The 3 International Conference of Mathematics, Science, and Education (ICMSE)

Proceeding of

Contribution of Mathematics and Science Research for Sustainable Life in Facing Global Challenge

The 3rd International Conference of Mathematics, Science, and Education (ICMSE)

3-4 September 2016

ICMSE
INTERNATIONAL CONFERENCE ON MATHEMATICS, SCIENCE, AND EDUCATION

Faculty of Mathematics and Natural Sciences Semarang State University
Phone: +62818-0584-4994 / +62815-6542-989
Email: icmse@mail.unnes.ac.id
Website: icmseunnes.com

RISTEKDIKTI

UNNES

PROCEEDING

INTERNATIONAL CONFERENCE ON MATHEMATICS, SCIENCE, AND EDUCATION

" Contribution of Mathematics and Science Research for Sustainable Life in Facing Global Challenge"

FACULTY OF MATHEMATICS AND NATURAL SCIENCES
SEMARANG STATE UNIVERSITY
2016

PROCEEDING
INTERNATIONAL CONFERENCE ON MATHEMATICS, SCIENCE, AND EDUCATION
SEMARANG STATE UNIVERSITY
2016

Reviewers:

Prof. Dr. Hans-Dieter Barke
Prof. Ir. Ibnu Maryanto, M.Si., Ph.D.
Prof. MD Rahim Sahar
Prof. Dr. Supama, M.Si.
Prof. San Pin Jiang
Prof. M.Supar Rohani
Prof. Dr. Poonsuk Prasertsan
Prof. Dr. Wiyanto, M.Si.
Prof. Dr. Edy Cahyono, M.Si.
Assoc. Prof. Visith Chavasit
Assoc. Prof. Dr. Heri Sutanto
Assoc. Prof Dr. Artoto Arkundato
Assoc. Prof. Dr. Hasniah Aliah
Prof. Dr. Supriyadi, M.Si.
Prof. Dr. Sutikno, M.Si.

Editor:

Dr. Sigit Saptono, M.Pd
Dr. Masturi, M.Si.
Aji Purwinarko, M.Cs
Dante Alighiri, S.Si., M.Sc.

Vol. 3 No. 1 Tahun 2016

ISBN : 978-602-1034-49-1
ISSN : 977-2477-3050-1

Publisher:
Faculty of Mathematics and Natural Sciences
Semarang State University
Gedung D12 Lt 1 Kampus Sekaran Gunungpati Semarang, Indonesia 50229
Phone : +62248508112, +62818241519
Website: http://icmseunnes.com
Email: icmse@mail.unnes.ac.id

PREFACE

Thanks to God Almighty this International Conference Proceeding could be completed. All articles in this proceeding are presented in International Conference On Mathematics, Science, and Education – Applied Research of Mathematics and Natural Sciences to Improve Its Usefulness for Knowledge and Society on September 3-4, 2016 at Grasia Hotel Semarang. This Conference is organized by Faculty of Mathematics and Natural Science. This proceeding has been reviewed of Mathematics and Science experts before it is published.

This conference is designed to improve the discussion and research scope in mathematics, science, and education area in the international level. Sub topics in this proceeding cover mathematics, applied mathematics, and mathematics education in accelerating character building. Enhancing biology and biology education research for a better life. Green chemistry in research and education. Physics and physics education for trending research.

Hopefully this publication of proceeding will be profitable for all of us.

Semarang, 23 December 2016

Regards
Committee of ICMSE 2016

CONFERENCE ORGANIZING COMMITTEE

Advisor	:	Rector of Unnes
		Dean of FMIPA Unnes
Vice Advisor	:	Prof. Dr. Edy Cahyono, M.Si
Chairman	:	Dr. Margareta Rahayuningsih, M.Si.
Vice Chairman 1	:	Prof. Dr. Sutikno, M.T.
Secretary 1	:	Sri Sukaesih, S.Pd., M.Pd.
Secretary 2	:	Stephani Diah Pamelasari, M.Hum
Treasurer	:	Dra. Dwi Yulianti, M.Si.
		Dra. Kristina Wijayanti, MS
		Ella Kusumastuti, M.Si
Persons in Charge		
Conference Program	:	Dr. Andreas B.P., M.Ed
		Dewi Mustikaningtyas, M.Si., Med.
		Dra. Langlang Handayani, M.AppSc
		Dr. Niken Subekti, M.Si.
		Dr. Mahardika Prasetya Aji, M.Si.
Administration	:	Dr. Suharto Linuwih, M.Si.
		Talitha Widiatningrum, M.Si., Ph.D.
		Muhammad Abdullah, S.Si, M.Sc.
		Kartika Widyaningrum, S.Pd.
		Sony Hermawan
Proceeding	:	Dr. Sigit Saptono, M.Pd
		Dr. Masturi, M.Si.
		Aji Purwinarko, M.Cs
		Dante Alighiri, S.Si., M.Sc.
Location	:	Ardhi Prabowo, M.Pd
		Wasi Sakti, S.Pd
Documentation		David M, S.Pd
	:	Solichin, S.Pd.
Publication	:	M. Aziz Muslim, M.Kom
		Budi Prasetiyo, M.Kom
Recreation and Exhibition	:	Dra. Endah Peniati, M.Si
		Arif Widiyatmoko, S.Pd. M.Pd.
Catering	:	Endang Sugiharti, M.Kom
		Retno Asih Wulandari, S.Pd
		Suwarti, S.Pd
Accommodation	:	Drs. Arief Aguoestanto, M.Si
		Dr. Khumaedi, M.Si
		Andin Irsadi, S.Pd., M.Si.
Sponsorship	:	Dr. Nanik Wijayanti, M.Si
		Dr. Enni Suwarsi Rahayu, M.Si
		Prof. Dr. Priyantini W., MS
LO	:	Samuel Budi Wardhana K, S.Si, M.Cs
		Fidia Fibriana, S.Si, M.Sc.
Medical health	:	Dr. Nugrahaningsih, M.Kes

COMMITTE

International Scientific Advisory Board

Edy Cahyono (*Chemistry Department, State University of Semarang*)
Rahim Sahar (*Department of Physics, Universiti Teknologi Malaysia*)
Uda Hashim (*Institute of Nano Electronic Engineering, Universiti Malaysia Perlis*)
Sutikno (*Physics Department, State University of Semarang*)
Masturi (*Physics Department, State University of Semarang*)
Putut Marwoto (*Physics Department, State University of Semarang*)
Yu-Cheng Hsu (*Department of Natural Resources and Environmental Studies, National Dong Hwa University*)
Takeshi Sakurai (*Department of Molecular Neuroscience and Integrative Physiology, Kanazawa University*)
Ibnu Maryanto (*Zoology Division Research Centre for Biology, Indonesian Institute of Sciences*)
Hans Dieter Barke (*Westfälische Wilhelms-Universität Münster, Institut für Didaktik der Chemie*)
Roberta Hunter (*Math Education, Institute of Education, Massey University*)
Anuradha Mathrani (*Computer Science and Computer Technology, Massey University*)
Arramel (*Chemical Physics, Department of Physics, National University of Singapore*)

MESSAGE FROM THE DEAN OF FMIPA UNNES

Dear Participants of ICMSE 2016,

It is a pleasure to welcome all of you in the first International Conference on Mathematics and Science Educations (ICMSE 2016) held by Faculty of Mathematics and Natural Sciences, Semarang State University.

Faculty of Mathematics and Natural Science Semarang State University or more popularly known as FMIPA Unnes has 6 departments and 11 study programs of Mathematics and Natural Sciences education backgrounds and non education backgrounds. FMIPA Unnes has the mission of being an excellent and meaningful faculty by improving human resources through scientific activity.

One of efforts to result excellent and meaningful human resources through scientific activity is by performing discussion and knowledge sharing. To widen discussion of science and research development in mathematics and science educations scopes in national and international level, ICMSE 2016 was initiated as the medium of that discussion. I believe that ICMSE 2016 as the first international conference held by FMIPA Unnes can facilitate the knowledge sharing in mathematics and science educations area in order to establish a global cooperation among experts and researchers.

With the hope that this conference will be the medium to optimize the role of Mathematics, Science and Education in global cooperation, I am proud to welcome all of you and I wish you a pleasant sharing and discussion in this conference and enjoyable stay in Semarang, Indonesia.

Prof. Dr. Zaenuri S.E, M.Si,Akt
Dean of Faculty of Mathematics and Natural Sciences
Semarang State University

PREFACE

We welcome you to the Third International Conference of Mathematics, Science, and Education (ICMSE) 2016 on 3-4 September 2016 in Semarang Indonesia. ICMSE 2016 is the third conference organized by Faculty of Mathematics and Natural Science, Universitras Negeri Semarang. ICMSE 2016 provides a platform to the research institutes, and industries to meet and share cutting-edge progress in the fields of mathematics and natural science as reflected in this year's theme "Contribution of Mathematics and Science Research for Sustainable Life in Facing Global Challenge".

This conference provides an opportunity to enhance understanding of the relationships between knowledge and research related to mathematics and science. The conference accepted 234 papers from 7 countries, 8 region and from 35 universities. The conference program represents the efforts of many people. We want to express our gratitude to the members of the Program Committee, and the reviewers for their hard work in reviewing submissions. We also thank to keynote speakers Prof. Intan Ahmad, Ph.D., Mr. Robby Gunawan, Prof. Takeshi Sakurai, Prof. Roberta Hunter, Dr. Anuradha Mathrani, Dr. Arramel, and Prof. St. Budi Waluya, also the invited speaker all the participant. Finally, the conference would not be possible without the excellent papers contributed by authors. We thank all the authors for their contributions and their participation in ICMSE 2016. We hope that this program will further stimulate research in Mathematics and Science Education, share research interests and information, create a forum of collaboration and build trust relationship. We feel honored and privileged to serve the best recent developments in the field of Mathematics and Science Education to you through this exciting program.

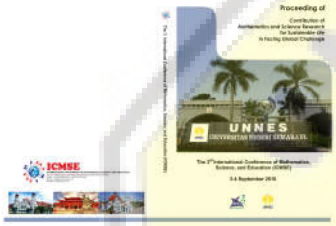
Wish you have great memorable event and enjoyable stay in Semarang.

Dr. Margareta Rahayuningsih S.Si, M.Si.
Chairperson of Conference Commitee

CONTENTS

Proceeding of ICMSE

Vol 3 No 1 (2016): ICMSE : Contribution of Mathematics and Science Research for Sustainable Life in Facing Global Challenge



Published: 2017-03-09

Articles

PDF

Synthesis of Strontium Ferrite Nanocomposite - Ceramic as Dielectric Capacitor Based on Iron Sands

Mohamad Sobirin, Reza Faizal, Margi Fitriawan, Nita Rosita, Farida Usriyah, Agus Yulianto P-11 - P-14

PDF

Tetrahedral Finite Elements (FE) for Multiscale Soft Composite Material Modeling

Sugeng Waluyo P-15 - P-18

PDF

The Influence of Project Based Learning Experiment Implementation to the Students' Concept Mastery of Rigid Body Equilibrium

Budi Astuti, Aufa Maulida Fitrianingrum, Sarwi Sarwi P-19 - P-24

PDF

Problem Solving Ability and Metacognition based Goal Orientation on Problem Based Learning

Laurensia Dhika Maretasani, Masrukan Masrukan, Dwijanto Dwijanto P-25 - P-30

PDF

Physics Education based Ethnoscience: Literature Review

Novika Lestari, Fajar Fitriani P-31 - P-34

PDF

Using Video Game inspired Baluran National Park in Science Education: Anxiety and Creative Thinking Skills

Pramudya Dwi Aristya Putra, Rif'ati Dina Handayani, Mochammad Iqbal P-35 - P-39

PDF

Development of Integrated Science Instruction Assessment as An Alternative to Measure Creativity and Scientific Attitude

Sukardiyono Sukardiyono, Dadan Rosana P-40 -P-45

PDF

Development of Student Worksheet with Conceptual Attainment Method to Improve Concepts Understanding and Science Process Skills in Equilibrium and Rotational Dynamics

ICMSE
INTERNATIONAL CONFERENCE ON MATHEMATICS, SCIENCE, AND EDUCATION

The Linkage of Problem Solving Between Geometry and Algebra: What Is Their Correlation?

Abi Suwito[1,a)], Ipung Yuwono[2], I Nengah Parta[3], Santi Irawati[4]
[1]Department of Mathematics Education, Teacher and Training Education Faculty Jember University, Jember, Indonesia
[2,3,4] Department of Mathematics, Mathematics and Science Faculty State University of Malang, Malang, Indonesia
Corresponding author: [a)] abi.fkip@unej.ac.id

ABSTRACT

This research aims to determine the students' geometry ability through algebra, and to find out algebra ability in solving geometry problems. Students are required to work on the geometry questions and solve those using algebra. In vice versa, students are given the algebra questions in the nuance of geometry to be completed. Then, the students' answers are traced with interviews to determine the ability of students in answering the question of algebraic geometry, and vice versa. There are two subjects of research from junior high school students in grade 9^{th}. The study was conducted in four weeks. The solving problems used think a loud method and interviews which were conducted three times. After the interviews, it is found out that there is a correlation between the students' ability of geometry and students' ability of algebra. This statement againsts the (Atiyah, 2001; Charbonneau, 1996; Kvasz, 2005) opinion which said that is not easy to connect geometry and algebra. In the solving problems, it was found that the subjects were using algebra and geometry modeling. Algebra and geometry has a very strong relationship. Students who have the ability to better geometry will have good algebraic ability as well, and vice versa.

Keywords: *Geometry, algebra, correlation*

INTRODUCTION

Mason, et.al (2010) stated that thinking mathematically related to the mathematical processes and it is not the branch of Mathematics. Thinking that Mathematics could be used in constructing the concept. Constructing the concept is viewing an object as a result of symbolic action (Gray& Tall, 2001). (Gray& Tall, 2001) also stated that in learning, it is started from observing the concepts that will be used as object. Brodie (2010) dan Van De Walle (2010) said that in constructing an idea, a student could communicate and connect between idea and any other concepts. Stacey (2006) suggested that the process of thinking mathematically is a way to think Mathematics. There are four components of thinking mathematically, those are spesialising, generalizing, conjecturing and convincing. Stenberg (2009) revealed that the process of thinking consists of understanding, building the opinion, and drawing a conclusion. To gain an understanding, students must analyse the characters of some objects then compare those. Some unnecessary characters should be removed. Building the opinion is necessary in order to place the relationship between two terms. Drawing a conclusion is the end of thinking process. This research included geometry and algebra discussion.

Regarding the process of thinking, some researchs about thinking geometric has been studied by some experts (Ekanayake, 2003; Patsiomitou, 2008; Meng, 2009; Pittalis, M., Mousalides, N., & Christon, C. 2009). Hollerands (2003) stated that there are three prominent reasons in learning geometry, those are giving opportunities for students to think about the important concepts in Mathematics, providing contexts in order to students could see mathematics as interrelated science, and giving opportunities for students to get involve in high level of thinking activity by using some representation. So as, Guven (2012) said that studying geometry takes a lot of exercises and use facilities which engaging students to solve the problems. Van de Walle (2001) also stated that the importance of studying geometry are; it is related to our

daily life, develops the ability of problem solving, plays prominent roles to learn another branch of mathematics, can be used in daily activities, and learning geometry is pleasant. Clements and Battista (1992) suggested that students' geometric way of thinking develops through the usage of measurement and transformation of an object. Dindyal (2007) said that students' thinking of geometry also needs algebra as facility. According to him, algebra has strong connection with geometry. Algebra is the beginning of studying Mathematics (Kriegler, 2008). Panaora da Gagatsis (2009) said that educators must understand how students build their geometric knowledge. It seems uneasy relationship between geometry and algebra (Atiyah,

2001; Charbonneau, 1996; Kvasz, 2005). NCTM (2000) said that geometric mastery which has to be owned by students are; (a) analysing geometric characters of two and three dimensions and develop the Mathematical argument about geometric connection; (b) determining the position and figure the spatial connection by using geometric coordinate and the other representation system; (c) applying transformation and the usage of symetric to analyse mathematical situation; (d) visualization which being used, spatial reasoning, and geometric modelling to solve the problems. Process of thinking algebra has been studied by many experts, among them are; Raquel,et.al (2004), Hallagan (2004), Lee & Frieman (2004), Francisco & Hahkioniemi (2006), Windson (2009), and Patton & Estella (2012). Entering the high school, a scholar must be proficient in algebra which contains of generalization of arithmetic with the usage of symbols, mathematical modeling, reasoning, and problem solving (Dooren, 2002). According to Windson (2009), thinking in the framework of algebra is very important in Mathematics. Likewise, according to Hallgan (2004), algebraic thinking process essentials to develop the students' thinking skill, and also can be used to trace errors that have been made. Usiskin (1999) stated that there are some conceptions regarding algebra; (1) algebra as arithmetic formulation, (2) algebra as a study of procedure to solve problems, (3) algebra as study of relationship among quantities, (4) algebra as study of numbers. NCTM (2000) wrote that algebra is more than just moving the symbols. Students are required to understand the concepts, structures which affecting the manipulation of symbols, and how those are used. Algebra involves generalisation more than study experience with numbers and calculation. This research studies the linkage between geometry and algebra.

METHODS

Time and Research Subject

The reseach was conducted on October 30th, 2015 until November 21st, 2015. Research subject is Junior High School students, grade 9th. Instrument of research are questions adopted from Pisa (2009) and questions created by the researcher himself. Subject of research are being asked to answer some questions using think a loud method. It aims to gain a clear illustration of how subjects answer the geometry and algebra questions.

Figure 1. *is the picture of three towers which have different heights and constructed in two dimensions; hexagonal and rectangle.*

What is the height of the shortest tower?

The second question is algebraic geometry shades. It is stated as follows:

Mr. Johan has a square land. It is planned for a garden. The size of the land is as twice as the size of the garden added to 880 as four times of the sides measurement. You are required to help him to calculate the size of garden!

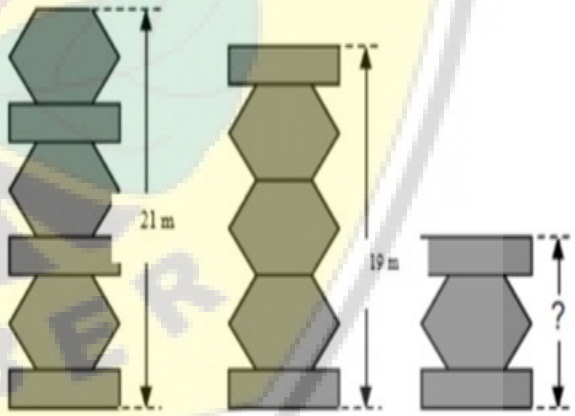


Figure 1. Questions for students

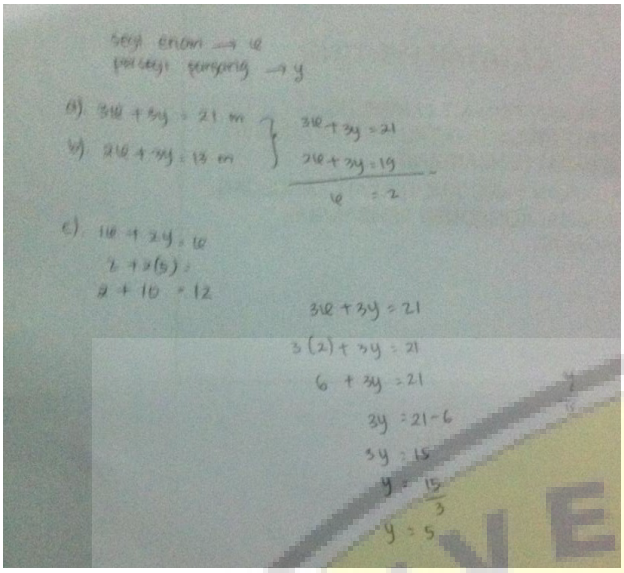


Figure 2. Result of subject I. Question 1

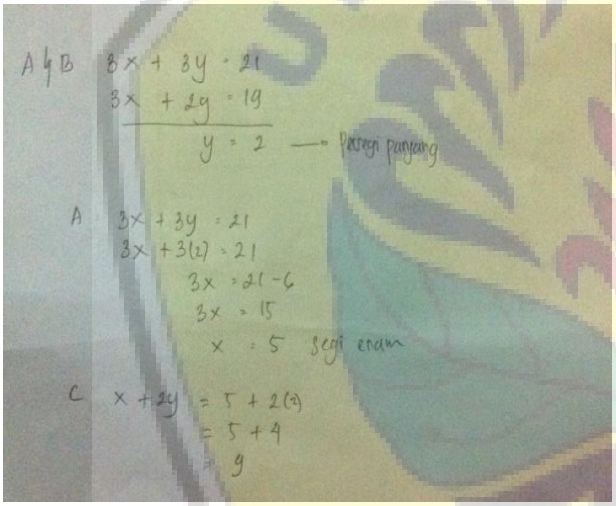


Figure 3. Working Result of Subject II on question I

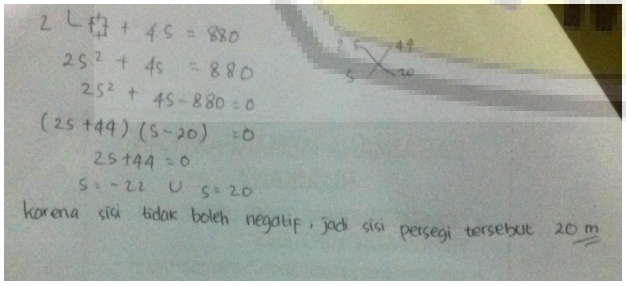


Figure 4. Result of Subject I on question II

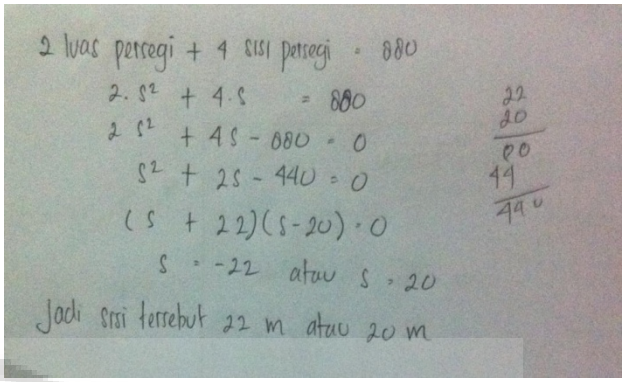


Figure 5. Result of Subject II on question II

Result and Discussion

Figure 2. is the result of subject (I). Result of subject (I): Before student were working on the question, he illustrated hexagonal tower as *X* and rectangle as *Y*. When researcher questioned the subject's reason to his decision of making illustration, he said that the question related to linear equation from two variables that could be solved by substitution and elimination. And then, after subject (I) found the value of *X* and *Y*, he could determined the value of the shortest tower. There was a problem. Subject (I) made mistake in written in the variables. He wrote, supposed to be. So, the rest of question completion were incorrect. Below is the interview conducted by researcher to subject I:

P : Why did you illustrated hexagonal tower as X and rectangle as Y? S1: It would made me easier to solve the question.

P : Is it ok for me to change the x and y to another letters? S1: It's ok.

From the above conversation, it is shown that subject I has been done the algebraic thinking activity. It is reflected from his worksheet that contain of symbols in answer the question. Subject I made a plan to do the strategy of working on symbols in order to get the value of *x* and *y*. Strategy used was substitution and elimination method. **Figure 3**. is the subject II's answer:

In solving the above question, first, subject II gave signs to the picture by writing A, B, and C. Next, he changed the recognised structures into two variables equation and solved it in elimination method. The value of *y* has been defined. It was substituted into the first equation and obtained value of *x*. So, the value of *x* and *y* could be used to determine the height of tower.

Figure 3. is the subject II's result in answering question 2: Result obtained from the subject I's completion was that he wrote the question into Mathematics sentence. Previously, he worked on geometric model. Since the land is in the form of square, subject I wrote the area as side x side. Next, he gave symbol to side as *s*. Furthermore, the subject completed the form quadratic equations in order to obtain two results. On the subject I's worksheet occurred error in the drawn conclusions. Subject I did not notice that the length of a land size cannot be in negative form. But, the answer given is 22 cm or 20 m. He immediately eliminated the negative sign at number 22 by writing that 22 is the answer as well without any reasons. Here is the interview that conducted by researcher to subject I.

P: What did you write for the first time?

S1: First, I wrote the mathematical sentence to be easily understood. P: And after that?
S1: I symbolized the sides of a square with an "s".

P: For what?

S1: To be easily solved.

From the conversation, it is shown that S1 has good geometry capabilities. It can be seen from S1's ability in formulating square wide. In addition, S1 also has good ability in algebra. It can be seen from his ability in completing a form of algebraic equations. S1 can solve quadratic equations well.

Similar to subject I, subject II's worksheet is an analog. At the beginning of his work, subject II already symbolizes mathematical sentence from the recognised question. Here, subject II is able to finish the worksheet well and also be able to choose which answer is correct. Subject II has already known that the size of the land cannot be negative.

Based on the answer to **Figure 4.** two subjects, it can be seen that the objects can complete algebra in geometry nuanced questions and geometry questions that can be solved by algebra. Geometry and algebra has a very strong relationship in accordance with the opinion of Dindyal (2007). Geometry questions can be solved algebraically and algebra questions mixed with geometry can be solved by analogy by illustrating one side length of a square with the letter *s*.

Following **Figure 5.** is a diagram which illustrating the subjects' way of thinking in solving the above problems:

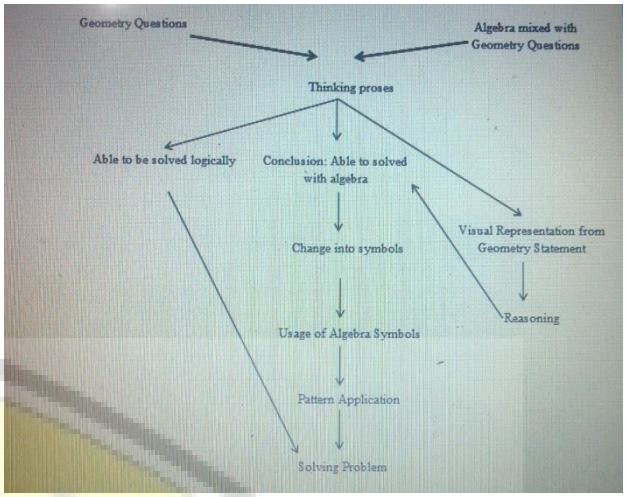


Figure 5. Diagram of Subjects' Thinking Process In Solving Problems

CONCLUSION

In geometry, students solve problems by using algebraic; this is in accordance with the opinion of Dooren (2002) and Usiskin (1999). Geometry modeling can also be done to solve the problems, which matches with the NCTM (2000), it can be seen from the second question that the research subject can solve the problem by using these methods. This statement againsts the (Atiyah, 2001; Charbonneau, 1996; Kvasz, 2005) opinion which said that is not easy to connect geometry and algebra. Subjects are using algebraic thinking to solve geometry problems. Geometry is a branch of mathematics that can be used to study other mathematical material, as well as algebra. Algebra is used in almost every study of mathematics. Geometry problems can be solved algebraically, so as to facilitate the students in solving these problems. Similarly with algebra questions which mixed with geometry, it involves thinking geometry to solve the problems. The linkage between the problems of algebra and geometry problems lies in the problems solved algebraically and both have a very strong relationship.

BIBLIOGRAPHY

Atiyah, M. (2001). Mathematics in the 20th Century, *American Mathematical Monthly*, *108*(7), 654-666

Brodie, K. 2010. *Teaching Mathematical Reasoning in Secondary School Classrooms*. New York: Springer, London: Dord Heidelberg.

Charbonneau, L. (1996). From Euclid to Descartes: Algebra and its relation to geometry. In N. Bednarz, C. Kieran, & L. Lee (Eds.), *Approaches to algebra: Perspectives for research and teaching*. (pp. 15-37). Dordrecht: Kluwer.

Clements, D. H. and Battista, M. T. (1992) "*Geometry and Spatial Reasoning*". In D. A. Grouws (Ed.) Handbook for Research on Mathematics Teaching and Learning. Reston, VA: National Council of Teachers of Mathematics, pages 420–464.

Dindyal, J. 2007. The Need for an Inclusive Framework for Students' Thinking in School Geometry, National Institute of Education Nanyang Technology University, Singapore, *The Montana Mathematics*, ISSN 1551-3440, Vol 4, no 1, pp 73-83.

Dooren, W.V., Verschafel, L., & Onghena, P. 2002. . The Impact of Prservice Teacher' Content Knowledge on Their Evaluation of Students' Strategies for Solving Arithetics and Algebra Word Problem. *Journal for Research in Mathematic Education*, Vol 33, No. 5, pp 319-351.

Ekanayake, M. B., Brown, C, and Chinnappan, M. (2003). Development of a Web-Based

Learning Tool to Enhance Formal Deductive Thinking in Geometry. In L. Bragg, C.Campbell, G. Herbert, and J. Mousley (Eds.), *Proceedings of the 26th Conference of the Mathematics Education Research Group of Australasia Vol 1 (pp 302-308*). Geelong, VIC: Mathematics Education Research Group of Australasia.

Francisco, J., & Hahkioniemi, M. 2006. Insight into Students' Algebraic Reasoning. *North American Chapter of the International Group for the Psychology of mathematics Education,* Vol. 3, 105-112

Gray, E & Tall, D. 2001. Relationships between Embodied Objects and symbolic Procepts: An Explanatory Theory of Success and Failure in Mathematics, http://homepages.warwick.ac.uk/staff/David.Tall/pdfs/dot2001j-pme25-pinto-tall.pdf, diakses 25 September 2015.

Guven, B. 2012. Using Dynamic Geometry software to improve eight grade student's understanding of transformation geometry. Aaaaaaaaaaustralian Journal of Educational Technology, 28(2), 364-382.

Hallagan, J. 2004. A Teacher's Model A His Students' Algebraic Thinking: " Ways Of Thinking" Sheets. *Proceedings Of The Twenty-Sixth Annual Meeting Noth American Chapter Of The International Group For The Psychology Of Mathematics Education*, 1(40), 277-244.

Hollebrands, K. F. 2003 . High School Students Understanding Of Geometric Transformations In The Context Of A Technological Environment. *Journal of Mathematical Behaviour*, 22, 55-72.

Kriegler, S. 2008. Just What is Algebraic Thinking?http://www.mathucla.edu/~kriegler/pub/algebra.html diakses 12 September 2015.

Kvasz, L. (2005). Similarities and differences between the development of geometry and of algebra. In C. Cellucci & D. Gillies (Eds.), *Mathematical reasoning and heuristics* (pp.25-47). London: King's College Publications.

Lee, L. & Freiman, V. 2004. Tracking Primary Students' Understanding of patterns. *Proceedings Of The Twenty-Sixth Annual Meeting North American Chapter of The International Group for the Psychology of Mathematics Education,* 1(41), 245-252

Mason, J., Burton, L., & Stacey K. (2000). *Thinking Mathematically*. Pearson: London.

Meng, C.C. (2009). Enhancing Students' Geometric Thinking Through Phase- Based Instruction Using Geometer's Sketchpad: a Case Study. *Jurnal Pendidik dan Pendidikan, Jil. 24, 89–107.*

National Council of Teachers of Mathematics (2000). *Principles and Standards For School Mathematics*. Reston, VA: Author.

Panaoura, G & Gagatsis, A. 2009. The Geometrical Reasoning of Primary and nSecondary School Students. *Proceeding of CRME 6, January 28th-February 1st 2009 pp 746-756*. http://ife.ens-lyon.fr/publications/edtion-electronique/cerme/wq5-08-panaoura-gagatsis.pdf, diakses 8 September 2015.

Patsiomitou, S. (2008). The Development of Students Geometrical Thinking through Transformational Processes and Interaction Techniques in a Dynamic Geometry Environment. *Issues in Informing Science and Information Technology* Volume 5.

Patton, B., & Estella De L.S. 2012. Analyzing algebraic Thinking Using "Guess My Number" Problems. International Journal of Intruction. ISSN. 1694- 609X, Vol 5. No 1.

Pittalis, M., Mousalides, N., & Christon, C. (2009). Students' 3D Geometry Thinking Profiles. *Proceedings of CERME 6, January 28th-February 1st 2009, Lyon France © INRP 2010 www.inrp.fr/editions/cerme6.*

Raquel, R. B., Mercedes, P.M., & Martin, S.R. 2004. Cognititive Abilities and Errors of Students in Secondary School in Algebraic language Processes. *Proceedings of The Twenty sixth annual Meeting North American Chapter of The International Group for the Psychology of Mathematics Education.* Vol 1, No 42

Stacey, K. 2006. What is Mathematical Thinking and why is it Important.

Progress report of the APEC project: Collaborative Studies on Innovations for Teaching and Learning Mathematics in Different Cultures (II). *Lesson Study Focusing on Mathematical Thinking*. 1(1):39.

Sternberg, R.J., & Sternberg, K. 2009. *Cognitive Psycology*. New York: Wadswordth.

Usiskin, Zalman. 1999. "Conceptions of school algebra and uses of variables". In *Algebraic Thinking, Grades K-12: Readings from NCTM's School Based Journals and Other Publications*, edited by Barbara Moses. Reston, Va: National Council of Teacher of Mathematics.

Van de Walle, dkk. 2010. *Elementary and Middle School Mathematics: Teaching Developmentally* (7th ed). Boston: Pearson Education, Inc.

Windson, W. 2010. Algebraic Thinking. A Problem solving Approach. *Proceedings of the 33rd annual conference of the Mathematics Education Research Group of Australia*. ISBN 978-1-920846-25-1