

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

ISBN 978-602-74529-3-0



Proceeding

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

5th ICRIEMS



ISBN 978-602-74529-3-0

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

Organizing Committee:

Agung Wijaya Subianto, Ed.D. (Chair)
Kismiantini, Ph.D. (Vice Chair)
Nur Aeni Ariyanti, Ph.D (Secretary)
Dr. Sri Andayani (Treasury)
Dr. Karyati (Program Coordinator)

Advisory Board (Steering Committee):

Prof. Dr. Wim T van Horssen (TU Delft, Netherland)
Prof. Dr. Yoshisuke Kumano (Shizuoka University, Japan)
Prof. Saberi Bin Othman (Universiti Pendidikan Sultan Idris, Malaysia)
Prof. Dr. Mudasir, M.Eng. (Universitas Gadjah Mada, Indonesia)
Osva Antonio Montesinos Lopez, Ph.D (University of Colima, Mexico)
Allen Price, Ph.D (Emmanuel College Boston, USA)
Hasan Daupor, Ph.D (Yala Rajabhat University, Thailand)
Dr. Hartono (Dean, Advisory Board Chair, Universitas Negeri Yogyakarta)
Dr. Slamet Suyanto (Vice Dean, Universitas Negeri Yogyakarta)

Reviewers:

Prof. Ferry Butar Butar, Ph.D. (Sam Houston State University, USA)
Prof. Muammer Calik, Ph.D. (Karadeniz Technical University, Turkey)
Prof. Dr. Fang-Ying Yang (National Taiwan Normal University)
Prof. (Assoc.) Dr. Azmi Mohamed (Universiti Pendidikan Sultan Idris, Malaysia)
Prof. Dr. Marsigit (Yogyakarta State University)
Prof. Dr. Jumadi (Yogyakarta State University)
Prof. Dr. Sriatun (Yogyakarta State University)
Prof. Dr. A.K. Prodjosantoso (Yogyakarta State University)
Prof. Dr. IGP. Suryadarma (Yogyakarta State University)
Prof. Dr. Bambang Subali (Yogyakarta State University)
Prof. Dr. Zuhdan Kun Prasetyo (Yogyakarta State University)

Editors:

Dr. Supardi
Evy Yulianti, M.Sc.
Nikenasih Binatari, M.Si.
Himmawati Puji Lestari, M.Si.
Didik Setyawarno, M.Pd.
Marfuatun, M.Si.

Published by:

FMIPA Universitas Negeri Yogyakarta
Karangmalang, Yogyakarta 55281
Tel. (0274)550227, Fax. (0274)548203
© October 2018

ISBN 978-602-74529-3-0

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

The Analysis of Students' Spatial Ability of 8th Grade on The Block And Cube Material

Wike Ellissi^{1, a)} and Hongki Julie^{2, b)}

¹Magister of mathematics Education, Faculty of Teacher Training and Education, Sanata Dharma University

²Departemen of mathematics Education, Faculty of Teacher Training and Education, Sanata Dharma University

^{a)}wike.elis@gmail.com

^{b)}hongkijulie@yahoo.co.id

Abstract. The goal of this research was to describe the spatial ability of 8th grade in a Junior High School in Yogyakarta after they followed the teaching learning process using the realistic mathematics approach. The kind of this research was design research developed by Gravemeijer and Cobb. The analysis involved correct student answers. Data was collected using test and interview. The steps of data analysis of this research were data reduction, data presentation, and conclusion. The results of the research showed that : (1) students were able to draw the block composed of the unit cubes (students used the concept of a factor of the block volume to determine the length, width, and height of the block); (2) students have understood the iterative pattern of the cube arrangement in columns and rows, so that students were able calculated the volume of an object composed of the cubes unit that was presented in the two-dimensional image form; (3) students were able to determine the surface area of the three-dimensional shape composed of the block and cube that was presented in the two-dimensional image form.

INTRODUCTION

One of the important issues in learning mathematics is to introduce students to learn the solids material in the form of geometry. Students should come to the study of geometry in the middle grades with informal knowledge about lines, fields, and variations of two- and three-dimensional shapes [1]. In middle-grades, students investigate relationships by drawing, measuring, visualizing, comparing, transforming, and classifying geometric objects [1].

Ben-Haim, et al [2] showed that to be able to calculated the volume of an object composed of the cubes unit, students should be able to coordinated and integrated the view arrangement either in the realization of block arrangement or image representation. The same thing is stated in research Revina et al. [3], which stated that many prior researchers found that most of students in grade five have difficulty in understanding the concept of volume measurement, because they have spatial structuring competence.

McGee [4] described two components of the spatial capability, namely spatial visualization and spatial orientation. According to Guilford and Lacey [4] Spatial visualization is the ability to manipulate, rotate, or reverse objects without refer to themselves. Spatial orientation is often interpreted as the ability to imagine the shape of an object from the view (perspective) of different observers [4].

In addition, Titus & Horsman [3] define spatial visualization as an ability involving mental skills to manipulate and rotate images into other compositions and imagine what is inside solid objects. Further Ben Haim, et al [2] stated that the skill to "read" a two-dimensional images representation of solids is part of the ability of spatial visualization.

Based on an interview conducted with a mathematics teacher in class VIII at one of the private junior high school that in understanding the concept of measurement of bloks volume using unit cubes, students were immediately faced with a two-dimensional problem of geometric objects. So students were required to understand two-dimensional representations such as images of a geometric solid objects. Students have difficulty in understanding the concept of measuring the volume of a blok through two-dimensions of a geometric object. The difficulty was caused by the teacher's ignorance in paying attention to the spatial visualization ability of students in learning.

From these situations, the applied mathematics learning is less meaningful because the students were not faced with real context such as unit of cubes in understanding the concept of measurement of blok volume. For that,

required a model of learning that begins with real problems so that students are directly involved to construct their own knowledge in understanding the concept of measurement of blok volume. One way that can be done used the realistic mathematics learning approach. The results of research by Revina et al [3] showed that the building blocks activity has helped the students to coordinate the separation of views of the arrays. They need to practice with more concrete tasks of increasing complexity the structure complexity which they can acquire personally constructed view of the organization of the three-dimensional rectangular arrays [3].

Realistic Mathematics Education (RME) was one of the best learning alternatives to solve the problem because in this learning model students were required to construct knowledge with their own ability through the activities undertaken in learning. This RME refers to Freudenthal's opinion that mathematics is a human activity [5]. According to Freudenthal, mathematics must be related to reality, close to the students and relevant to the community to be meaningful [6]. Basically realistic mathematics learning is the utilization of reality and the environment experienced by students to optimize the process of learning mathematics. In realistic mathematics learning, the role of teachers as mentors and facilitators [7]. Gravemeijer [7] mentions that the role of the teacher must also change, from a validator (stating whether the student's work and answers are right or wrong), becomes a mentor who respects each student's contribution (work and answers).

From the problem above then the problem formulation in this research was how the spatial ability of the students of class VIII SMP after they followed the teaching learning process using the realistic mathematics approach when they solve the surface area and volume problem of bloks and cubes.

RESEARCH METHOD

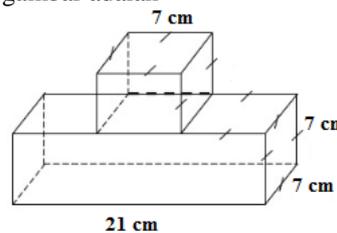
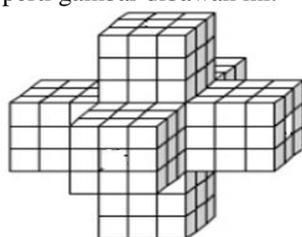
The type of the research was a design research developed by Gravemeijer and Cobb. The subject of the research were two students of class VIII in one of private junior high school in Yogyakarta. The analysis involved correct student answers. Data was collected by giving test and condutions interviews on the forms of mathematical spatial ability. The instruments used was test sheets and interview sheets. This research process was carried out from designing hypothetical learning trajectory (HLT), implementation of HLT in learning, and spatial ability test. Data analysis used were data reduction, data presentation, and conclusion. Data reduction is done by sorting data from result of student answer sheet and result of interview which is grouped based on indicator of spatial ability of student, then presented based on indicator of spatial ability of student, and finally the researchers could conclude the students' spatial ability analysis and the strategies students used in solving the problem.

Indicators of spatial ability in this research are (a) drawing the blok composed of unit cubes in the field of two-dimensional, (b) determining the volume of an object composed of the cubes unit in a two-dimensional image, and (c) determining the surface area of the three-dimensional shape composed of the block and cube in the field of two-dimensional.

Tina ingin merancang bangunan berbentuk balok dengan menggunakan 16 kubus satuan. Seperti apa bentuk bangunan yang dapat dibuat Tina ?

Desi sedang merancang model menara dari kubus-kubus satuan sehingga terbentuk model menara seperti gambar dibawah ini.

Perhatikan gambar dibawah ini. Luas permukaan bangun pada gambar adalah



Tentukan banyaknya seluruh kubus satuan yang dibutuhkan Desi untuk membuat menara ini.

(a)

(b)

(c)

FIGURE 1. Student Test Sheet to Problem Number 1 (a), Problem Number 2 (b), and Problem Number 3 (c)

RESULT AND DISCUSSION

Based on the research process that has been done, explanation of each stages of the research can be describe as follows.

Stage I: designing hypothetical learning trajectory (HLT).

The learning objectives are (1) students can rediscover of surface cube and block formulas; (2) students can rediscover of volume of cube and block formulas; (3) students can apply of surface cube and block formulas to

solve mathematic problems; and (4) students can apply of volume of cube and block formulas to solve mathematic problems. Then the researcher built the learning design.

Outline of the learning process using RME approach designed by researchers is to do some learning activities as follows.

Activity I: in the discussion group, students estimated the content of the candy that has been contained a pack of candy. Activity II: In the discussion group, students solved problems about the form of packaging that can be made from 12 candy. Note: researchers have prepare the cubes instead of candy and paper with the size of one unit area as a candy wrapper for each discussion group. Students made presentations, then teachers did a class discussion and guided the discussion so that could construct knowledge about the concept of a factor of the block volume interrelationships between and the length, width and height. Activity III: In the discussion group, students solved the problem of minimal paper needed to wrap 12 candy. Students made presentations, then teachers did a class discussion and guided the discussion so that students could construct knowledge of the block surface area formula. Activity IV: in the discussion group, students solved the problem about the form of candy packaging that can be made from 24 candy. Students made presentations, then teachers did a class discussion and guided the discussion so that students could see some possible answers and students could find the number in each candy was the block volume formula. Then the teacher drew a pack of 24 candy on the black board. The goal was to made the students realize that the packaging is drew on a three-dimensional field and not all parts of candy were look intact. Activity V: in the discussion group, students solved the problem of the content and surface area of the shape three-dimensional composed of unit cubes. Students made presentations, then teachers did a class discussion and guided the discussion so that students could rediscover of the surface area and volume of cube formula. Activity IV: in the discussion group, students solved daily problems by applying of surface and the volume cube and block formulas. Students made presentations, then teachers did a class discussion and guided the discussion so that students could realize that daily problems could be solved by applying of surface and the volume cube and block formulas.

Stage II: implementation of HLT in learning.

Implementation of HLT conducted on October 18th and 19th, 2017. The role of teachers in learning activities was as a facilitator and motivator so that students can construct their knowledge.

Stage III: spatial ability test.

The test was given to 21 students on October 20th, 2017. Then the analysis involved two correct student answers. The test results were analyzed based on 3 indicators of spatial ability. Data analysis used were data reduction, data presentation, and conclusion.

Here are the result of spatial ability of students after they followed the teaching learning process using the realistic mathematics approach.

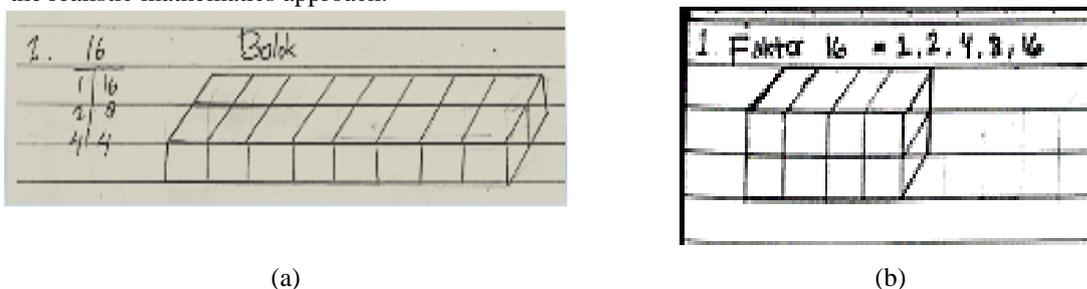


FIGURE 2. Answers of Student 1 (a) and Student 2 (b) in Problem Number 1

From the **figure 2** shows that the student 1 (S1) and student 2 (S2) were able to draw the blok consisting of cubes unit in the two-dimensions planes. This can be seen from the images that have been made by S1 and S2. Here's one of the student interview transcripts.

P : "What are your steps in solving the first problem?"

S1: "emm, search first factor from 16."

P : "Why are you looking for a factor of 16?"

S1: "to find the length, width, height of the block."

The first step done by S1 and S2 to solve the problem was by first determining factor of 16. Then from that factor determine the length, width and height of blok to be drawn. Based on the results of the answers and interviews it can be concluded that the students were able to draw the block composed of the cubes unit .

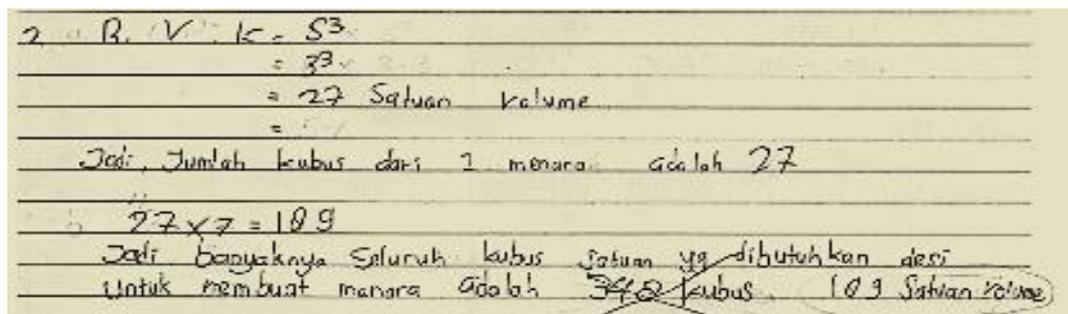


FIGURE 3. Answers S1 on Problem Number 2

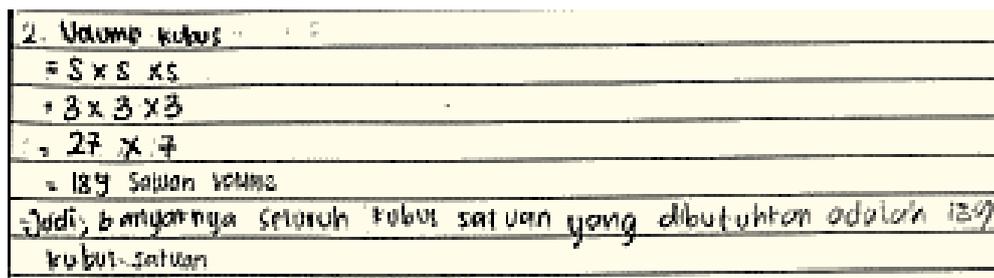


FIGURE 4. Answers S2 on Problem Number 2

Based on the **figure 3** dan **figure 4**, S1 and S2 were able to identify the cube of the tower image. It could be seen when S1 and S2 wrote "27 x 7", meaning that there were 7 cubes of the same with each having the same volume of 27 unit of cubes. Here's the transcript of one of the students:

P: "For the second problem, how did you solve the problem?"

S2: "first search the volume of this tower (pointing to the big cube), the volume is 27 units of volume, then 27 multiplied by the number of towers in this picture there are 7 Mam, this middle tower is not visible".

S1 and S2 were also able to calculate the volume of cubes composed of a unit cube in a two-dimensional plane. This can be seen in the strategy of S1 and S2 to solve problems and interviews. S1 and S2 realized that the unit cube needed to construct the tower that is composed of 7 large cubes with each has a contents of 27 cubes of units

According to Olkun [8], there are three levels of students in calculating the volume of cube consisting of the composition of unit cubes. Which the third level is students understand the arrangement of the cube as an organized cube. At this stage, students understand the iteration pattern of the cube arrangement in columns or rows.

Thus, students can perform jumping calculations such as addition and multiplication of successive iterations. This can be seen when students were able to calculate the units of cubes needed to made towers without counting the cubes of units one by one. Based on the results of student answers and interviews can be concluded that students were able calculate the volume of the three-dimensional shape composed of the block and cube of the two-dimensional field.

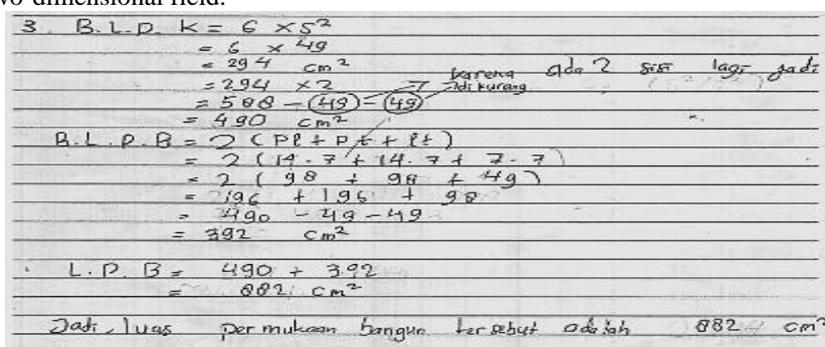


FIGURE 5. Answers S1 on Problem Number 3

From the **figure 5**, the strategy used S1 to determining the surface area of the box was to calculate the surface area of the cube then multiplied by 2 (because students imagine the same 2 cubes) and subtracted the two sides of the cube. Then added to the surface area of the first blok reduced with 2 sides of the side of the blocks. Based on the process that was done, it can be concluded that the way S1 determined the surface area of the box is correct.

3. luas permukaan kubus
 $= 5 \cdot 5^2$
 $= 5 \cdot 7^2$
 $= 5 \cdot 49$
 $= 245 \text{ cm}^2$
 Luas permukaan balok
 $= 2(p \times l) + 2(p \times t) + 2(l \times t)$
 $= 2(21 \times 7) + 2(21 \times 3) + 2(7 \times 3)$
 $= 2 \cdot 147 + 2 \cdot 147 + 2 \cdot 49$
 $= 294 + 294 + 98 = 588 + 98$
 $= 686 \text{ cm}^2 - 49$
 $= 637 \text{ cm}^2$
 Jumlah = $245 + 637$
 $= 882 \text{ cm}^2$
 Jadi, luas permukaan pada gambar 882 cm^2 .

FIGURE 6. Answers S2 on Problem Number 3

From the **figure 6**, the strategy used by S2 to calculate the surface area of the box is to calculate the square area 5 times. Then added to the surface area of the beam which was first deducted with the surface area of one side of the cube. From the process that was done, it can be concluded that the way S2 determined the surface area of the box was correct.

CONCLUSION

From the result of spatial ability analysis seen based on 3 indicators in solving the problem after applied of realistic mathematics learning approach, hence can be made conclusion as follows: (a) Students were able to draw block composed of cubes unit. Students used the concept of a factor of the block volume to determine the length, width, and height of the block. Then the students draw the block in accordance with the length, width, and height that have been obtained; (b) Students have understood the iterative pattern of the cube arrangement in columns and rows, so that students were able calculated the volume of an object composed of the cubes unit that was presented in the two-dimensional image form; (c) Students were able to determine the surface area of the three-dimensional shape composed of block and cube in the two-dimensional image form.

REFERENCES

- [1] National Council of Teachers of Mathematics. (2000). *Principles and Standards for School Mathematics*. NCTM: Reston VA
- [2] Ben-Haim, D., Lappan, G., & Houang R.T. (1985). *Visualizing Rectangular Solids Made of Small cubes: Analyzing and Effecting Students' Performance*. Educational Studies in Mathematics, 16: 389 – 409.
- [3] Revina, S., Zulkardi, Darmawijoyo, & van Galen, F. (2011). Spatial Visualization Task to Support Students' Spatial Structuring in Learning Volume Measurement. *IndoMS. J.M.E*, pp 127-146.
- [4] Hegarty M. & Waller D. A. (2005). Individual Differences in Spatial Abilities. Shah, P. and Miyake, A (Ed). *The Cambridge Handbook of Visuospatial Thinking*. New York: Cambridge University Press.
- [5] Wijaya, Ariyadi (2012). Pendidikan Matematika Realistik, Suatu Alternatif Pendekatan Pembelajaran Matematika. Yogyakarta: Graha Ilmu.
- [6] Van den Heuvel-Panhuizen, M. (1996). *Assessment and Realistic Mathematics Education.Thesis*. Utrecht : CD-β Press.
- [7] Hadi, Sutarto. (2017). Pendidikan matematika realistik: teori, pengembangan, dan implementasinya. Jakarta: Rajawali Pers.
- [8] Olkun, Sinan. (2003). *Establishing Conceptual Bases for The Measuremnt of Volume*. Turkey:Abant Izzet Baysal University.



Certificate

Ref: 1109/UN34.13/TU/2018

This is to certify that

Wike Ellissi

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:

The Analysis of Students' Spatial Ability of 8th Grade on The Block And Cube Material



Dean,

Dr. Hartono

NIP.19620329 198702 1 002

Yogyakarta, May 8, 2018
The Head of Committee



ICRIMS
FMIPA UNY

Dr. Agung W. Subiantoro

NIP.19810127 200501 1 002