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Mathematical writing ability in Problem Based Learning observed from the level of logical-mathematical intelligence

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Abstract

The purpose of this study were to (1) prove the students' mathematical writing ability in the application of PBL achieve classical mastery criteria; (2) describe the mathematical writing ability of students in PBL observed from the level of logical-mathematical intelligence. The research used a mixed-method. The population of this study was 278 VIIth grade students in SMP 4 Kudus. The sample in this study was 32 students of VII-A class. Quantitative data sampling was done using simple random sampling technique. Quantitative data were obtained using tests. Quantitative data analysis used the normality test, homogeneity test, t-test, and z-test. The subjects in this study were 6 students. Qualitative data analysis was the analysis of data from interviews. The results showed that (1) the mathematical writing ability of VIIth grade students observed from the level of logical-mathematical intelligence achieved classical mastery criteria; (2) Students with high, moderate and low logical-mathematical intelligence levels met all three aspects of their mathematical writing ability, such as written text, drawing, and mathematical expression.

1. Introduction

Learning mathematics has an important role in life. According to Puspitasari, et al (2015) Mathematics needs to be taught to students because (1) it is always used in all aspects of life; (2) all fields of study require appropriate mathematical skills; (3) is a strong means of communication; short and comprehensive; (4) can be used to present information in various ways; (5) increase the ability to think logically, accuracy and spatial awareness; (6) providing satisfaction of efforts to solve challenging problems.

One of the goals of learning mathematics is to develop the ability to convey information or communicate ideas, among others, through conversation, graphs, maps, diagrams, in explaining ideas. According to Junaedi (2010), one of the mathematical skills in the mathematics curriculum is mathematical communication. Baroody (1993) stated that there are five aspects of mathematical communication activities, such as (a) representing, (b) listening, (c) reading, (d) discussing, and (e) writing. One aspect of mathematical communication activities is writing. Mathematical writing is one way to convey ideas or mathematical ideas that can be in the form of problem solving, understanding and reasoning. According to Junaedi (2010) writing is one aspect of communication that need to be developed in mathematics learning, through writing activities of students 'learning processes can be documented in files and students' writing can be used as an evaluation tool. so that it cannot be separated from mathematics learning. Problem-solving skills are not only needed to solve problems in mathematics but also needed by students for evaluation tools.

Aside of mathematical writing skills, the students' learning objectives are also very necessary in improving students' mathematical writing skills, since the students' objective in learning can encourage them during the efforts to achieve achievement.

In an interview with one of the teachers at SMP N 4 Kudus. VIIth grade students in SMP N 4 Kudus tend to work hard on questions in the form of stories, especially in Linear Equations with One Variable (LEOV) topic. Students are difficult to reform the problem in the form of mathematical models and write their thoughts in written form.

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Meanwhile according to Sufi (2016) on problem-based learning, discussions were happened in small groups reflecting in interactions between students and between students-teachers called communication. Likewise, when presenting the results of their group-work, students were required to communicate with friends and teachers. Based on the research, the use of problem-based learning models in mathematics learning influences mathematical communication skills. Through the problem-based learning model, students are expected to improve their mathematical communication skills so they will feel comfortable and happy while participating in mathematics learning and can readily understand the concepts.

According to Yanti (2016), after applying problem-based learning model, it was shown that students' mathematical communication skills in writing in groups on the probability topic were very good, while students' mathematical communication skills verbally in groups on the probability topic were still lacking.

In the process of mathematics teaching and learning, teachers should use learning models that involve student in the activities since by involving students, they will understand, appreciate, and perceive their experiences. One learning model that can be used to stimulate student activity is the Problem Based Learning (PBL) model. In the study of Dwiningsih, et al (2015) stated that there are internal factors and external factors that influence the learning process. One external factor that influences the learning process is the learning model used by teachers in mathematics learning. While one of the internal factors is the intelligence of the students. In Suhendri's (2011) research, each child has a different personality so that they have different abilities and intelligence. According to Gardner as quoted by Ekasari (2014) intelligence is the ability to solve problems and produce products in a structured state. Gardner formulated eight types of intelligence, namely: (1) linguistic intelligence, (2) logical-mathematical intelligence, (3) visual-spatial intelligence, (4) musical intelligence, (5) body-kinesthetic intelligence, (6) interpersonal intelligence, (7) intrapersonal intelligence, (8) naturalistic intelligence, where each intelligence has characteristics that distinguish each student.

Dwiningsih, et al. (2015) stated that logical-mathematical intelligence has the characteristics that distinguish it from other intelligence. This difference will certainly affect the ability of students to deal with problems, especially in terms of creativity in viewing and solving a problem both observed from students' answers and thinking processes. Logical-mathematical intelligence is a part of intelligence that is important in strengthening students' thinking abilities, problem-solving skills and improving memory so that it is one of the important things in learning mathematics. Understanding students' various ways of thinking makes it easy for them to choose the right step of learning with their level of logical-mathematical intelligence. This can increase students' chance of success in solving mathematical problems.

Based on the background that has been explained, the formulation of the problems that will be examined in this study are as follows: (1) whether students' mathematical writing ability in the application of PBL achieve classical mastery criteria; (2) how is the mathematical writing ability of students in PBL observed from the level of logical-mathematical intelligence.

2. Methods

This research is a mixed-methods research. A mixed-methods research is a research using two existing studies, namely quantitative research and qualitative research. According to Creswell (2009: 5), mixed methods research is a research approach that combines or associates qualitative and quantitative forms. This approach involves philosophical assumptions, the application of qualitative & quantitative approaches, and mixing the two approaches in one research phase. This approach is more complex than just collecting and analyzing two types of data, it also involves the function of the two research approaches collectively so the strength of this research as a whole is greater than qualitative research and quantitative research itself.

Data-collecting methods used in this study were scaling, written tests, interviews, and documentation. The population in this study were 288 VIIth-grade students of SMP Negeri 4 Kudus year 2018/2019. The sample in this study were 2 classes including class VII-I as many as 32 students as the pilot class and class VII A as many as 32 students as the experimental class. The experimental class received the treatment of mathematics learning with the PBL model.

In quantitative research, samples were selected using simple random sampling techniques. Quantitative methods are used to determine the

achievement of mathematical writing ability of the experimental class. In qualitative research, purposive sampling was used, namely the subject taking technique with certain considerations. Qualitative methods are used to describe the mathematical writing ability of students observed from the level of logical-mathematical intelligence in high, moderate, and low groups.

The study was conducted at SMP N 4 Kudus. The subjects used as data sources were students of the experimental group consisting of 2 students with high logical-mathematical intelligence, and 2 students with moderate logical-mathematical intelligence, and 2 students with low logical-mathematical intelligence. Based on the results of a logical-mathematical intelligence scale and strengthened by interviews with consideration of being able to communicate well and the consideration of mathematics teachers in VIIth grade of SMP N 4 Kudus. Qualitative data analysis includes the analysis of interview data. Data analysis in qualitative research includes data reduction, data presentation, and concluding. Analysis of students' mathematical writing abilities in this study is based on the results of a mathematical writing ability test and also the results of interviews in which there are indicators for mathematical writing ability. Darmawan, as quoted by Oktaviarini (2015), the indicators achieved, are as follows.

1. Aspects of written text, in this ability, students are required to write an explanation of the answer to the problem mathematically, rationally, clearly, logically-arranged, and systematic.
2. Aspects of drawing, in this ability, students are required to paint drawings, diagrams, and tables completely and correctly.
3. The aspect of mathematical expression, on this ability, students are expected to make a model of mathematical problems correctly or express mathematical concepts by expressing daily events in mathematical language or symbols correctly, then doing calculations or getting complete and correct solutions. The results of the interview analysis will be used as triangulation to identify students' mathematical writing ability observed from the level of logical-mathematical intelligence in selected students.

3. Results & Discussions

The study was conducted using class VII A as an experimental class. Research data was taken in in SMP Negeri 4 Kudus. The PBL model was applied to the experimental class. The learning was carried out four times for each class. The results of the descriptive analysis of students' mathematical writing ability tests in class as show in table 1.

Table 1. Results Summary of Mathematics-Writing-Ability Test for Experimental Class

No	Descriptive Statistics	Test Results of Experimental Class
1	Maximum Score	95.45
2	Minimum core	63.64
3	Range	31.89
4	Means	77.65
5	Standard Deviation	7.81

As for the data-obtaining of logical-mathematical intelligence level, scale was used. The level of logical-mathematical intelligence scales to group students into categories of logical-mathematical intelligence level of students. The grouping is divided into 3 namely high groups, moderate group, and low group. Categorization of the students' logical-mathematical intelligence level in this study was based on the results of logical-mathematical intelligence tests in which there were indicators for logical-mathematical intelligence. Students with high logical-mathematical intelligence tend to like the activity of analyzing and studying the cause and effect of something. Students like to think conceptually, for example developing hypotheses and holding categorizations and clarifications of what they are facing. Such students tend to like counting activities and have high speed in solving mathematical problems. These students also really like various games that involve active thinking, regularly and playing puzzles. The results of data processing on the scale of logical-mathematical intelligence level of experimental group students can be seen in the table 2.

Table 2. The Categorization Results of Students' Logical-mathematical Intelligence Levels

No.	Category	Number of Students
1	High	5
2	Moderate	21
3	Low	5

Based on the categorization of the logical-mathematical intelligence level, 6 students were selected, then interviewed to find out the level of students' logical-mathematical intelligence in depth. The selected research subjects to be analyzed mathematical writing ability can be seen in Table 3.

Table 3. The selected research subjects

No	Code of Students	Category
1	A-30	High
2	A-05	High
3	A-26	Moderate
4	A-09	Moderate
5	A-01	Low
6	A-28	Low

Based on the research that has been done and the results of the research-hypothesis-test, obtained that: (1) The data-analysis results of the experimental-class students' writing-ability test in the (Linear Equations in One Variable) LEOV and Linear Inequality in One Variable (LIOV) chapters especially the LEOV topic were known that at least 75% of the test participants meet the Minimum Mastery Criteria (MMC) score of 70, which was as many as 27 out of 30 (90%) students have met the MMC with an average mathematical writing ability test result of 77.65. Based on the calculation results obtained z_{score} in the classroom with Problem-Based Learning were 1.897. At a significance level of 5%, z_{table} was 1.64, so that $z_{score} > z_{table}$, which means H_0 is rejected and H_1 is accepted, meaning that the proportion of students who meet the individual mastery criteria on mathematical writing ability with Problem-Based Learning is more than 75% of the total number of students in class; (2) Based on the results-analysis, students' mathematical writing ability observed from the level of logical-mathematical intelligence after the implementation of Problem-Based Learning in solving mathematical writing ability test questions as follows.

3.1. Mathematical Writing Ability with a High Level of Logical-Mathematical Intelligence using Problem Based Learning

The results of mathematical writing ability analysis of students with a high level of logical-mathematical intelligence are students who have the characteristics of being slow in answering problems, but careful or thorough, so the answers tend to be correct. Based on the results of the mathematical writing ability test work of the two subjects with a high level of logical-mathematical intelligence, it was found that in the written text aspect, subject A-30 had the ability to have criteria with questions number 1 and 3, high in questions number 2 and 4, while subject A- 05 has the ability with high criteria in questions number 1, 2, and 4, while question number 3 has moderate criteria. In general, the written text aspect of the two subjects with a high intelligence level can write what is known in full even though some do not use symbols. This is consistent with what was stated by Liang (2012) that someone with high intelligence has a unique potential in creative productivity. According to Sharp as quoted by Mahmudi (2010: 2) stated that productivity refers to the construction of any number of idea, regardless of whether the idea is new or not. So they generally can use symbols in constructing the process of finding answers.

Based on the test results of the mathematical writing ability of the two subjects with a high level of logical-mathematical intelligence it was found that in the drawing aspect subjects A-30 and A-05 had the ability with the same criteria, namely high in questions numbers 3 and 5. In general, in the second drawing aspect subjects with a high level of logical-mathematical intelligence can draw images correctly accompanied by complete and precise information. This is following the statement of Zulkardi (2003: 7) that mathematics emphasizes the understanding of concepts, meaning that in learning mathematics, students must understand mathematical concepts first to solve problems. Based on the results of the mathematical writing ability test work of the two subjects with a high level of logical-mathematical intelligence it was found that in the mathematical aspect of the subject A-30 has the ability to have high criteria on all questions, while subject A-05 has the ability with sufficient criteria in question number 3 and high criteria on other questions. In general, the mathematical expression aspects of the two subjects with a high level of logical-mathematical intelligence can write a structured

and systematic solution accompanied by a correct calculation even though there was an error in understanding the concept of the difference between the numerator and denominator. Based on the results of the interview, one of the subjects wrote the answer on scribbling paper first and some steps were not written on the answer sheet. Both subjects re-checked the calculations that had been done so they felt sure that the answer was correct. All subjects at each level of logical-mathematical intelligence have two superior logical-mathematical intelligence indicators, namely knowing abstract patterns and doing calculations to make the subject get the right answer and correct procedure (there are calculations in the procedure). So it can be seen that students who excel in doing calculations will automatically be able to smoothly solve problems of calculation and settlement. This is consistent with what was stated by Fatimah (2009: 15) that children can do calculations correctly and precisely because children can do calculations smoothly. According to Lwin (2008: 43) that "logical-mathematical intelligence is the ability to handle numbers and calculations, patterns and logical thinking and science.

From the description above it can be concluded that the two subjects with a high level of logical-mathematical intelligence meet aspects of written text, drawing, and mathematical expressions where both subjects do not have the ability with low criteria in every aspect, so that in general it can be said to have the ability to write mathematically sufficiently maximal .

Based on the teacher's observations when learning to use the problem-based learning model of learning both subjects have a high curiosity both easy and difficult questions and are more active when discussing in completing mathematical writing assignments on the workseets. This is following Uno (2014: 11) states that students with high intelligence will tend to try to ask questions and look for answers to things they do not understand.

In terms of responding to interview questions, both subjects with a high level of logical-mathematical intelligence took a long time to consider the answers to be given, the child considered many alternatives before responding, so there was a high possibility that the response given was correct. The relatively long time when solving problems is also the reason both subjects with high logical-mathematical intelligence make mistakes because they use the time to think deeply in answering questions. This is following research.

3.2. Mathematical Writing Ability with Moderate-Level of Logical Intelligence Using Problem Based Learning

The results of mathematical writing ability analysis of students with moderate logical-mathematical intelligence level are students who have the characteristics of being slow in answering problems, but careful or thorough, so the answers tend to be correct. Based on the results of the mathematical writing ability test work of the two subjects with the level of logical-mathematical intelligence being obtained that the written text aspect of subject A-26 has the ability with the criteria being in questions number 1, 3, and 4, high criteria in question number 2, while the subject A-09 has the ability with sufficient criteria in questions number 1 and 3, while in questions number 2 and 4. In general, in the written text aspect, two subjects with a level of logical-mathematical intelligence can write what is known in full even though some have not used it. symbol and some still have a little lack, for example, there is information related to the core of the question that has not been written down.

Based on the results of the mathematical writing ability test work of both subjects with a level of logical-mathematical intelligence is being obtained that in the drawing aspect subjects A-26 and A-09 have the ability with the same criteria, which is high on all drawing problems. In general, the aspects of drawing the two subjects with a level of logical-mathematical intelligence is being able to make a picture correctly accompanied by complete information and.

Based on the results of the mathematical writing ability test work of the two subjects with the level of logical-mathematical intelligence it was found that in the mathematical aspects of the subject A-26 and A-09 had the same criteria, namely being in question number 3 and high in the other numbers .. Generally in aspects of mathematical expression of both subjects with a level of logical-mathematical intelligence are able to write a structured and systematic solution accompanied by a correct calculation even if there are still shortcomings. This is following research Misofa (2017) states that people who have logical-mathematical intelligence are also able to do various manipulations to make it easier to perform calculations. Based on the results of the interviews the two subjects rechecked the calculations that

have been done so they feel confident that the answer is correct.

From the description above it can be concluded that the two subjects with the level of logical-mathematical intelligence are fulfilling aspects of written text, drawing, and mathematical expressions where both subjects do not have the ability with low criteria on each aspect, so that in general it can be said to have the ability to write mathematically sufficiently maximal although the written text aspect of the two students with logical-mathematical intelligence level is still below the students with high intelligence level. This is consistent with the results of Novitasari's (2015) research that the mathematical creativity ability of students who have high logical-mathematical intelligence is better than students who have moderate logical-mathematical intelligence.

Based on the teacher's observations when learning to use the problem-based learning model of learning, both subjects have a high level of curiosity both easy or difficult questions and are more active when discussing in completing mathematical writing assignments on the worksheets. This is following Bruner's theory in Hidayat (2005) which stated that in solving problems students need to learn through active involvement in concepts.

In terms of responding to interview questions, both subjects with a level of logical-mathematical intelligence were long considering the answers to be given, the child considered many alternatives before responding so that the high possibility that the given response was correct. The relatively long time when completing a problem is also the reason the two reflective subjects make a little mistake in using the time to think deeply in answering questions.

3.3. Mathematical Writing Ability with Low-Level of Logical Intelligence Using Problem Based Learning

The results of mathematical writing ability analysis of students with low levels of logical-mathematical intelligence, namely students who have the characteristics of quickly answering problems, not thorough, so the answers tend to be mistaken. Based on the results of the mathematical writing ability test work of the two subjects with a low level of logical-mathematical intelligence, it was found that in the written text aspect, subject A-01 had the ability with low criteria in questions number 1, 3, and 4, high in question number 2, while subject A -28 have the ability with the criteria being in questions number 2 and 3, enough number 1 and 4. In general, in the written text aspect, two subjects with a low level of logical-mathematical intelligence write what is known well but there are still many who have not used symbols mathematics and there is still information related to the core problems that have not been written down.

Based on the results of the mathematical writing ability test work of the two subjects with a low level of logical-mathematical intelligence in the number problem, it was found that in the drawing aspect of subject A-01 has the ability with the same criteria, which is enough in questions numbers 3 and 5. In general, in the drawing aspect of the two subjects with a low level of logical-mathematical intelligence can take pictures well, but there are still some shortcomings. Based on the results of the test work mathematical writing ability of two subjects with a low level of logical-mathematical intelligence is obtained that the mathematical aspects of the subject A-01 and A-28 have the ability with criteria the same, namely low on questions number 2 and 3, high criteria for questions number 1, 3, and 5. In general, in the mathematical aspects of the two subjects with low logical-mathematical intelligence can write a structured and systematic solution accompanied but in the calculation, there are several errors, jam n that there is a misconception in the difference between the square of the numerator and the denominator. Subjects with low logical-mathematical intelligence do not use mathematical concepts that have been taught. This is following the theory of Bruner in Hidayat, (2005) which stated that in solving problems students need to learn through active involvement with concepts. Based on the results of the interviews the two subjects did not write the answers on opaque paper first. One of the subjects rechecked the calculation that had been done so that he was sure that the answer was correct.

From the description above it can be concluded that the two subjects with a low level of intelligence meet the aspects of written text, drawing, and mathematical expression where both subjects do not have the ability with low criteria in every aspect, so that in general it can be said to have the ability to write mathematically sufficiently maximal.

Based on the teacher's observations when learning to use the problem-based learning model of learning, the two subjects did not have high curiosity either easy or difficult questions, were

not very active during discussions in completing mathematical writing assignments on the worksheet.

In terms of responding to interview questions, the two old reflective subjects considered the answers to be given, a child with a low level of logical-mathematical intelligence. Do not consider too many alternatives before responding, so it is not too high a possibility that the response given is correct. The relatively fast time when solving problems is also the reason the two subjects with a low level of logical-mathematical intelligence do little to make mistakes because they use the time to think deeply in answering questions.

Subjects with low logical-mathematical intelligence do not explore understanding the concepts they have in working on problems so that the difficulty in the process of finding the right answer. This is following the statement of Zulkardi (2003: 7) that mathematics emphasizes the understanding of concepts, meaning that in learning mathematics, students must understand mathematical concepts first to solve problems.

Based on the results of the analysis in table 1, table 4, table 5, and table 6 it is known that subjects with low logical-mathematical intelligence do not explore the understanding of the concepts they have in working on problems so that the difficulty in the process of finding the right answer. This is following the statement of Zulkardi (2003: 7) that mathematics emphasizes the understanding of concepts, meaning that in learning mathematics, students must understand mathematical concepts first to solve problems.

4. Conclusion

Based on the results of research and discussion of students' mathematical writing ability in the Problem-Based Learning model observed from the level of logical-mathematical intelligence in VIIth grade students of SMP Negeri 4 Kudus on LEOV topic, the following conclusions can be obtained. (1) Mathematical writing skills of students in VIIth grade on the problem-based learning model observed from the level of logical-mathematical intelligence has met the classical mastery criteria (2) Students with high, moderate and low logical-mathematical intelligence levels meet the three aspects of mathematical writing ability, including writing, drawing, and mathematical expression.

Students with a high level of logical-mathematical intelligence meet all three indicators of mathematical writing ability very well such as able to formulate what is known and asked of a mathematical problem; able to use mathematical symbols or notations in accordance with the problems; able to develop strategies in solving mathematical problems that are associated with mathematical formulas or concepts completely; able to calculate or use mathematical operations and the results are appropriate; able to present mathematical problems into graphic very well and clearly; and can formulate conclusions in their language.

Students with a moderate-level of logical-mathematical intelligence are reaching the three indicators of mathematical writing ability well such as able to formulate what is known and asked from a mathematical discourse quite well; able to use mathematical symbols or notations in accordance with the problems in the problem; able to develop strategies in solving mathematical problems that are associated with mathematical formulas or concepts completely; able to calculate or use mathematical operations and the results are appropriate; able to present mathematical problems into graphic well and clearly; and can formulate conclusions in their own language.

Students with low levels of logical-mathematical intelligence meet the six indicators of mathematical communication skill but are weaker than students with high and moderate intelligence levels in term of the written indicator, students have difficulty reforming questions into mathematical models. In drawing indicators and mathematical expressions, students experience errors in calculations so that the obtained final results are less precise and in the presentation of graphic, students are incomplete in drawing.

References

Baroody, A. J. (1993). *Problem Solving, Reasoning and Communicating*. New York: Macmillan Publising.

Creswell, J. W. (2009). *Research Design Pendekatan Kualitatif, Kuantitatif, dan Mixed.* Yogyakarta: Pustaka Pelajar.

Dwiningsih, P., Mardiyana, & I. Slamet. (2015). Eksperimen Model Pembelajaran Creative Problem Solving, Think Aloud Pair Problem Solving Dan Student Team Achievement Division Dengan Pendekatan saintifik Ditinjau Dari Kecerdasan Logis Matematis. *Jurnal Elektronik Pembelajaran matematika*, 3(6): 637-647.

Ekasari, Y. (2014). Profil Kecerdasan Logis matematika dan Linguistik siswa kelas VII SMP dalam Memecahkan Masalah Persamaan Linear Satu Variabel Ditinjau dari Perbedaan Jenis Kelamin. *Jurnal Mathedunesa.* 3(2): 267-273.

Fatimah. (2009). *FUN MATH: Matematika Asyik dengan Metode Pemodelan*. Bandung: DARI Mizan.

Gardner, H. (2013). *Multiple Intelligences*. Jakarta: Daras Books.

Hidayat, M. A. (2005). *Teori Pembelajaran Matematika.* Semarang: Program Pascasarjana Unnes.

Junaedi, I. (2010). Pembelajaran Matematika dengan Strategi Writing in Performance Taks (Wipt) untuk Meningkatkan Kemampuan Menulis Matematika. *Kreano, jurnal Matematika Kreatif Inofatif.* Vol 1(1), 11-20.

Liang, J. C. (2002). Exploring Scientific Creativity Of Eleventh Grade Students In Taiwan. Disertasi.

Lwin, May, *et al*. (2008). *How to Multiply Your Child's Intelligence*. Yoyakarta : Penerbit Indeks.

Mahmudi, A. (2010). "Mengukur Kemampuan Berpikir Kreatif Matematis". Makalah. N. Hidayah et al/UNNES journal of Mathematics Education Konferensi Nasional Matematika XV UNIMA, 30 Juni- 3 Juli.

Misofa, Y . Rochmad, & Mulyono. (2017). Analisis Kemampuan Siswa pada Aspek Kreativitas dan Miskonsepsi Matematis Ditinjau dari Kecerdasan Logis Matematis pada Pembelajaran CORE Berbantuan Kartu Kerja. *Unnes Journal of Mathematics Education,* 6 (2).

Novitasari, D ., Rahman, A., & Alimuddin. (2015). Profil Kreativitas Siswa dalam Pemecahan Masalah Matematika Ditinjau dari Kecerdasan Visual Spasial dan Logis Matematis pada Siswa SMA N 3 Makasar . *Jurnal Daya Matematis*, 3(1): 24-33. Syuhendri. (2010)

Oktaviarini, K. A. (2015). Penerapan Model Pembelajaran Berbasis Masalah untuk Meningkatkan Kemampuan Komunikasi Matematis. In Seminar Nasional Matematika dan Pendidikan Matematika. Jurusan Pendidikan Matematika FMIPA UNY

Puspitasari *et al*. (2015). Analisis Kemampuan Literasi Matematika Siswa Kelas X MIPA 5 SMA Negeri 1 Ambulu Berdasarkan Kemampuan Matematika (The Analysis of Student's Mathematical Literacy of X MIPA 5 Grade at SMA Negeri 1 Ambulu Bassed on Mathematical Ability).

Sufi, L. F. (2016). Meningkatkan Kemampuan Komunikasi Matematis Siswa Melalui Model Pembelajaran Problem Based Learning. Tesis. Lampung: PPS Universitas Lampung.

Suhendri, H. (2011). Pengaruh Kecerdasan Matematis-Logis dan Kemandirian Belajar terhadap Hasil Belajar Matematika. *Jurnal Formatif*, 1(1): 29-39.

Uno, H. B. & M. Kuadrat. (2014). *Mengolah Kecerdasan dalam Pembelajaran.* Jakarta: Bumi Aksara.

Yanti, A. A. (2016). Penerapan Model Pembelajaran *Problem Based Learning* untuk Meningkatkan Kemampuan Pemecahan Masalah dan Komunikasi Matematis Serta *Self Efficacy Siswa* SMP (Doctoral dissertation, UNPAS). UNPAS.

Zulkardi. (2003). Pendidikan Matematika di Indonesia: *Beberapa Permasalahan dan Upaya Penyelesaian*. Palembang: Universitas Sriwijaya.