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Research Article

Representation Ability through the Problem Based Learning Model (PBL) for Junior High School Students

Nur Ajimah*, Cut Morina Zubainur, Hajidin

Department of Masters in Mathematics Education, Universitas Syiah Kuala, Banda Aceh, 23111, Indonesia
*Corresponding Author: nurajimah92@gmail.com

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ABSTRACT

This research aims to investigate the development of mathematical representation abilities through PBL. This research approach is quantitative. The population in this study was 150 students in class VII of SMP Negeri 13 Banda Aceh, while the sample was 23 students in class VII-5. The data collection technique was carried out through tests with mathematical representation ability test instruments which were carried out after each lesson. The data analysis technique for mathematical representation abilities is carried out by comparing students' answers to mathematical representation abilities in each lesson based on indicators of mathematical representation abilities, namely visual, symbolic and verbal. The results of the research show that students' mathematical representation abilities develop in various ways. The first indicator of mathematical representation ability is presenting data from a problem in the form of pictures, diagrams, graphs or tables. At the first meeting 10 out of 23 students complied, then at the second meeting 13 students met, at the third meeting 16 students complied, and the fourth meeting 20 students complied. The second indicator is solving problems involving mathematical expressions. At the first meeting 9 out of 23 students complied, then at the second meeting 12 students complied, at the third meeting 14 students complied, and at the fourth meeting 19 students complied. The third indicator is processing scientific language at the level of words, phrases and sentences. At the first meeting 12 out of 23 students fulfilled it, then at the second meeting 13 students fulfilled it, at the third meeting 15 out of 23 students fulfilled it, and at the fourth meeting 17 out of 23 students fulfilled the third indicator.

Keywords: Representation Ability; Mathematics; Problem Based Learning Model; Junior High School

1. INTRODUCTION

Representation ability is one of the basic abilities that each student must have. This is in accordance with NCTM, namely that one of the competencies to be able to learn mathematics is the ability to represent mathematics (NCTM, 2000). Mathematical representation ability is the ability to express mathematical ideas or ideas in the form of pictures, graphs, tables, diagrams, mathematical equations or expressions, symbols, writing or written words. Mathematical representation skills help students build concepts, understand concepts and express mathematical ideas, and make it easier to develop their abilities (Mandur, Sadra, and Suparta, 2013). Representation is grouped into visual representation (imagistic), which is a form of representation that includes visualized images, diagrams; verbal representation (syntactic) is a person's ability to process natural language, at the level of words, phrases and sentences; and symbolic representation is the ability to formulate notations or symbols from the situation presented and interpret the description of the image provided (Goldin, 2002).

Skills can be developed through answering mathematical questions, especially those in the form of story problems (Misel, 2016). Mathematical representation abilities can be developed in students through solving contextual problems. namely problem solving can make it easier for students to represent problems. Mathematical representation abilities make it easier for students to solve problems (Ahmad, Tarmizi, & Nawawi, 2010). The skill of representing problems also greatly influences students' success in solving problems such as constructing and using mathematical representations in the form of words, graphs, tables, pictures, and manipulating symbols. (Brenner, and Mayer, 1997). Thus, it can be concluded that representation skills are important in learning mathematics because through representation students can help students solve problems and communicate them to others.

In reality, there are still many Indonesian students who have problems with representation skills (Rahmawati, 2016). Indonesian students still need to strengthen their ability to integrate information, draw conclusions, and generalize the knowledge they have to other things/represent the results from image representation. Apart from that, the TIMSS results also show that in the Applying section (40%), namely selecting, representing, modeling, applying, solving routine problems, only 4% of Indonesian students were able to answer the Applying questions correctly. The low mathematical representation of students is also shown in the PISA results. In PISA questions which consist of six levels of difficulty, students have problems when answering questions with the highest level of difficulty, namely those related to questions that require students to generalize using information based on modeling in complex situations. They can connect different information sources flexibly and translate them (Johar, 2012). So, it can be concluded that Indonesian students have problems in mathematical representation skills, especially in verbal representation (Yumiati, 2017).

Students still have difficulty conveying mathematical ideas in mathematical representation questions related to SPLDV material. Students are still not able to describe the graph of the story problem given, so they cannot find the solution set, students are also less able to change the form of the problem into a mathematical sentence. The low ability of students' mathematical representation is caused by limited teacher knowledge and students' learning habits in class. The problem in the classroom when delivering mathematics learning material is the lack of development of junior high school students' representational abilities (Hutagaol, 2013). This was also discovered by researchers when conducting observations before conducting research, in learning students were less active and only followed the teacher's directions. Students are rarely given the opportunity to provide their own representation. The reason why students lack development in representation skills is because teachers deliver material using conventional learning and students often imitate the teacher's steps (Muslim, 2013).

PBL is a learning model for developing thinking skills and problem-solving skills, learning authentic adult roles and becoming independent students. According to Chakrabarty & Mohamed (2013) PBL is studentcentered learning where it emphasizes the learning process on the students themselves with solutions and the teacher acts as a facilitator. Students work in small groups and relate to real life situations. This allows students to be part of the learning process where students learn independently. PBL is a modern teaching method that allows each student to build his or her own scheme. According to Fatade, Mogari, & Arigbabu (2013) students' PBL mathematics classes focus on problem solving and conceptual understanding. Therefore, in PBL students make decisions about what they need to know to solve a problem scenario, and this raises interesting questions about how they determine what knowledge they need.

Achieving indicators of mathematical representation ability in each syntax is very important and requires a process of both time and energy. This process can be seen from the development of mathematical representation abilities. This means that the process of achieving mathematical ability indicators needs to be carried out in several meetings. If the first meeting of the mathematical representation indicator is not optimal, it will be raised again at the next meeting. Thus, research on the development of mathematical representation abilities is very important to do. Based on this description, the purpose in this research is to know develop students' mathematical representation abilities through the Problem Based Learning (PBL) model.

2. RESEARCH METHOD

This research was conducted to see students' mathematical representation abilities through the Problem Based Learning (PBL) model. The approach used is a descriptive quantitative approach. The population in this study were all VII students at SMP Negeri 13 Banda Aceh, totaling 150 students and the samples in this research were class VII-5 students, totaling 23 students. Class selection is carried out randomly. This research aims to determine the development of students' mathematical representation abilities through the Problem Based Learning model. To achieve this goal requires data in the form of answers to mathematical representation ability tests during the learning process, namely at 4 meetings. Observation of students' representational abilities during the learning process can be seen from students' answers and interview results. The data processing technique used in this research is data analysis of mathematical representation ability tests. Then the mathematical representation ability test is carried out by comparing students' answers to their mathematical representation ability in each lesson based on indicators of mathematical representation ability. The indicators of mathematical representation ability in this trial are:

1) Ability to present data or problems in the form of images, tables and diagrams.
2) Ability to create models or mathematical expressions of given problems.
3) Ability to answer questions using written text (Goldin & Steingold, 2001).

3. RESULTS AND DISCUSSION

The research results showed that students' mathematical representation abilities from the first to the fourth meeting experienced development. This can be seen at each meeting, students are able to fulfill the first indicator, namely changing a problem into an image to make it easier to solve, and the third indicator is the ability to process scientific language at the level of words, phrases and sentences. The development of students' mathematical representation abilities during the learning process with the PBL model is presented in **Table 1.**

Table 1. Development of Students' Mathematical Representation Ability in the Mathematical Representation Ability Test

Indicators	2nd Meeting			
	1	2	3	4
1	10	13	16	20
2	9	12	14	19
3	12	13	15	17

Based on the **Table 1**, it is found that the development of mathematical representation abilities consists of three indicators. The first indicator of mathematical representation ability is the ability to present data or information from a problem in the form of images. There was significant development, namely at the first meeting, 10 out of 23 students met the first indicator, then at the second meeting there were 13 students who met the first indicator and at the third meeting the number of students 16 students from 23 students met and the fourth meeting was 20 students who met the first indicator. Students experience good development for the first indicator, namely presenting data or information obtained from a problem in the form of pictures, diagrams, graphs and tables.

The second indicator of mathematical representation ability is the ability to solve problems in the form of mathematical expressions. There was also development, namely at the first meeting, 9 out of 23 students met the second indicator, then at the second meeting there were 12 students who met the second indicator and at the third meeting the number of students who met it became 14 students. from 23 students and the fourth meeting to 19 students meeting the second indicator. Students experience development for the second indicator, namely solving problems in the form of mathematical expressions. The third indicator of mathematical representation ability is the ability to process language at the level of words, phrases and sentences, there is development, namely at the first meeting, 12 out of 23 students met the third indicator, then at the second meeting there were 13 students who met the third indicator and at the third meeting the number of students 15 students from 23 students met and the fourth meeting saw 17 students meet the third indicator. Students experience good development for the third indicator, namely processing language at the level of words, phrases and sentences.

Students' mathematical representation abilities can be seen from the results of TRKM answers and the results of interviews conducted. The first indicator is to present data or information in the form of pictures, diagrams and tables as follows.

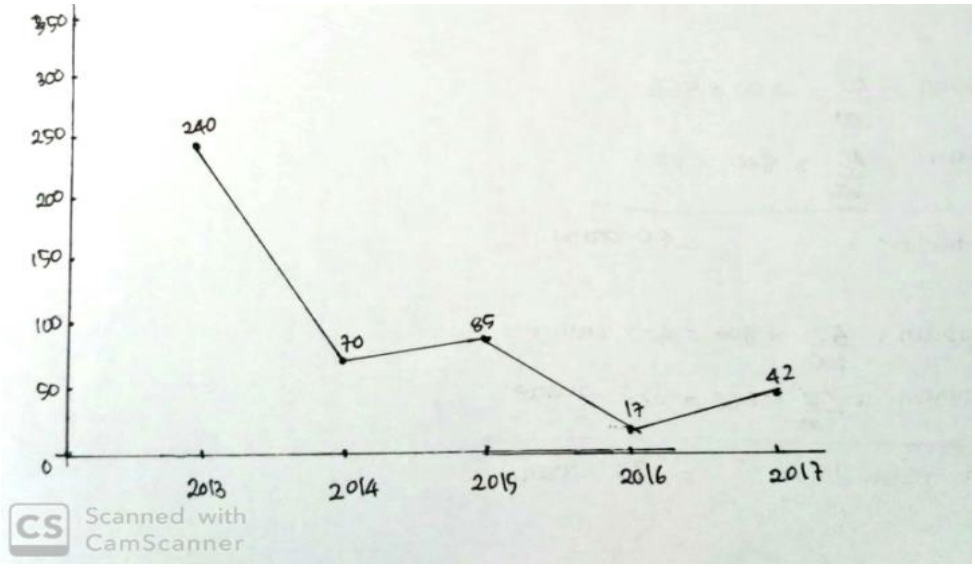

Figure 1. Results of student answers to Indicator One

Based on the **Figure 1,** shows that students' answers regarding the ability to present data or information from a problem in the form of pictures, diagrams, graphs or tables. Figure 1 presents data in the form of a line diagram containing female participants who have not graduated in the last 5 years. The distance written is 50 people. Based on the analysis, Figure 1, in terms of the students' expected answers, has met the ability of indicator one. The ability to present data or information from a problem in the form of images, diagrams, graphs or tables shown in the answers to TKRM can also be seen from the following interview excerpt. The ability to present data or information from a problem in the form of images, diagrams, graphs or tables shown in the answers to TKRM can also be seen from the following interview excerpt.

Q : What does the question ask?
S : Create diagrams from information obtained from bar charts and tables
Q : Are you sure the answer you answered is correct?
S : Yes, ma'am
Q : What is the title of the diagram you made?
S : Line diagram of female participants who have not graduated for 5 years
Q : Why does the bar chart you made start at 0? next 5 0 ,100, and so on like that?
S : I took the distance to be 5 0 to make it easier for us to plot points on a line diagram
Q : What do you do in the next step?.
S : Plots points, and connects the points to form a line

The results obtained from interviews regarding student answers regarding indicator one were that students explained clearly. Based on the TKRM results and interviews, it was clear that the student had fulfilled the ability to present problems in a bar diagram. Student answers that meet the second indicator are solving problems in the form of mathematical expressions which can be seen in the **Figure 2.**

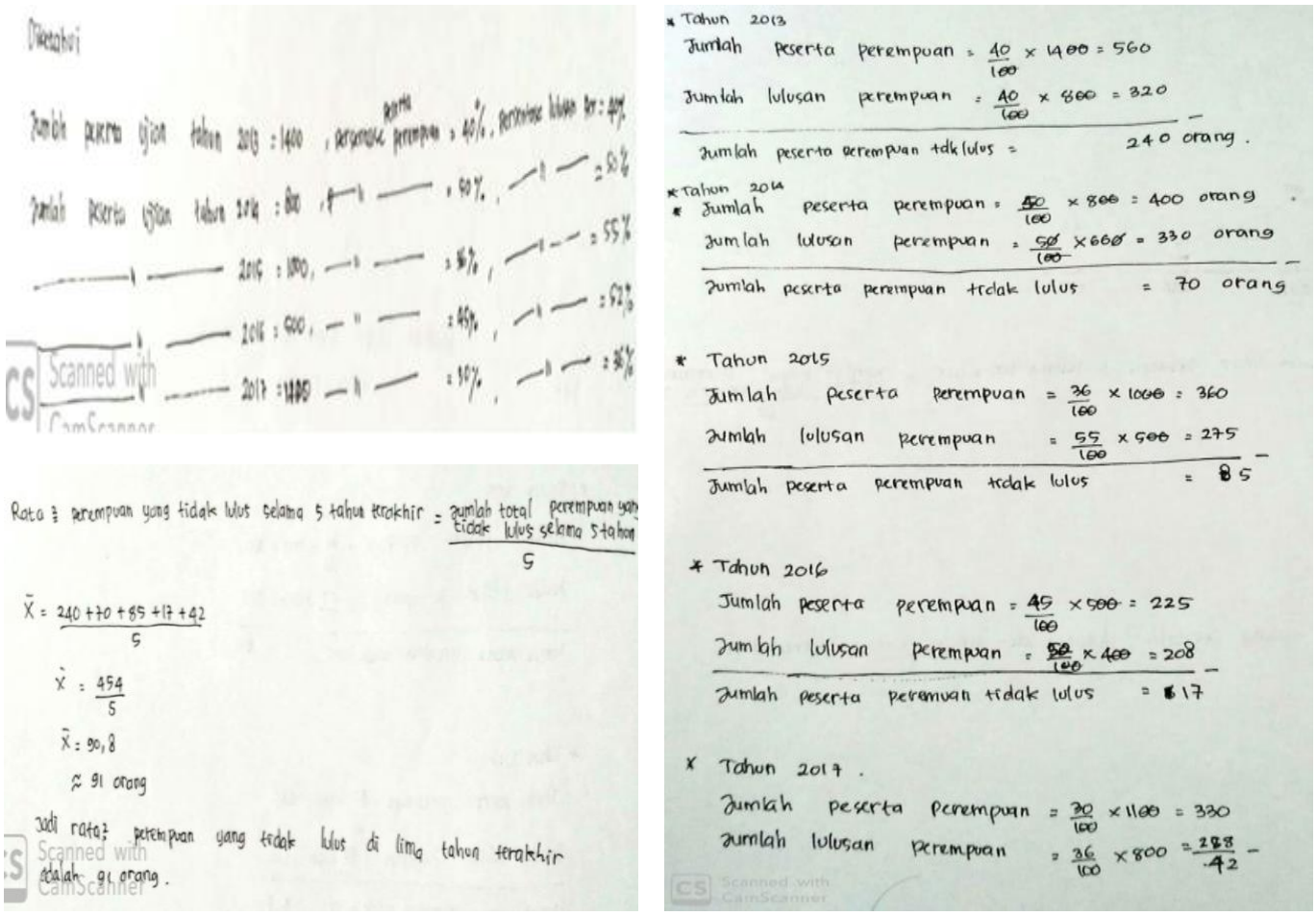

Figure 2. Results of student answers to Indicator Two

The results obtained from interviews regarding student answers regarding indicator one were that students explained clearly. Based on the TKRM results and interviews, it was clear that the student had fulfilled the ability to present problems in a bar diagram. Student answers that meet the second indicator are solving problems in the form of mathematical expressions which can be seen in the **Figure 3.**

Q : What is asked in the question? (while showing the question)

S : Looking for the average number of women who do not graduate

Q : What were the first steps you took?

S : The first step I took was to write the information given in the bar chart into written form

P : So, what are you doing again?

S : I immediately looked for the number of female participants over four years

Q : How do you find it, what equation do you use?

S : I immediately searched by plugging it into the equation

$$\text{Number of Female Participants} = \frac{\text{Percentage of female participants}}{100} \times \text{Percentage of female participants}$$

Q : Why do you use that formula?

S : Because that's the percentage formula, ma'am

Q : After you get the number of female participants, what do you do as the next step? S : I am looking for the number of female graduates by entering it into the formula

$$\text{Number of Female Graduates} = \frac{\text{Percentage of female graduates}}{100} \times \text{Number of graduates}$$

Only after that can we find the number of women who did not graduate = the number of female participants the number of female graduates

Q : the next step is to find the average how do you find it?

S : I use the average formula, namely $\overline{X} = \frac{\sum x}{n}$

Based on the TKRM results, students solve problems involving mathematical expressions, namely percentage formulas. The results obtained from interviews regarding student answers regarding indicator two were that students explained clearly. Based on the TKRM results and interviews, it is clear that the student has fulfilled the ability to solve problems with mathematical expressions. Student answers that meet the third indicator, namely processing language into words, sentences and phrases, are as follows:

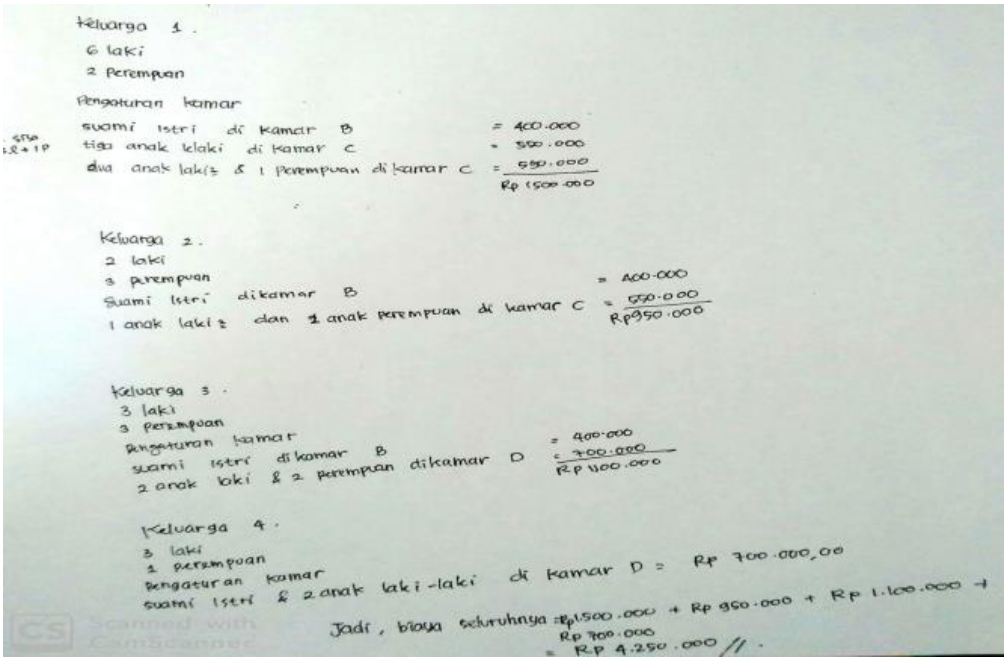

Figure 3. Student answer results for indicator three

Figure 3 shows students' answers regarding processing scientific language at the level of words, phrases and sentences. Figure 3 Students arrange the room arrangements so that the rooms occupied by the four families are 3 types of rooms, namely room types B, C, and D. Family 1 consists of 6 men and 2 women with husband and wife divided into room B, three children the boy is in room C, and two boys & 1 girl occupy room C. Next, the rooms are arranged for the fourth family. Based on the analysis, Figure 4.20, in terms of the students' expected answers, meets the ability of indicator three. The ability to process scientific language at the level of words, phrases and sentences shown in the answers to TKRM can also be seen from the following interview excerpt.

Q : What is asked in question number 2?

S : arrange rooms for the group so that the total cost of accommodation is as cheap as possible and determine the total cost?

Q : How do you manage it

S : I arranged it in stages, first I arranged the room arrangements for family 1 first, then to the next family because men or women cannot share a room with men or women from other rooms.

Q : For family 1, how do you arrange it?

S : I counted the number of men, namely 6 people and the number of women, there were 2. I arranged the husband and wife in room B which was only occupied by two people. The reason I put husband and wife in room B is because husband and wife have to sleep in the same room as their partner. Next, there were 5 boys remaining, 1 girl. I placed three boys who could only be accommodated in room 3 because it had a capacity of 3 people. Meanwhile, the remaining boys and girls I placed in Room C. Next, I counted expenses incurred for the family 1.

Q : What types of rooms are suitable for a family so the cost is cheap?

S : Types B, C, and D

Q : After you arrange the rooms occupied by the four families, what do you do?

S : I will calculate the total amount spent by the 4 families

Based on the TKRM results, students solve questions by processing scientific language at the level of words, phrases and sentences. The results obtained from interviews regarding student answers regarding indicator three were that students explained the arrangement of the places occupied by the 4 families so that they met the requirements given in the question. Based on the TKRM results and interviews, it is clear that the student has fulfilled the ability to process scientific language at the level of words, phrases and sentences.

4. CONCLUSION

Based on the results of research at SMPN 13 Banda Aceh, it was found that mathematical representation abilities through the PBL model developed in various ways. The first indicator of mathematical representation ability is presenting data or information from a problem in the form of images, diagrams, graphs or tables. At the first meeting 10 out of 23 students met the first indicator, then at the second meeting this increased to 13 out of 23 students meeting the first indicator, at the third meeting 16 out of 23 students met the first indicator, and at the fourth meeting 20 out of 23 students met the first indicator. The second indicator of mathematical representation ability is solving problems involving mathematical expressions. At the first meeting 9 out of 23 students met the second indicator, then this increased at the second meeting to 12 students meeting the second indicator, at the third meeting 14 out of 23 students met the second indicator, and at the fourth meeting 19 out of 23 students met the second indicator. The third indicator of mathematical representation ability is processing scientific language at the level of words, phrases and sentences. At the first meeting 12 out of 23 students met the third indicator, then this increased at the second meeting to 13 students meeting the third indicator, at the third meeting 15 out of 23 students met the third indicator, and at the fourth meeting 17 out of 23 students met the third indicator.

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REFERENCES

National Council of Teachers of Mathematics. (2000). *Principles and standards for School Mathematics*. Reston, VA: NCTM.

Mandur, K., Sadra, I.W., Suparta, I.N. (2013). Kontribusi Kemampuan Koneksi, Kemampuan Representasi, dan Disposisi Matematis Terhadap Prestasi Belajar Matematika Siswa SMA Swasta Di Kabupaten Manggarai. *E-journal Program Pascasarjana. Program Studi Universitas Ganesha Program Studi Matematika*. Vol 2(1).

Goldin, G.A. (2002). *Representation in Mathematical Learning an Problem Solving*. Dalam L.D English (Ed). Handbook of International Research in Mathematics Education (IRME). New Jersey: Lawrence Erlbaum Assosiates

Misel, Suwangsih,E. (2016). Penerapan Pendidikan Matematika Realistik untuk Meningkatkan Kemampuan Representasi Matematis Siswa. *Jurnal Metode Didaktik, 10*(2), 1-10

Ahmad, A., Tarmizi, R. A., & Nawawi, M. (2010). Visual representations in mathematical word problem solving among form four students in Malacca. *Procedia - Social and Behavioral Sciences*, *8*(5), 356–361.

Brenner, M.E.,Mayer, R.E. (1997). Learning by understanding: the role of multiple representations in learning algebra. *American Eduacational Research Journal, 34*(4), 683-689

Rahmawati. (2016). *Hasil TIMSS 2015, Diagnosa Hasil untuk Perbaikan Mutu dan Peningkatan Capaian.* Jakarta: Kemdikbud

Johar, R. (2012). Domain Soal Pisa untuk Literasi Matematika. *Jurnal Peluang,* 1(1) 2012

Yumiati, Noviyanti, M. (2017). Analysis of Mathematics Representation Ability of Junior High School Students in the implementationof Guided Inquiry Learning. *Journal of Mathematics Education*, *6*(2), 137-148

Hutagaol, K. (2013). Pembelajaran Kontekstual Untuk Meningkatkan Kemampuan Representasi Matematis Siswa Sekolah Menengah Pertama. *Jurnal Ilmiah Program Studi Matematika STKIP Siliwangi Bandung 2*(1),85-99

Muslim, A. P., (2013). *Peningkatan Kemampuan Representasi dan Disposisi Matematis Siswa SMP Melalui Penerapan Thinking Aloud Pair Problem Solving disertai Hypnoteaching (Hypno-Tapss).* UPI. Tidak diterbitkan

Chakrabarty, S., & Mohamed, N. S. (2013). Problem Based Learning: Cultural Diverse Students' Engagement, Learning and Contextualized Problem Solving in A Mathematics Class. *WCIK EJournal of Integration Knowledge*, 2289-5973.

Fatade, A. O., Mogari, D., & Arigbabu, A. A. (2013). Effects Of Problem Based Learning on Senior Secondary School Students' Achievements in Further Mathematics. *Acta Didactica Napocensia*, 6(3), 27-44

Whitcombe, S. W. (2013), Problem Based Learning Students' Perception of Knowledge and Professional Identity: Occupational Therapist as 'knowers', British. *Journal of Occupational Therapy*, 1(76), 37-42.

Goldin, G & Shteingold, N. (2001). Systems of representations and the development of mathematical concept. In Albert A. Cuoco. *The role of representation in school mathematics 2001 yearbook.* (National Council of Teacher of Mathematics, 2001).