRIEMS

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
Universitas Negeri Yogyakarta

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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

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

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

		Page
	Front Cover	i
	Organizing Committee, Advisory Board, Editorial Board and Reviewers	ii
	Preface	iii
	Forewords From The Head of Committee	iv
	Forewords From The Dean of Faculty	v
	Conference Program	vi
	Table of Content	vii
	Regular Papers:	
	MATHEMATICS	
01	A Mathematical Model of Influenza Spread of Two Strains with Cross Immunity <i>Hilda Fahlana</i>	M – 1
02	Predicting TB Death Using Logistic Regression and Decision Tree on VA Data <i>Muhamad Rifki Taufik, Apiradee Lim, Phatrawan Tongkumchun, and Nurin Dureh</i>	M – 7
03	Position Estimation of ITSUNUSA AUV Based on Determined Trajectory using Kalman Filter (KF) <i>Teguh Herlambang, Subchan and Hendro Nurhadi</i>	M - 15
04	ARIMAX, FFNN, and Hybrid ARIMAX-FFNN Methods for Forecasting Pertamina <i>Uzlifatus Syarifah, Heri Kuswanto, and Suhartono</i>	M - 23
05	Modeling The Number of Infant Mortality in East Java Using Hierarchical Bayesian Approach <i>Prizka Rismawati Arum, Nur Iriawan, and Muhammad Mashuri</i>	M - 33
06	The Control Design on Non-Minimum Phase Nonlinear Systems with Relative Degree Two <i>Ahmadin, Janson Naiborhu, Roberd Saragih</i>	M - 41
07	Parameter Estimation of Bayesian Multivariate Regression Model with Informative Prior Distribution: Multivariate Normal and Inverse Wishart <i>Dewi Retno Sari Saputro, Dina Arieq Prasdika, Purnami Widyaningsih, and Kornelius Ronald Demu</i>	M - 47
08	Total Edge Irregularity Strength of Book Graphs of Several Types <i>Lucia Ratnasari, Sri Wahyuni, Yeni Susanti and Diah Junia E.P</i>	M - 57
09	The Estimation of Binary Nonparametric Regression Model based on The	M - 65

	Kernel Estimator by Generalized Additive Models Method <i>Suliyanto, Marisa Rifada, Eko Tjahjono and Sediono</i>	
10	The Norwegian Traffic Light Models and Its Modifications Using The Basic Petri Net <i>Tomi Tristono, Setiyo Daru Cahyono, Sutomo, and Pradityo Utomo</i>	M - 73
11	Goal Programming on Production Planning Using Ant Colony Optimization-Genetic Algorithm (ACOGA) <i>Dinita Rahmalia, Thomy Eko Saputro, Teguh Herlambang</i>	M - 81
12	Study Ethnomathematics: Classification of Geometrical Aspects of Traditional Timor Woven Fabrics by Ornamental Group <i>Erina Widiani</i>	M – 89
13	The Binary Logistic Regression for Index Numbers of Monthly Stock Price <i>Mutijah</i>	M - 97
14	Choosing Initial Hyper-Parameter Based on Simple Feature Data for Gaussian Process Time Series State Space Models <i>S S Sholihat</i>	M - 103
15	Claims Reserving Estimation for BPJS Using Archimedean Copulas <i>Yuciana Wilandari, Sri Haryatmi Kartiko, and Adhitya Ronnie Effendie</i>	M - 113
16	On The Inclusion Between Weak Lebesgue Spaces and Stummel Classes <i>N K Tumulun, H Gunawan, J Lindiarni</i>	M - 121

MATHEMATICS EDUCATION

01	Understanding How Blind Student Learn Rigorous Mathematical Thinking on Two-Dimensional Shapes <i>Andriyani</i>	ME – 1
02	Characteristics of Effective Mathematics Teachers in Rural Areas <i>Roseleena Sumiati and Jailani</i>	ME – 7
03	Analysis of Metacognitive Skills of Undergraduate Students in Solving Math Problems <i>Faliqul Jannah Firdausi</i>	ME – 15
04	Mathematics Disposition of Vocational High School Students Viewed by Adversity Quotient <i>Muhammad Darmawan Dewanto, Budiyono, Hasih Pratiwi</i>	ME - 29
05	Improving Students' Interpersonal Skills Through Problem-Based Learning <i>U Santria, and J Jailani</i>	ME - 37

06	Implementing Van Hiele Theory on Circle Module <i>Isnaeni Umi Machromah, Christina Kartika Sari, Mega Eriska Rosaria Purnomo</i>	ME - 45
07	Students' Geometry Skills Viewed from Van Hiele Thinking Level <i>Dwi Laila Sulistiowati, Tatang Herman, Al Jupri</i>	ME - 55
08	Students' Error in Derivatives of Functions Concept <i>Arum Dahlia Mufidah, Didi Suryadi, and Rizky Rosjanuardi</i>	ME - 63
09	Algebraic Skills on Solving PISA Problems <i>Luthfiah Asri and Zulkardi</i>	ME - 71
10	Learning to Think Mathematically Through Reasoning and Problem Solving in Secondary School Mathematics: A Literature Review <i>Nanang Ade Putra Yaman and Jailani</i>	ME - 77
11	Investigating Vocational School Students' Difficulties in Solving Basic Mathematics Problems as Their Prior Knowledge <i>Irham Baskoro, W Setyaningrum</i>	ME - 83
12	Implementation of Guided Inquiry Learning to Improve the Collaborative Skills of Mathematics <i>Syahlan Romadon and Ali Mahmudi</i>	ME - 91
13	Activated Scheme in Pattern Problems by Student with Low Mathematics Ability <i>Helti Lygia Mampouw, Agung Lukito, St. Suwarsono</i>	ME - 97
14	Mathematics Anxiety: Causes and the Effects on Student's Mathematics Achievement <i>Primaningtyas Nur Arifah and Djamilah Bondan Widjajanti</i>	ME - 105
15	Improving Student Interaction in Mathematics Learning Through Problem Based Learning <i>Nira Arsoetar, and J Jailani</i>	ME - 111
16	Modification of Polya's Step to Solve Math Story Problem <i>Isfa Hayyulbathin, Retno Winarni, Tri Murwaningsih</i>	ME - 119
17	Students' Understanding of Negatif Integers and Its Operations Based on Pseudo-Scaffolding <i>S N A Aziz, Y Fuad, and R Ekawati</i>	ME - 127
18	Students' Fraction Magnitude Knowledge in Solving Equation Word Problems <i>I K Amalina, Y Fuad, and Masriyah</i>	ME - 133
19	Task Commitment : Concept, Characteristic, and Its Relationship to Student Mathematics Achievements <i>N R Kurniasih and I Harta</i>	ME - 141

- 20 **Categorizations of Students' Reasoning Behavior for Solving Integer Comparison Problems in Elementary School** ME - 147
R Febriyanti, Y Fuad, and Masriyah
- 21 **Analysis and Evaluation of Decision-Making Factors Prospective Students Choose Department of Statistics (Case study on Student of Statistics Department UII Acceptance year 2015 – 2017)** ME - 155
Achmad Fauzan, Asmadhini Handayani Rahmah and Sendhyka Cakra Pradana
- 22 **Relationship Analysis Between Mathematics Problem Solving Skill and Student's Mathematics Anxiety Level** ME-163
Fatya Azizah and Hartono
- 23 **The Effectiveness of E-learning Media with Guided Discovery Method from The Perspective of Student's Mathematics Problem Solving Skill** ME-169
Ulfa Lu'luilmaknun and Dhoriva Urwatul Wutsqa
- 24 **Student's mathematical communication ability after applying missouri mathematics project with problem solving approach** ME-177
A Aprisal and A M Abadi
- 25 **An Analysis *Experiential Learning* on The Mathematical Critical Thinking Ability in Primary School** ME-185
Hamdah Munawaroh, Sudiyanto, Riyadi
- 26 **Identification of Calculation and Measurement Estimation Strategies Based on Visual-Spatial Intelligence** ME-193
Siti Lailiyah, Ahmad Lubab, Agus Prasetyo Kurniawan, Sutanti Dwi Payanti
- 27 **Longitudinal Study Process Cognitive for Mathematics Education Students In Problem Solving Mathematics and Physics** ME-201
Muh. Rizal and Jusman Mansyur
- 28 **Intertwining Characteristic In Realistic Mathematics Education (RME) In Learning of Linear and Quadratic Equations System** ME-211
Florensius Widodo Yulianto
- 29 **The Influence of *MathLite* on Motivation and Mathematics Anxiety of IV Graders Elementary School** ME-219
Yohana Setiawan and Yulia Ayriza
- 30 **Analysis of Students' Higher Order Thinking Skills in Solving The Contextual Problem** ME-225
Tea Tasia Wiwin, Marcellinus Andy Rudhito and Herman Joseph Sriyanto
- 31 **Problem Solving On The Linear Program** ME-233
Lokana Firda Amrina and R. Rosnawati
- 32 **Analysis of the Problem Solving Ability of VIII-A Student on Linear Equation System of Two Variables (LESTV)** ME-237
Bernadus Bin Frans Resi and Hongki Julie

- 33 **The Students' and Teacher Reflection for Introduction Probability Theory Course at 2016** ME-243
Hongki Julie
- 34 **Profile Students' Understanding on The Linear Equation and Inequalities in One Variable of Grade VIII Junior High School** ME-249
A. Sri Mardiyanti Syam, Heri Retnawati
- 35 **Improving the Ability of Mathematical Reasoning and Communication Student of Vocational High School** ME-257
Difia Esa Bunga and Ariyadi Wijaya
- 36 **The Relation between Curiosity, Self-efficacy and Student' Mathematical Reasoning Ability** ME-263
Hanifah Latifah Hadiat and Karyati
- 37 **The Instruments Development Of Cooperative Learning Model Type Murder With CTL Approach To Improve Mathematics Learning Achievement** ME-271
Nunung Fajar Kusuma, Mardiyana, dan Dewi Retno Sari S
- 38 **Bachelors of Mathematics Education Work as Non-educator: Why is It Happen?** ME-277
Sylviyani Hardiarti and Marsigit
- 39 **Development of Teaching Materials Based on Constructivism Theory to Improve Problem Solving and Mathematics Communication Skills of 5th Grade** ME-285
Siska Dian Anggraeni Christinningrum and Haryanto
- 40 **Algebra Problems of PISA-LIKE in Indonesian Mathematics Textbook** ME - 289
Amalia Agustina and Zulkardi
- 41 **Teaching Materials Based Development Of Art Traditional Geometri Kasab Aceh** ME - 295
Ariyani Muljo
- 42 **Effectiveness of Rigorous Mathematical Thinking on Mathematical Problem Solving** ME - 303
Yunita Herdiana, Elah Nurlaelah, and Dian Usdiyana
- 43 **Developing An Assessment Instrument Of Higher Order Thinking Skills (HOTS) In Mathematics For Junior High School: "Theoretical Analysis of HOTS According to the Expert"** ME - 311
Syaifulloh Bakhri, R.Rosnawati
- 44 **Should We Diagnose Difficulty Connections, Reasoning and Mathematical Proof to High School Students?** ME - 319
Tari Indriani and Heri Retnawati
- 45 **Lift The Flap Story Book Based Child-Friendly: An Innovative Literature** ME - 323

in Primary School Mathematics Learning

Kurnia Darmawati and Kus Eddy Sartono

- 46 **Mathematical Generalization : A Systematic Review and Synthesis of Literature** ME - 329
Fevi Rahmawati Suwanto and Ariyadi Wijaya
- 47 **Learning Motivation on Mathematics of Homeschooling Students** ME - 337
Bayu Adhiwibowo and Heri Retnawati
- 48 **Students' Error of Mathematics Problem-Solving in Ratio and Scale Material** ME - 343
Annisa Eprila Fauziah and Sugiman
- 49 **Analysis of Students Difficulties on Algebra Based on the Classification of SOLO Taxonomy** ME - 351
Putri Rahayu S and Agus Maman Abadi
- 50 **The Development of Reasoning and Proofing Questions in High School Mathematics (A Need Assessment)** ME - 359
Arina Husna Zaini dan Heri Retnawati
- 51 **The Analysis of Mathematical Understanding Ability on Derivatives Definition for Mathematics Education Students** ME - 363
Chintya Kurniawati and Hongki Julie
- 52 **PISA-Like Problems With Swimming Context** ME - 371
Eko Septiansyah Putra, Ratu Ilma Indra Putri, Ely Susanti
- 53 **Improving Mathematical Literacy of Problem Solving at The 5th Grade of Primary Students** ME - 379
Umi Zainiyah and Marsigit
- 54 **Pisa-Like Mathematics Task Using Weight-Lifting Context** ME - 387
Dian Fitra, Ratu Ilma Indra Putri and Ely Susanti
- 55 **Self-Regulated Learning Mathematics of Students in Secondary School** ME - 393
Budi Yanto and Heri Retnawati
- 56 **Need Assessment Device Development of Measurement Test of Connection and Mathematics Representation of Class XI** ME - 399
Sofi Saifiyah and Heri Retnawati
- 57 **Relationship between The Ability of Mathematical Reasoning and Emotional Quotient (EQ) Students Secondary School** ME - 405
Helva Elentriana and Hartono
- 58 **Computers in Mathematics Learning : Training Mental Number Line to Increase Counting Ability** ME - 411
Sri Retnowati, Siti Maghfirotn Amin, Elly Matul Imah

59	PISA-Like Mathematics Problems Using Road Cycling Context in Asian Games <i>Levana Maharani, Ratu Ilma Indra Putri, and Yusuf Hartono</i>	ME - 417
60	Spatial Visualization in Visual Thinking of Polyhedron Materials Viewed from Mathematical Ability <i>Jaka Fadlin, Mega Teguh Budiarto, and Masriyah</i>	ME - 423
61	Students' Skills in Teaching Statistics on the Simulation Process of High School Mathematics Learning Course <i>Maria Suci Apriani</i>	ME - 429
62	Efforts to Increase Self-Confidence Students Junior High School in Learning Mathematics with Discovery Learning Method <i>Lana Sugiarti, Jailani</i>	ME - 435
63	The Representations of Mathematics Education Students In Solving Algebra Problems <i>Baiduri</i>	ME - 441
64	Influence of Discovery Learning Model with Aptitude Treatment Interaction Strategy on Student Mathematics Concept Understanding <i>Arny Hada Inda dan Djamilah Bondan Widjayanti</i>	ME - 449
65	Analysis Characteristic of Diagnostic Instrument to Measure Error of Mathematics Problem Solving based on Politomus <i>Muhamad Arfan Septiawan, Heri Retnawati</i>	ME - 455
66	Process of Students Thinking in Geometry's Room Problems in X Grade of Public Senior High School 1 Manyar Gresik <i>Sutini, Aning Wida Yanti</i>	ME - 461
67	What is The Urgency of Students' Mathematical Literacy, Reasoning and Metacognition Skill Analyzing? <i>Yustine Maulina and Heri Retnawati</i>	ME - 467
68	The Use of TAPPS in Mathematics Learning: Is It Good or Not? <i>Ahmad Wafa Nizami, and Ali Mahmudi</i>	ME - 473
69	A Two-Tier Diagnostic Test Instrument on Calculus Material: What, Why, and How? <i>Asma' Khiyarunnisa' and Heri Retnawati</i>	ME - 479
70	The Process of Scientific Thinking in Mathematics Learning: Geometry in Senior High School <i>Indra Ivanti Siregar, Budiyono, Isnandar Slamet</i>	ME - 485
71	Design Learning Mathematics With Sport in Asian Games 2018 <i>Chika Rahayu, Ratu Ilma Indra Putri, Zulkardi, Ely Susanti</i>	ME - 491
72	The Analysis of Students' Spatial Ability of 8th Grade on The Block And Cube Material <i>Wike Ellissi and Hongki Julie</i>	ME - 501

- 73 **Analysis of the Mathematical Communication Ability of Grade X Student on the Logarithmic Functions** ME - 507
Archangelia Maria Lelu and Hongki Julie
- 74 **Analyzing Student's Ways of Thinking on Fraction Estimation: A Case of Student from Rural Area** ME - 513
Trisno Ikhwanudin, Wahyudin and Sufyani Prabawanto
- 75 **Mathematics Education Students' Metaphorical Understanding of Mathematics Problem Solving** ME - 521
Ika Santia
- 76 **A Semiotic Analysis Of Pattern Generalization: A Case of Formal Operational Student** ME - 527
Mu'jizatin Fadiana, Siti M Amin, Agung Lukito
- 77 **Team Assisted Individualization to Improve Student's Self Confidence in Mathematics Learning** ME - 535
Resvita Febrima, Jailani
- 78 **Game-Based Edutainment Media Using Guided Discovery Approach: What teachers say?** ME - 541
Riska Ayu Ardani and Wahyu Setyaningrum
- 79 **Analysis of Mathematical Ability of Mathematics Students As Candidate of Teachers in Solving Mathematical Problem** ME - 549
Muh. Samad Rumalean, Dwi Juniati, Mega Teguh Budiarto
- 80 **Mathematical Abstraction of Junior High School Students With Process CRA (Concrete Representational Abstract) Approach** ME - 553
Annisa Nurainy
- 81 **Students' Metacognition in Problem Solving of Trigonometric Identity in term of Learning Styles** ME - 561
M Muklis, Mega Teguh Budiarto, and Manuهارawati
- 82 **Students Descriptions in Problem-Solving Based on Cognitive Domain Bloom's Taxonomy Viewed from Logical-Mathematical Intelligence** ME - 569
Arif Widayanto, Hasih Pratiwi, and Mardiyana
- 83 **Creative Thinking Process on FI and FD Students in Mathematics Problem Solving** ME - 577
Ika Setyana, Tri Atmojo Kusmayadi, and Ikrar Pramudya
- 84 **PISA-Like Problem with Golf Context in ASIAN GAMES 2018** ME - 583
Dewi Rawani, Ratu Ilma Indra Putri and Hapizah
- 85 **The Implementation of Case-based Learning Viewed from Mathematical Connection Ability** ME - 591
Erlinda Rahma Dewi and Marsigit
- 86 **Mathematical Thinking Ability in Solving Mathematics Problems** ME - 597

Consider Cognitive Styles of Field Independent and Field Dependent

Eva Dwi Minarti, Ratni Purwasih, Ratna Sariningsih

- 87 **An Ability of Mathematical Connection in Trigonometric Problem-solving Viewed from The Tenth Grade Students' Mathematics Logical Intelligence** ME - 603
Sarkam and Imam Sujadi, Sri Subanti
- 88 **Effects of Enhancing Computational Thinking Skills using Educational Robotics Activities for Secondary Students** ME - 613
Muneeroh Phadung, Sirichai Namburi, Praewsree Dermrach, and Ismaae Latekeh
- 89 **Analysis of Students' Error on Quadratic Factoring** ME - 619
Bagus Ardi Saputro, Didi Suryadi, Rizky Rosjanuardi and Bana G. Kartasasmita
- 90 **The Effects of the Use of the Child-Friendly Based Lift the Flap Story Book toward Students' Mathematical Connection Skill** ME - 623
Dwi Ardi Meylana, Pratiwi Pujiastuti and Kus Eddy Sartono
- 91 **Effect of Cooperative Learning Type Student Team Achievement Division (STAD) on Mathematics Learning Result of Students of SMP Negeri 7 Yogyakarta** ME - 629
Astri Wahyuni

PHYSICS

- 01 **The Designing and Constructing of the Simplest Pico- hydropower Generator for the Rural Community** P-1
Eleeyah Saniso
- 02 **Evaluation Of Thermal Insulation Efficiency From Areca Palm Fiber** P-8
Roseleena Jarawae
- 03 **Sensitivity and Linearity Test Weight Sensor Based on Polymer Optical Fiber with Circular Form and TiO₂ Nanoparticles as a Coating on Cladding** P-16
Yohana Putri Safitri and Heru Kuswanto
- 04 **Fiber Optic Humidity Sensor Based on Polymer Optical Fiber Coated with Silver Nanoparticles** P-22
Ichwan Abimanyu and Heru Kuswanto
- 05 **Selokan Mataram Water Filtering Using Active Carbon of Coconut Shell, Indrayanti Sand and Zeolit Stone** P-26
Amar Amrullah, Angga Fajar Setiawan, Dedi Sastradika, Arneta Dwi Safitri, Suparno
- 06 **Abrasion and Accretion in Batam Island** P-32
Arif Roziqin and Oktavianto Gustin

- 07 **Mechanical Test Characteristics of Terminalia Catappa Fruit Fiber Composite Material** P-40
Iwan Dahlan, Aris Doyan and Kosim
- 08 **Microtremor Survey In Landslide Zone Of Ngroto Girimulyo Kulonprogo Yogyakarta** P-48
Novia Nurul Khayati, Denny Darmawan, Bambang Ruwanto, Laila Katriani, Nugroho Budi Wibowo
- 09 **Soil Erosion and Conservation in Kokap Yogyakarta: An Analysis Using Geospatial Information** P-52
Arif Roziqin and Oktavianto Gustin

PHYSICS EDUCATION

- 01 **Effect of Free Inquiry Models to Learning Achievement and Character of Student Class IX** PE-1
Melkyanus Kaleka
- 02 **Megabiodiversity Utilization Model for Sciences Material to Improve Technology Literacy And Patriotism Character** PE-6
Sukardiyono and Dadan Rosana
- 03 **Developing Set of Physics Learning Based on Elaboration Learning (EL) to Increase Concept Comprehension and Scientific Attitude** PE-20
Yosaphat Sumardi and Asti Dwi Kusumawati
- 04 **Development of Physics Instructional Media by Using The Cultural Theme (Rowboat) Based on Android Mobile Phone for Junior High School Students** PE-30
Mulinda Dewi Lestari and Heru Kuswanto
- 05 **The Effectiveness of Local Wisdom-Based Teaching Materials of Physics at Hulu Sungai Selatan** PE-36
Syubhan An'nur, Khalid and Misbah
- 06 **The Effect of Gender on Higher Order Thinking Skills Students in Subject of Work and Energy** PE-44
Anggita Permatasari, Wartono and Sentot Kusairi
- 07 **Students' Conception on Momentum and Impulse toward Higher Order Thinking Skill** PE-50
A Wilujeng Afifah Al Faizaha, Suparmi and Nonoh Siti Aminah
- 08 **Influence of E-learning on PBL Model in Physics Learning at Student's Scientific Literacy Skill and Analytical Thinking Skill** PE-56
Bayu Setiaji and Jumadi
- 09 **The Effect of Project Based Learning as Learning Innovation in Applied Physics** PE-68
Chairatul Umamah and Herman Jufri Andi

- 10 **The Effects of Creativity and Student-Teacher Interaction on Scientific Literacy Skill** PE-76
S Ridho, N S Aminah and A Supriyanto
- 11 **Developing The Android-Assisted Physics Interactive Learning Media to Reduce Senior High School Students' Misconception About Physics and Improve Their Attitude Towards It** PE-82
Nani Mardiani and Heru Kuswanto
- 12 **Analysis of Senior High School Students' Higher Order Thinking Skills in Physics Learning** PE-90
Septi Ria Maulita, Sukarmin, Ahmad Marzuki

CHEMISTRY

- 01 **Optimization Of Plasticizer Glycerol In Edible Film Based Water Hyacinth (Eichornia Crossipes) Starch** C – 01
Abidah Walfathiyyah, Angli Pramudita Kusuma, Febi Nur Cahya Witana, Nurriza Qusyairi and Dewi Wahyuningtyas
- 02 **Preparation and Quality Control of I-131 Capsules for Therapy** C – 11
Adang H.G., Hotman L., Sriyono, Maskur, Wida R., Yayan T., Amal R.P., Purwoko, Yono S., Enny L., Sri Aguswarini, Karyadi, Abidin, and Hambali
- 03 **The Effectivity of Arowana Pinoh (Scleropages macrocephalus) Vitellogenin Production using Estradiol Stimulation by Injection and Oral.** C – 19
Ahmad Musa and Rina Hirnawati
- 04 **Biodiesel Synthesised from Nyamplung Seed Oil (*Callopyllum inophyllum*) at Various Conditions of Transesterification Used KOH as Catalyst** C – 25
Endang Dwi Siswani, Susila Kristianingrum, Suyanta, and Annisa Fillaeli

CHEMISTRY EDUCATION

- 01 **Identification of Chemical Basic Cognitive Ability and Learning Styles as References for Chemical Learning Optimization** CE – 01
Atiek Winarti and Almubarak
- 02 **Students' Scientific Literacy Profile in Karanganyar** CE – 13
Betharia Siregar, Elfi Susanti Van Hayus, and Sri Yamtinah
- 03 **Developing of NGSS-oriented Teaching Materials in the Bundle of Matter and Its Interactions for High School Chemistry Classroom** CE – 19
Dyah Fitriani Sani, Hidayatun Nafiah, Via Riska Andani, and A. K. Prodjosantoso
- 04 **Teachers' Perception of Science Generic Skills in Chemistry Learning** CE – 25
Eva Lutviani, Sentot Budi R, Elvi Susanti VH, Sri Yamtinah, Sulisty Saputro, and Sri Mulyani

- 05 **The Development of HTML5-based Virtual Chemistry Laboratory (VICH-LAB) Media on Acid-Base Material to Improve High School Students' Self-Efficacy** CE – 31
Fitriana Ibrahim, Kristian Handoyo Sugiyarto, and Jaslin Ikhsan
- 06 **Students' Scientific Reasoning Ability in High School Chemistry** CE – 39
Kharisma Resti Kurnia Diah Sangandita, Agung Nugroho Catur Saputro, and Nurma Yunita Indriyanti
- 07 **The Influence Of Technological Pedagogical And Content Knowledge Approach On Scientific Literacy And Social Skills** CE – 47
Luthfia Ulva Irmita, and Sri Atun
- 08 **Design and Validation of STEM-based Lesson Plan to Empowering Student's Critical Thinking Skill in Stoichiometry** CE – 55
Nirmala Chayati, Mohammad Masykuri, and Suryadi Budi Utomo
- 09 **The Content Validity of Instrument of Character Education in Chemistry Learning** CE – 63
Novaliah, and Badrun Kartowagiran
- 10 **The Effectiveness of Implementation of Virtual Based Guided-Inquiry Module on Thermochemistry Concept at One of State Senior High School in Selong** CE – 71
Rifqi Pratama, Mohammad Masykuri, and Ashadi
- 11 **Profile of Senior High School Students on Scientific Literacy Skills** CE – 77
Riza Dwi Pupspitasari, Sri Poedjiastoeti and Pirim Setiarso
- 12 **The Use of Problem-Based Learning Supported by Virtual Laboratory to Improve the Ability of Chemical Representation on Metal Coating** CE – 83
Sri Nuryanti, Mohammad Masykuri, and Endang Susilowati
- 13 **Teacher's Understanding of Science Literation in Learning Chemistry** CE – 91
Stefanus Kristiyanto, Ashadi, Sri Yamtinah, Sulisty Saputro, and Sri Mulyani
- 14 **The Effectiveness of Student Worksheet Based on Problem Solving to Enhance Scientific Literacy** CE – 99
Vioni Kurnia Armus, and Suyanta

BIOLOGY

- 01 **The Construction of ARandugunting Dam As A Water Resources Conservation Effort in Blora Regency** B – 01
Hani Dwi Trisnarningsih and Dwi P. Sasongko
- 02 **The effect of comic to increase the knowledge about nutrition in Kalasan** B – 09
Daru Retnowati

BIOLOGY EDUCATION

- | | | |
|----|---|---------|
| 01 | Infection Model of Guided Inquiry to Improve Ability High Order Thinking Skills of Students Course Plant Morphology
<i>Marike Muskitta, Bambang Subali, Djukri, and Bagus Endri Yanto</i> | BE- 01 |
| 02 | Learning Science Based on Green Economy to Enhance Student Entrepreneurial Mindset of Secondary School
<i>Kodirin, and Heru Nurcahyo</i> | BE – 05 |
| 03 | Perception Teacher About Media Quipper School for Improve Learning Management
<i>Miftahul Khairani, and Slamet Suyanto</i> | BE – 13 |
| 04 | Effect Of Web-Based Learning Quipper School, On High School Student Motivation
<i>Lady Rahmawati, and Slamet Suyanto</i> | BE – 19 |
| 05 | Development of Concept Mastery Tests Polymerase Chain Reaction in Molecular Biology
<i>Evi Suryanti, Any Fitriani, Sri Redjeki, and Riandi</i> | BE – 27 |
| 06 | The Effect of Socio-scientific Issues on Biology Learning Towards Student's Reflective Judgement and Humanistic Knowledge
<i>Lisdyawati Harun A.T, and Slamet Suyanto</i> | BE – 33 |
| 07 | Development of Student Worksheet Based on Local Wisdom with Discovery Learning Model
<i>Laras Auliantika Hapsari and I.G.P. Suryadarma</i> | BE – 39 |
| 08 | Development of Student Worksheet based on Outdoor Activities to Increase Critical Thinking Skills
<i>Hafidhah Hasanah and I.G.P. Suryadarma</i> | BE – 49 |
| 09 | Development of Technological Pedagogical Content Knowledge (Tpack) Instrument for Biology Preservice Teachers
<i>Wahyu Oktamarsetyani and Paidi</i> | BE – 57 |
| 10 | Implementation of Socio-Scientific Issues Based Instruction to Improve Critical Thinking Skills in Biology Learning
<i>Yakun Paristri and Slamet Suyanto</i> | BE – 65 |
| 11 | Instrument Test Design of Scientific Creativity in Ecosystem Topics based on Hu & Adey
<i>Nandhika Wahyu Sahputra and Tien Aminatun</i> | BE – 73 |
| 12 | The Pedagogical Competence of Biology Teacher Candidates
<i>Kukuh Munandar, Muslimin Ibrahim, and Leny Yuanita</i> | BE – 81 |
| 13 | Developing Instrument of Motivation to Become a Teacher for Student in Biology Education Study Program
<i>Nastia Cahyaning Ahsani and Paidi</i> | BE – 87 |

- 14 **The Effect of Using E-module Isolation and Characterization Bacteria for Biology Enrichment Program to Improve Cognitive Learning Outcomes** BE – 95
Dyah Aniza Kismiati and Heru Nurcahyo
- 15 **Development of an Alternative Assessment of Scientific Literature Skills for Students of Prospective Biology Teacher** BE – 103
Murni Sapta Sari, Sunarmi, Eko Sri Sulasmi, and Herlizza Basyarotun Amaliah
- 16 **Lecturers' Perceptions of the Empowerment of Students' Argumentation Skill and the Challenges of Teaching the Skill to Students** BE – 111
Astuti Muh. Amin and Romi Adiansyah
- 17 **The Influence of Contextual Teaching And Learning (CTL) towards Chritical Thinking and Problem Solving Ability on Skeletal System Materials** BE – 117
Riska Septia Wahyuningtyas and Wuryadi

SCIENCE EDUCATION

- 01 **The Effects of Sintering Time on The Properties of Hydroxyapatite Nano Crystals** SE-1
Nurlely, Djarwani S. Soejoko1, and Rahmi Febriani
- 02 **Effectiveness Worksheet of The Global Warming Based on Problem to Improve Students Science Literacy** SE-9
Sasmita Erzana, Sunyono, and Chandra Ertikanto
- 03 **Analysis of Science Literacy Tests in Senior High School Students of Brebes District** SE-17
Ardina T.P. Retno, Afrizal Abdi M
- 04 **Elementary Teacher Profile about Assessment of Higher Order Thinking Skills (HOTS) in 2013 Curriculum** SE-25
Gunaning Epinasti, ST.Y.Slamet, and Sri Yamtinah
- 05 **Examining of Information Literacy and Science Process Skills towards Grade Point Average: A Preliminary Research** SE-31
Hasan Subekti, Herawati Susilo, Ibrohim, and Hadi Suwono
- 06 **Multiple-Choice With Reason (MCR) To Measure The Critical Thinking Skill On Natural Science : Plant and Animal Movement System** SE-35
Taufiq Satria Mukti, Edi Istiyono
- 07 **The Implementation of Science Learning Model Based Child Friendly School in SDN 1 Ampenan Mataram City** SE-41
Siti Ruqoiyyah, Erni Munastiwi
- 08 **The Importance of Inquiry Learning for Training student's Thinking Skill in Secondary School** SE-47
Linda Ochtivah Widiyastuti, Baskoro Adi Prayitno, and Ashadi

- 09 **Physiologic Characteristic of Transgenic Rice (*Oryza Sativa* L.) Overexpression SoSUT1 Gene** SE-53
Cesha Ananda Putri, Bambang Sugiharto, and Parawita Dewanti
- 10 **Pre-Service Elementary Teachers (PETs) Perception toward the Scipreneur's Concept (Entrepreneurship in Science)** SE-57
Idam Ragil Widianto Atmojo, Sajidan, Widha Sunaryo, Ashadi, and Dewanto Harjunowibowo
- 11 **The Effect of Knowledge about Drugs and HIV/AIDS on Teenagers' Premarital Sexual Behaviors in Yogyakarta** SE-63
Muhammad Agus Hardiansyah, Badrun Kartowargiran, and Setyabudi Indartono
- 12 **Primary Teacher's View on STEM Education: A Case of Pre-Service Teachers in a Professional Development Program** SE-71
Naomi Dias Laksita Dewi
- 13 **Lesson Plan for STEM Approach at a Junior High School in Yogyakarta** SE-79
Tarsisius Sarkim, Albertus Hariwangsa Panuluh, and Hongki Julie
- 14 **The Effects of Guided Inquiry Learning Model Toward Seventh Grade Students' Scientific Literacy on The Classification of Living Things Material** SE-85
Nadia Listianingrum, Maridi, and Nonoh Siti Aminah
- 15 **The Effects of Android-Assisted Creative Problem Solving Learning Model towards The Improvement of Students' Scientific Literacy** SE-89
Rasyid Zuhdi, Senam, Insih Wilujeng, and Jumadi
- 16 **Science Teacher's Response on Implementation of Integrated Science Learning in Junior High School** SE-95
Wiwin Puspita Hadi, and Irsad Rosidi
- 17 **User Experience Analysis Utilization of Virtual Reality Technology on Application About Ancient Human Life *Homo Soloensis*** SE-99
Fendi Aji Purnomo, Eko Harry Pratisto, Firma Sahrul Bahtiar, Berliana Kusuma Riasti, and Nahwan Adhiguna Pratama
- 18 **The Effect of SETS Learning with Android on Scientific Literacy and Cross Disciplinary Knowledge** SE-105
Dita Dzata Mirrota, Senam, Jumadi, and Insih Wilujeng
- 19 **Adapting Next Generation Science Standard to Improve Using Mathematics Computational Thinking in Science Learning** SE-113
L. W. Hapsari, D. Rosana, A.K Prodjosantoso, I. Wilujeng, and IGP. Suryadarma
- 20 **The Effectiveness of Science Learning Outcome Based on the Next Generations Science Standard** SE-119
Amiratul Ratna Putri, I Gusti Putu Suryadarma, Insih Wilujeng, and AK. Prodjosantoso
- 21 **Development of Learning Video Based on Local Potential** SE-129
Anis Setyawati, I Gusti Putu Suryadarma, and Insih Wilujeng

- 22 **Effectiveness of Education for Environmental Sustainable Development to Enhance Environmental Literacy** SE-135
Anita Ekantini, Insih Wilujeng
- 23 **A Training Model for Pre-Service Science Teacher to Develop The Competency of Test Instrument Arrangement Based on International Mapping and Benchmarking** SE-145
Dadan Rosana, Eko Widodo, Didik Setyawarno, and Wita Setianingsih
- 24 **Effectiveness Interactive Multimedia of Digestive System Based on Guided Inquiry to Improve Science Literacy** SE-155
Dwi Jayanthi, Sunyono, and Tri Jalmo
- 25 **Effect of Guided Inquiry Learning Model with Virtual and Real Learning Media on the Improvement of Learning Result Viewed from Critical Thinking Skills of the Students** SE-163
Emi Wijayanti, Ashadi, and Widha
- 26 **Development the Science Learning Planning Based on Pedagogy for Sustainability in Global Warming Themes to Grow Environmental Literacy of Junior High School Students** SE-171
Susilowati, I. Wilujeng, and Purwanti Widhy H
- 27 **Developing Video for Food Analysis Course on the Subject of Effect of Yeast, Sugar, and Gluten to Bread Leavening** SE-177
Andian Ari Anggraeni, Mutiara Nugraheni, and Wika Rinawati

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) interventionist: 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

$$n \text{ tahun} \rightarrow \text{Juml. Penduduk} + (\text{Juml. Penduduk} \times \text{Laju Pertumbuhan}) = 300$$

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

$$\begin{aligned} 1 \text{ Jam} &= 20 - (20 \times \frac{1}{5}) \\ &= 20 - 4 \\ &= 16 \\ 2 \text{ Jam} &= 16 - (20 \times \frac{1}{5}) \\ &= 16 - 4 \\ &= 12 \end{aligned}$$

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

$$\begin{aligned} n \text{ tahun} \rightarrow \text{Juml. Penduduk} + (\text{Juml. Penduduk} \times \text{Laju Pertumbuhan}) &= 300 \\ \frac{300}{200} + (200 \times 0,025) &= 300 \\ 200 (1 + 0,025) &= 300 \\ a (b)^n &= x \\ b^n &= \frac{x}{a} \\ n &= \frac{\log x}{\log a} \\ n &= \frac{\log 300}{\log 200} \\ n &= 16 \text{ tahun} \end{aligned}$$

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 $a \cdot b^n = x$, and orally as seen in the above interview.

Q2

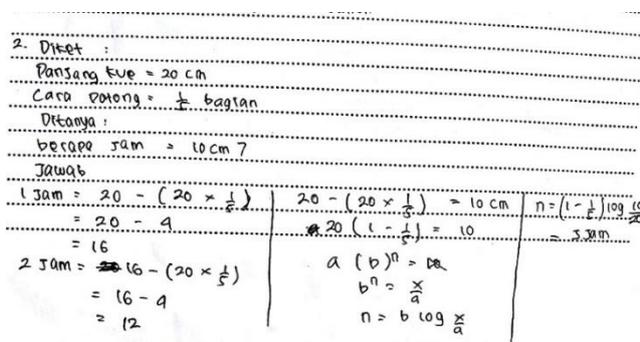


Figure 4. second part of student's answer for Q2

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 $a \cdot b^n = x$, and orally seen as in the above interview.

3. Ability to demonstrate and describe through oral and written

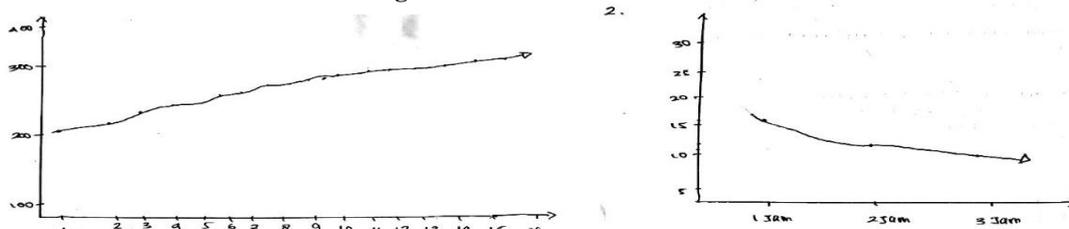


Figure. 5 graphs made by the student for Q1 (a) and Q2 (b)

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.

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Certificate

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as a

Presenter

with the paper entitled:

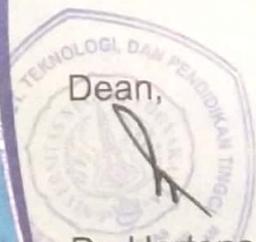
Analysis of The Mathematical Communication Ability of Grade X Student on The Logarithmic Functions

Yogyakarta, May 8, 2018
The Head of Committee



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