THE EFFECTIVENESS OF PROBLEM BASED LEARNING AND SCIENTIFIC LEARNING MODEL COMBINED WITH COOPERATIVE JIGSAW IN MATHEMATICS LEARNING FOR STUDENTS' ACHIEVEMENT AND MATHEMATICAL COMMUNICATION SKILL

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Abstract

The aim of this study was to know about the effect of Problem Based Learning (PBL) and learning with scientific approach combined with cooperative learning Jigsaw in terms of mathematical communication skill and student's achievement in mathematic. The research method is quasi experiment which used pretest posttest group design. The data were collected through a mathematical communication and student's achievement andobservation form for learning activities. The result of this study showed that PBL-Jigsaw is not effective in mathematical student's achievement and student's mathematical communication skill. While, scientific approach-Jigsaw is effective in mathematical student's achievement and student's mathematical communication skill. PBL-Jigsaw is not better than scientific approach-Jigsaw in mathematical student's achievement and student's mathematical communication skill reviewed by gain score of posttest and pretest students.

Keyword: PBL, cooperative Jigsaw, scientific approach, mathematical communication, mathematical student's achievement

INTRODUCTION

Not only the students, but also the teacher has a direct role in education system. Teachers should be able to choose the learning model that will be used in the classroom according to the characteristics of the learners in the class. There are many different learning models that have various advantages of each learning model. However, the latest learning model may not be the best learning model when applied in the classroom. Remember that when there are many different characteristics of the learners, the ability of the teacher to choose which model that appropiate is a priority for the implementation of learning. Huda (2015: 76) argues that only a creative, flexible, and untelligent teacher that will get the benefit from the learning models.

The expertise of the teachers in choosing a learning model would have an effect on the learning objectives. The one of the learning objectives that set by the teacher is to accomplish the student's achievement. The achievement is the result after doing a job. According to Sudijono (2012: 434), the achievement of learners symbolized by the values of learning results that reflects the extent to which the level of success that has been achieved by the learners in achieving the educational goals that have been determined for each subject or field studies. The tendency of learners who are less understanding of mathematics will have poor learning

achievement. In addition, the lack of the understanding in mathematics material also affects the ability of mathematical communication in learners, so that teachers should be able to act as wise as possible, so that learners can understand math, in order to achieve good learning achievement and the ability of smooth mathematical communication.

The succesful of mathematical communication is characterized by the high ability of learners in conveying the message of math in the form of concepts, work ideas, or problem solving strategies. The messages can be done with oral and written. When learners are brave to communicate, then the ideas and concepts of the participants's thoughts become clearer. According to NCTM (1996), conversation and discussions in exploring ideas and views can encourage people to think more sharply in building interconnectedness between concepts. Therefore, to be able to increase the ability of mathematical communication, the application of learning model should use active learning model.

Based on observations at SMP N 1 Sidoharjo in class VII, the learners were passive during the learning exercised. This condition can be caused that the learning is still teacher-centered and didnt require students to be active. According to previously theories that mentioned before, the tendency of learners who remain silent durinng learning, the teachers that can't encourage learners to express the mathematical ideas, will alsoo affect the learning achievement. Research conducted by M. Farhan and heri Retnawati (2014) shows that problem based learning was more effective than conventional learning. Therefore, it is necessary to do more research by using active learning model in that class.

Cooperative learning is one example of the classroom setting for increasing active learning that can achieve the student-centered learning activities. According to Isjoni (2010: 15), in cooperative learning students are actively involved in the learning process, thus giving a positive impact on the quality of interaction and quality of communication. One type of cooperative learning is Jigsaw. Firstly, the Jigsaw method was developed by Aronson in 1975. In the Jigsaw, students work in groups. First they were in each group and second in expert group. In each group, each group member has an obligation to study a material part. Then the assemblage of group members who have the same material part is called the expert group.

Jigsaw class setting can be combined with other learning models such as Problem Based Learning (PBL) and Learning with the Scientific Approach. There were many studies that mention that both models of learning can improve learning achievement of math and mathematical communication ability of learners. According to Edi Susanto and Heri Retnawati 92016), learning tools that characterized by PBL effective in terms of High Order Thinking Skill (HOTS) students. Problem based learning leads learners to solve the problem that presented. Based on research conducted by Husnul Laili (2016) mentioned that PBL is effective in terms

of mathematics learning achievement of learners. While the research conducted by Abdul Khamid (2016), PBL was effective in terms of the mathematical communication ability of learners.

The teacher in Problem Based Learning is only a facilitator. Learners were the main actors in this learning. The role of teachers in PBL is to offer authentic problems, facilitate the investigation of learners, and support the learning of learners (Arends, 2008: 41). The syntax of learning with PBL model combined with Jigsaw setting were

a. The learners are grouped into small groups of 4 people called as origin groups.
b. Each group of origin was given a variety of issues to solve.
c. The problems gained are shared among each group member.
d. The learners found friends who had the same problems and form a new group called the expert group.
e. The learners in a group of experts jointly look for the information needed to solve problems using the basic knowledge they had before.
f. The learners in each group of experts discusss to find a solution of the problem.
g. The learners who had found a solution within the expert group then return to the original group.
h. In the group of origin the learners share the results of the previously discussion from the expert group.
i. One member of the group read out the results of their discussion in front of the class.

On the other hand there was another learning model that is scientific approach. Accordinng to Lazim (2014), scientific approach is a process of learning designed in such a way that learners construct concept actively, through observing stages (to identify or find problems), formulate problems, propose or formulate hypotheses, collect data with various techniques, analyzing data, make conclusions, and communicating concepts or principles that are founded. Learners are required to be active during the learning process. Teachers are expected to act only as learning facilitators and the role of teachers is greatly reduced in this. The steps of learning by scientific approach in Jigsaw were

a. The learners are divided ino group that consist of 4 people called the original group.
b. Each group of origin was given a worksheet which contains some activities and guidelines to solve them.
c. Each member of the original group wass assigned the task of completing an activity
d. The learners who have the same tasks gathered into a group called the expert group.
e. The investigation activity begins within the group of expert with due regard to the guiding steps in accordance with the scientific approach syntatic.
f. The investigation was continued to the original group by conducting the search for

materials gatheres from several expert groups.

g. The solution founded from yhe discussion on the initial group is written or informed in front of all the classes.

These steps were combination of each learning model in which learners got some benefit from each model of learning to improve mathematical communication skills and learner's mathematics achievement. Journal entitled *"The Effect of Problem Based Learning (PBL) Combined with Cooperative Learning Jigsaw in Terms of Mathematical Communication Skill and Student's Achievement Grade 11th Science SMA N 2 Yogyakarta"* by Valeria Kartikaningtyas (2015) shows that PBL in Jigsaw is no morre effective than scientific learning in Jigsaw.

RESEARCH METHOD

Type of Research Method

This study wa a quasi experimental research. The research design was pretest posttest group design.

Table 1. Design of Research

Kelas	*Pretest*	Perlakuan	*Posttest*
Experiment 1	O1	X1	O2
Experiment 2	O1	X2	O2

Time and Place

This research did at SMP N 1 Sidoharjo on 11th April 2017 until 11th Mei 2017.

Population and Sample

The population in this research was the student of grade 7th of SMP N 1 Sidoharjo in the academi year of 2016/2017. The samples were students of class VII D as the first experiment class and VII E as the second experiment class. The sample had been chosen randomized.

Variables

The variables were consisted of independent variable, dependent variable and control variable. The independent variables were the leaarning methods; they are Problem Based Learning (PBL) combined with cooperative Jigsaw and learning with scientific approach combined with cooperative Jigsaw. The dependent variables were mathematical communication and student's mathematical achievement. The control variables were teacher, material, and allocation time of learning.

Data, Instrument, and Data Collection Techniques

The instruments in this study were the test instrument of mathematical communication and student's achievement and observation form of learning activities. The tests were pre-test and post-test about mathematical communication and student's achievement that given before and after the treatment. The questionnaire was given after the treatment.

Data Analysis Techniques

The data that used in statistic analysis were pretest and posttest data. The data were presented in descriptive and inferential. Data analysis techniques was done by describing data

and analyzing inferential statistics to the data obtained. Description of data was done by searching for mean, standard deviation, variance, minimum score, and maximum score either for data before treatment or for data after treatment. To test whether PBL combined with Jigsaw and learning with scientific approach combined with Jigsaw were effective in terms of mathematical communication skill and students's mathematics achievement was used one sample t-test with the formula below:

$$t = \frac{\bar{x} - \mu_0}{\frac{s}{\sqrt{n}}}$$

Where:

t = calculated t value

$\bar{x}$ = the average of sample

μ_0 = specified value

s = standard deviation of sample

n = number of sample

The average value set (μ_0) for the effectiveness criteria in terms of mathematical communication skill was 60 and for learning achievement was 76. Hypothesis testing using SPSS 22 for Windows with the learning model decision criteria was said to be effective if the value of significance obtained is greater or equal with 0,5.

While to analyze which learning model was more effective between two models also use t-test to the average of gain score of posttest and pretest. The gain score is calculated using the following formula :

$$Skor\ gain\ (g) = \frac{x_2 - x_1}{x_{maks} - x_1}$$

Information:

x_1 : pretest score of student's learning achievement or mathematical communication skill

x_2 : posttest score of student's learning achievement or mathematical communication skill

x_{maks} : maximum score of learning achievement score

T−test that used for data analysis was

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$$s^2 = \frac{(n_1 - 1){S_1}^2 + (n_2 - 1){S_2}^2}{n_1 + n_2 - 2}$$

Information :

t = t-test score

$\bar{x}_1$ = the average score of posttest gain of fist experimental

$\bar{x}_2$ = the average score of posttest gain of second experimental

S = combined of standard deviation

${S_1}^2$ = variance of first experimental

${S_2}^2$ = variance of second experimental

n_1 = number of first experimental's students

n_2 = number of second experimental's students

Testing data using SPSS 22 for Windows with test criteria that used was problem based learning combined with Jigsaw was more effective than the learning model with a scientific approach combined with Jigsaw in terms of mathematics learning achievement or mathematical communication skill if the value of significance indicates number shows greater than or equal to 0.05.

RESULT AND DISCUSSION

The average of learning achievement from first experimental class and second experimental class were increase afterthe treatments was given. Student's learning achievement data was as in Table 2.

Tabel 2. Pretest and posttest data of student's learning achievement

Statictic Description	First Experimental Class		Second Experimental Class	
	Pretest	*Postest*	*Pretest*	*Postest*
Number of student	31	31	31	31
Average	18,56	75,22	28,44	82,19
Minimum Score	0	48	0	42
Maximum Score	54	94	68	100

Table 2 showed that the average of pretest and posttest student's learning achievement on the second experimental class higher that the first experimental class.

The average from mathematical communication skill in the first and seconng experimental class also increase after treatment was given. Data from mathematical communication skill test showed in Table 3.

Table 3. Pretest and Posttest score of Student's Mathematical Communication Skill

Description of Data	1st Experimental Class		2nd Experimental Class	
	Pretest	*Postest*	*Pretest*	*Postest*
Number of student	31	31	31	31
Average	28,77	63,48	27,74	70,45
Minimum Score	8	36	0	40
Maximum Score	84	84	52	92

Table 3 showed that the average pretest of second experimental class was higher than the first experimental class. Neither the posttest result of mathematical communication skill indicates that the result of the second experimental class were higher than the first experimental class.

The hypotetical test was performed after the data were tested for normality and homogenity. Normality test was done to determine whether the data was distributed normally or not. Normality tests were performed using SPSS 22 for Windows software with result as in Table 4 below.

Table 4. Normality Test Result

Score	Class	Sign	α	Result
Score of mathematical communication skill pretest	A1	0,000	0,05	Normal
	A2	0,024		Normal
Score of learning achievement score	A1	0,021		Normal
	A2	0,083		Normal
Score of mathematical communication skill posttest	A1	0,187		Normal
	A2	0,000		Normal
Score of learning achievement posttet	A1	0,141		Normal
	A2	0,037		Normal

Table 4 shows that pretest and posttest data of mathematical learning achievement and mathematical communication skill of the students in first and second experimental classes indicate that data was normally distributed.

Homogenity test was done to find out whether the two classes had the same variance or not. If $f_{count} \leq f_{table} = 1.884087$ then the data had the same variance or the data was homogeneous.

Tabel 4. The result of Homogenity Test

Data	F_{count}	Result
Pretest of mathematical communication	1,6436	Homogen
Pretest of student's learning achievement	1,7207	Homogen
Posttest og mathematical communication	1,1272	Homogen
Pretest of student's learning achievement	1,1426	Homogen

Table 5 showed that the variance of the pretest and posttest scores of mathematics learning achievement and mathematical communication skill between two classes were same. After the test of normality and homogenity, then tested the hypothesis.

Problem Based Learning Combined with Jigsaw Not Effective Viewed from Student's Mathematics Learning Achievement

Accordinng to Westwood (2008), there are some things that become PBL advantages such as can provokw the active involvement of students in learning processes and can prepare student for critical thingking and analysis. In westwood (2008: 31), PBL had disadvantages there are the groups that do not work effectively can affect the process of analysis and some learners are less flexible in approaching from narrow insight. So it can reducce the effectiveness of problem based learning model.

In this research, mathematics learning using problem based learning combined with Jigsaw was given to class VII D as first experimental class. The effectiveness of this learning in term of mathematics learning achievement was based on the valie of significance derived from score gain pretest posttest mathematics learning achievement. The applying of this learning model in the first experimental class, it appears that students were not familiae with cooperative class settings. So the students were confusion about the researchers plan on the class.the instrument that used by researcher in the first experimental class was also had less support for the achievement of the learning indicator. So the lesson was applied in less accordance with existing theories.

This learning model was effective in terms of mathematics learning achievement if the value of significance obtained less than 0.05. based on the result of the analysis that has been done befor, the significance value that obtained in the first hypotesis testing was 0.075. So H_0 was accepted. It was means that learning mathematics with problem based learning combined with Jigsaw was not effective in terms

of mathematics learning achievement of students.

The result of the analysis of the effectiveness of mathematics learning using problem based learning combined with Jigsaw was also relevant with Miftakhus Sholikhah (2014) research which states that the problem based learning combined with Jigsaw wass not effective in terms of learning achievement, although problem based learning effective in terms of critical thinking skills and mathematical dispositions.

Problem Based Learning Combined with Jigsaw Not Effective in Terms of Student's Mathematical Communication Skills

In Prince and Felder (2007) explained that problem based learning was more able to motivate students to learn from concepts that support, facts, and principles because they are all needed to get a solution from the problem. Students who had been less motivates to get these things in such a way that less effective learning. In this research, the effectiveness of problem based learning combined with Jigsaw not only observed from mathematics learning achievement of students but also viewed from mathematical communication skill.

In this research, groups that have been formed were less cooperative. This was shown by the habitualness of students in self-study was still visible in this cooperative seats setting. At the time of workmanship worksheet, students also pay less attention to the information that arise from the problems given to learners.

The result of the analysis of the effectiveness of mathematics learning using the problem based learning combined with Jigsaw was also relevant to the research conducted by Della Anggraini (2016) the conclusion given that PBL was not effective in terms of mathematical communication skill of learners because of the proportion of students who have good mathematical communication skill didn't reach 60% of the number of students.

Learning Model with Scientific Approach Combined with Jigsaw in Terms of Mathematics Learning Achievement

According to Suherman (2013), learning with a scientific approach can encourage and inspire students to be able to think hipothetically in viewing differences, similarities, and links to each other from learning materials. Learning with a scientific approach has a purpose of learning that was formulated in a simple and clear but interesting presentation system. In this research activity, scientific approach was packed with cooperative class setting that allows students to discuss about differences or similarities that they meet in their discussion. Learning model using scientific approach was given to class VII E as second experimental class. The effectiveness of this learning model was viewed from the achievement of learning mathematics based on the value of the significance obtained from the posttest achievement mathematics learning. This learning was said to be effective in terms of mathematics learning achievement if the significance value

obtained less than 0.05. based on the result of the previous analysis, the significance value obtained in the third hypothesis test was 0.025, so H_0 was rejected. It was stated the learning of mathematics bu using learning model with scientific approach combined with Jigsawwas effective in terms of mathematics learning achievement.

The result of the analysis of the effectiveness of learning mathematics using learning model with scientific approach in terms of mathematics learning model with scientific approach in terms of student's mathematics learning achievement relevant to research conducted by Nilam Nawang Puspita (2016).

Learning Model with Scientific Approach combined with Jigsaw Effective in Terms of Mathematical Communication Skill

According Kurnik (2008), in the process of learning teachers help students to find and learn to know new concepts of mathematics. Knowledge gained by students using various ways and the basis of all the methods are also theoretical concepts. Based on this, students can use their own way and language to understand learning more effectively. The effectiveness of mathematics learning using learning model with scientific approach combined with Jigsaw was not only viewed from student's mathematics learning achievement but also viewed from mathematical communication skill. This effectivenesswas based from the significant value derived from the posttest result of mathematical communication skill. This learning model was effective in terms of student's mathematical communication skill if the significance value obtained was less than 0.05. Based on the results of previous analysis, the significance value in the fourth hypotesis test on the control class was 0.000. So, H_0 was rejected. It was stated that the learning of mathematics using learning model with scientific approach combined with Jigsaw was effective in term of student's mathematical communication skill.

The result of this analysis were in line with research conducted by Juliana Rakony Untayana dan Undris Hatta (2016) which states that learning with an scientific approach effective in terms of mathematical communication skill.

Problem Based Learning Combined with Jigsaw was Not More Effective Compared to Learning Model with Scientific Approach Combined with Jigsaw in terms of Student's Mathematic Learning Achievement

After testing the first and third hypotheses and the result of the analysis that there was an difference average in score posttest between two samples. Then futher analysis was made to know which method was more effective between two models in terms of students mathematics learning achievement. The analaysis used using posttest pretest gain scores of student's learning achievement from each experimental class using independent sample t-test. The analysis's result obtained that the significance value is 0.096 more thab 0.05 which means that the learning of mathematics by using problem based learning

combined with Jigsaw is no more effective than the model of learning with scientific approach combined with Jigsaw in terms of student's mathematics learning achievement.

The result of this analysis were in line with research conducted by Valeria Kartikanningtyas (2015) showed that the problem based learning combined with Jigsaw is not more effective than learning model with scientific approach.

Problem Based Learning Combined with Jigsaw is Not More Effective Compared to Learning Model with Scientific Approach Combined with Jigsaw in Terms of Mathematics Communication Skill

After testing the secomd amd fpurth hypotheses andt the result op analysis that there is an average difference in the posttest score, then further analysis is made to know which method was more effective between two learning models. The analysis used posttest pretest gain score of student's mathematical communication skill from each experimental class using independent sample t-test. From the analysis results obtained that the significance value is 0.589 more than 0.05 which means that the learning of mathematics by using problem based learning model combined with Jigsaw was not more effective than the learning model with scientific approach combined with Jigsaw in terms of student's mathematical communication skill.

The result of the analysis of the effectiveness of mathematics learning using problem based learning combined with Jigsaw was also relevant to the research result of Fatia fatimah (2009) which states that student's communication skill using problem learning is not more effetctive than ordinary learning.

CONCLUSION AND SUGGESTION

Conclusion

Based on the results of the analysis and discussion that has been produced, the researcher concludes: (1) learning with problem-based learning model with jigsaw type and cooperative setting is not effective in terms of student's mathematics learning achievement, (2) learning with problem-based learning model with jigsaw type and cooperative setting is not effective in terms of students' mathematical communication skills, (3) learning with scientific approach in the jigsaw type and cooperative setting effective in terms of students' mathematics learning achievement, (4) learning with scientific approach in the jigsaw type and cooperative setting effective in terms of students' mathematical communication skills, (5) learning with problem-based learning model with jigsaw type and co-operative setting is not more effective than the learning model with scientific approach to the students' mathematics learning achievement viewed from the average of posttest and pretest gain score of students' mathematics learning achievement, (6) learning with problem-based learning model with jigsaw type and co-operative setting is not more effective than the learning model with scientific approach to the students' mathematical communication skills viewed from the average posttest and pretest

gain score of students' mathematical communication skills.

Suggestion

Based on the results of the research, the researcher gives suggestions as a contribution for better mathematics learning for other researchers, the suggestions are to increase the number of observers as the number of groups formed in cooperative settings in the research class, other researchers are expected to take control the learning model and the learning objectives used in research, researchers have to ensure that the learners are familiar with cooperative setting class, the learning process in the research should be done by the teachers who are familiar with cooperative class settings as well as understand the characteristics of the students, other researchers who will conduct research using problem-based learning model with Jigsaw type and cooperative settings are expected to adjust the materials that match with the problem-based learning model, other researchers who will conduct research using problem-based learning model with Jigsaw type and cooperative setting are expected to add the variables that will be measured or to compare them with other learning models to get better results.

REFFERENCES

Anggraini, D., Gunowibowo, P., & Djalil, A., (2016). Efektivitas Problem Based Learning Ditinjau dari Kemampuan Komunikasi Matematis Siswa. *Journal Pendidikan Matematika Universitas Lampung*, 4(1).

Arends, R. I. and Kilcher, A. (2010). *Teaching for student learning : Becoming an accomplished teacher.* Oxon : Routledge.

Arends, R. (1997). *Classroom Instructional Management.* New York : The MCGraw-Hill Company.

_____. (2008). *Learning to Teach*. (Translated by Helly Aprajitno Soetjipto and Sri Mulyantini Soetjipto). Yogyakarta : Pustaka Pelajar.

Chance, P. (2003). *Learning and Behavior*. Belmont : Thomson Learning, Inc.

Cohen, E. G., Brody, C. M., & Shevin, M. S. (eds). (2004). *Teaching Coorperative Learning : The Challenge for Teacher Education.* Albany : State University of New York.

Cooke, B. D. & Buchholz. (2005). Mathematical Communication in the Classroom: A Teacher Make a Difference. Early Childhood Education Journal, 32(6), 365-369.

Dell'Olio, J. M. & Donk, T. (2007). *Models Of Teaching : Connecting Students Learning With Standards.* California : Sage Publication.

Fatimah, F. (2012). Kemampuan Komunikasi Matematis Dalam Pembelajaran Statistika Elementer Melalui *Problem Based Learning*. *Cakrawala Pendidikan*, 2, 267-277.

Farhan, M. & Retnawati, H. (2014). Keefektifan PBL dan IBL Ditinjau dari Prestasi Belajar, Kemampuan Representasi Matematis dan Motivasi Belajar. *Jurnal Riset Pendidikan Matematika*. 1 (2), 227-240.

Gillies, R. M. (1949). *Coorperative Learning : Integrating Theory And Practice*. California : Sage Publications.

Hergenhahn, B. R. & Olson, M. H., (1997). *An Introduction To Theories Of Learning.* New Jersey : Prentice-Hall, Inc.

Huda, M. (2015). *Model – Model Pengajaran dan Pembelajaran : Isu – Isu Metodis dan Paradigmatis.* Yogyakarta: Pustaka Pelajar.

Johnson, B. & Christensen, L. (2012). *Educational research : quantitative, qualitative, and mixed approaches (fourth ed)*. California : Sage.

Isjoni. (2010). *Pembelajaran Kooperatif: Meningkatkan Kecerdasan Komunikasi Antar Peserta Didik.* Yogyakarta: Pustaka Pelajar.

Kartikaningtyas, V. dan Retnawati, H. (2016). The Effect of Problem Based Learning (PBL) Combined With Cooperative Learning in Terms of Mathematical Communication Skill and Student's Achievement Grade 11th Science SMA N 2 Yogyakarta. *Jurnal Pendidikan Matematika,* 5(2), 1-8.

Khamid, A. dan Santoso, R. S. (2016). Keefektifan PBL dan CTL Ditinjau dari Komunikasi Matematis dan Motivasi Belajar Siswa SMP. *PHYTAGORAS: Jurnal Pendidikan Matematika*, 11(2), 111-122.

Kurnik, Z. (2008). The Scientific Approach to Teaching Math. *Metodika 17,* 421 – 432.

Laili, H. (2016). Keefektifan Pembelajaran dengan Pendekatan CTL dan PBL Ditinjau dari Motivasi dan Prestasi Belajar Matematika Siswa. *PHYTAGORAS: Jurnal Pendidikan Matematika*, 11, 25-34.

Lazim, M. (2014). *Penerapan Pendekatan Saintifik Dalam Pembelajaran Kurikulum 2013.* Accessed 6th November 2016, 21.30 o'clock from http://p4tksb-jogja.com/arsip/index.php?option=com_phocadownload&view=category&download=122:penerapan-pendekatan-saintifik-dalam-pembelajaran-kurikulum-2013&id=1:widyaiswara.

NCTM. 1996. *Communication in mathematics, K-12 and Beyond*. Virgina: NCTM.

Prince, M., & Felder, R. (2007). The many faces of inductive teaching and learning. *Journal of College Science Teaching*, 35(5), 14-20.

Puspita, N. N. (2016). Penerapan Model Scientific-Jigsaw Guna Meningkatkan Keaktifan dan Prestasi Belajar Siswa pada Mata Pelajaran Dasar dan Pengukuran Listrik. *Jurnal Pendidikan Teknik Elektro,* 6(4), 28-35.

Retnawati, H. (2014). Membuktikan Validitas Instrumen dan Pengukuran. Accessed on 25th August 2017 from http://www.evaluation-edu.com

Solikhah, M. dan Hartono. (2015). Perbandingan Keefektifan Antara Problem-Based Learning Setting Numbered Head Together Dan Setting Jigsaw. *Jurnal Riset Pendidikan Matematika*, 2(1), 63-77.

Sudijono, A. (2012). *Pengantar Evaluasi Pendidikan.* Jakarta: Raja Grafindo Persada.

Sugiyono. (2010). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung : Alfabeta.

_____. (2015). *Metode Penelitian Pendidikan (Pendekatan Kualitatif, Kuantitatif, dan R&D).* Bandung : Alfabeta.

Susanto E. & Retnawati, H. (2016). Perangkat Pembelajaran Matematika Bercirikan PBL untuk Mengebangkan HOTS Siswa SMA. *Jurnal Riset Pendidikan Matematika.* 3 (2), 189-197.

Untayana, J. R. & Harta, I. (2016). Pengembangan Perangkat Pembelajaran Limit Berbasis Pendekatan Saintifik Berorientasi Prestasi Belajar dan Kemampuan Komunikasi Matematis. *Jurnal Riset Pendidikan Matematika,* 3(1), 45-54.

Wagiran. (2013). *Metodologi penelitian : Teori dan Implementasi.* Yogyakarta : Deepublish.

Westwood, P. (2008). *What Teachers Need to Know About Teaching Methods*. Victoria : Acer Press.

Yamin, S. & Kurniawan, H. (2009). *SPSS COMPLETE : Teknik Analisis Statistuk Terlengkap dengan software SPSS.* Jakarta : Salemba Infotek.