



Improving Learning Activity and Students' Problem Solving Skill through Problem Based Learning (PBL) in Junior High School

Rustam E. Simamora^{a*}, Dewi Rotua Sidabutar^b, Edy Surya^c

^{a,b,c}*State University of Medan, Jln. Willem Iskandar Pasar V, Medan 20222, Indonesia*

^a*Email: erustam@yahoo.co.id*

^b*Email: dewisidabutar2206@gmail.com*

^c*Email: edi_surya71@yahoo.com*

Abstract

The aim of this study to determined whether the implementation of Problem Based Learning Learning (PBL) model could improve learning activities and problem solving skills of mathematics students in class VIIB SMP Negeri 3 Medan (Seventh Year Juniour High School), amounting to 30 students. The type of this study was a classroom action research that took two cycles. Data collection was done through tests and observations. The results of the research in the Cycle 1 showed that the average value of observation of the research activity was 2.9 with good category, and the percentage of student learning activity was 57% with less active category. The average value of problem solving ability is 4.87 with very low category. The results of the research in Cycle 2 showed the average value of observation 3.65 with very good category. Percentage of student learning activity was 79% with active category. The average problem solving ability of student math was 8.38 with high ability category. The result of the research showed that the implementation of Problem Based Learning (PBL) model could increased learning activity and problem solving ability of student mathematics in class VIIB of SMP Negeri 3 Medan.

Keywords: students' activity; problem solving ability; problem based learning.

* Corresponding author.

1. Introduction

Mathematics is one of the compulsory subjects in formal education and takes a very important role in education. Mathematics skills is needed to learn other subjects, such as physics, chemistry, biology and even social science. Mastery of mathematics will provide the basis of knowledge and skill for great importance areas, such as the mastery of science and technology [1]. Basic all of sciences sains and technology which application cut across all areas of human knowledge founded with mathematics as a foundation [2,1].

Although mathematics has a central role in the mastery of science and technology, mathematics has not become interesting subject for students students generally. Pranoto tated that the process of teaching and learning achievement of Indonesian students' mathematics is low [3]. The students' mathematical problem solving abilities in PISA and TIMSS did not show good performance, and was below the average of international mathematics problem solving abilities in both tests [4]. The author found same casues in SMP Negeri 3 Medan through interviews with students and teacher. Interview with teachers showed that word problems was difficult for the students on learning mathematics. It was found that many students whom did not like mathematics for mathematics was too hard for them.

Based on the results of observations, author obtained information that the teacher was too monotonous in delivering the lesson, so students was less responsive to mathematics lessons. Non-routine problem was too difficult for this students. To knew the problem solving skills of students in Junior High School, research given test to students of class VIIB (Seven Year Class), amounting to 30 students. The test results showed that the average class math problem solving skill got very low category.

1.1. Problem Solving Skill

This lack of mathematical problem solving ability should not be allowed because the problem solving ability is one of the main principles of science and technology and also teaching crucial to the progress of mathematics education itself [5]. Pinter states that problem-solving ability is a very important skill. With problem-solving skills, students will be able to arrange real-life situations in mathematical models [6]. The problem-solving ability itself is not just a goal in mathematics learning, but also something that is very meaningful in everyday life, and in the world of work, being a problem solver can provide benefits or benefits [7]. In addition, increased problem-solving skills will improve student learning outcomes themselves, and thus will advance math education quality.

The student's skill in solving the problem can be seen from the student's ability in solving the problem by using steps consisting of: (1) understanding the problem, (2) make plans, (3) implement the plan, and (4) recheck problem solving process again [8].

1.2. Students' Activity

In learning, activity is a very important thing to be noted by teacher. Actually, without teaching-learning design, students will still do activites. But with a better teaching-learning design, students' activity will be more

effective to grab knowledge or skill. Inside each student, there are active principles; desire to do and work alone without instruction by their teacher. This active principle controls student behavior. Learning has to direct the mind and behavior to achieve competencies. In teaching-learning situation, the principle of activity can be carried out in every face-to-face activity in a structured classroom, in the form of direct communication, group activities, small group activities [9].

Activities can be identified in the learning process, i.e: (1) hearing, (2) viewing, (3) feeling, smelling, and tasting/savoring, (4) write or take notes (5) reading. (6) creating an overview, or summary and underlining. (7) observing tables, diagrams and Charts. (8) remembering. (9) thinking (10) exercise or practice [10]. But in this research, activity is shown in (1) expressing opinion, (2) Asking, (3) Answering questions, and (4) participation in discussion.

1.3. Problem Based Learning (PBL)

A good learning strategy plays an important role in addition to mastering the content of the mathematics [11,12]. Uworbabayeho states that the low mathematical ability of students is caused by the use of inappropriate learning methods, and if the teacher wants to improve problem solving skills, critical thinking skills, and reasoning, then the teacher must abandon the conventional method [13]. Therefore selection of learning strategies, by mathematics teacher, should be increasingly scrutinized. One of the learning strategies assessed will be able to improve students problem solving abilities is Problem Based Learning Learning Model (PBL).

Table 1: Syntax of Problem Based Learning Learning (PBL)

Phases	Teacher Behavior
<i>Phase 1</i> Student orientation to the problem	<ul style="list-style-type: none"> – Explain the purpose of learning – Describes the required logistics – Motivate students to be actively involved in solving the selected problem
<i>Phase 2</i> Organize students	<ul style="list-style-type: none"> – Help students define and organize learning tasks related to the problem
<i>Phase 3</i> Individual and group research guide	<ul style="list-style-type: none"> – Encourage students to gather appropriate information – Encourage students to carry out experiments for explanations and problem solving
<i>Phase 4</i> Develop and present the work	<ul style="list-style-type: none"> – Assist students in planning and preparing suitable works such as reports, models and sharing assignments with friends
<i>Phase 5</i> Analyze and evaluate the problem-solving process	<ul style="list-style-type: none"> – Evaluate learning outcomes about the material that has been studied / ask group presentation of the work.

Problem Based Learning Learning Model (PBL) can be defined as a series of learning activities that emphasize the process of problem solving. Through the solving of mathematical problems in PBL, students are directed to develop their ability to build new knowledge, solve problems in various contexts related to mathematics, apply

various strategies as needed, in reflecting on the mathematical problem solving process [14]. In addition, problem-solving activities can be viewed as an activity that gives students the opportunity to build and experience the influence or impact of mathematics. Problem-solving activities are also an approach that allows students and teachers to learn and apply mathematical knowledge [15].

According to Sheryl, Problem Based Learning (PBL) as a learning method, was built with the idea of constructivism and student-centered learning approach. When using PBL, teachers help students focus on solving problems in real-world contexts, which will encourage students to think of situations of problem when students try to solve problems [16]. As a model, this learning is done through collaborating of students in small groups; using student-centered learning approaches; teachers acting as facilitators, and using real-life situations as the focus of learning. Students will work in groups to solve real and complex problems that will develop problem solving skill, reasoning, communication, and self evaluation skills through Problem Based Learning. PBL is also a learning model based on the many problems that require authentic investigation of the investigation that requires a real settlement of the real problems [17].

1.4. Limitations

Limitations in this study are:

- This classroom action research takes only one course as a subject of research that amounting to 30 students.
- Research is conducted on only one topic, namely *social arithmetic*, consisting of four meetings.
- Problem solving skills that focus in this study are students' skills in implementing Polya's steps in solving tasks, namely: (1) *understanding the problem*, (2) *make plans*, (3) *implement the plan*, and (4) *recheck problem solving process again*.
- The activities in this research referred to how students: (1) *express an opinion*, (2) *inquiring*, (3) *answering questions*, and (4) *Discussion*.

2. Method

Type of this research was classroom action research with aim to saw the improvement of problem solving ability in Social Arithmetic topic in class VIIB SMP Negeri 3 Medan. So, the research has an action hypothesis, that Problem Based Learning (PBL) model could increased student activity and problem solving ability of students in class VIIB SMP Negeri 3 Medan.

Before *Cycle 1*, the researcher has given the initial test to the students as much as 4 questions. Initial test given in the form of prerequisite material matter to study social arithmetic which aims to knew the level of problem solving ability of students. Result showed that students' problem solving skill was very bad category.

2.1. Planning 1

At this stage, researcher plan:

- Develop Lesson Plan (RPP) which contain steps of learning activities using Problem Based Learning model.
- Prepare learning facilities: Students' Activity Sheet (LAS), Text Book.
- Prepare tests used to see student learning outcomes.

2.2. Implementation 1

After prepare planning action 1, the next stage did this action:

- Conducting learning activities using Problem Based Learning model as planned in RPP by researchers.
- The researcher observes all learning activities: teachers, and students.
- At the end of the meeting, students are given individually-performed tests where the test is an evaluation of the newly accepted learning by students to find out the student activity, student problem solving skills and student difficulties.

2.3. Observation 1

The observations was conducted simultaneously with the learning process on the implementation of action 1. In this research, researcher observes teacher that teach with Problem Based Learning Model and also observes students. Observer aims to provide input on the ongoing learning. The input play role as a reflection for researchers. Observation for the teacher intend to find how: (1) reminiscent of past learning, (2) explain the purpose of learning, (3) motivate students to actively engage in problem solving, (4) guiding students to realize the problem to be solved, (5) guiding students to formulate problems, (6) guiding students to find and describe the information needed for problem solving, (7) directing students to take or formulate appropriate conclusions, (8) guiding students makes an alternative problem solving, (9) Test the students' understanding through the test, and (10) assign test to students. Whereas observation to students as figure out how them: (1) express an opinion, (2) inquiring, (3) answering questions, and (4) Discussion.

2.4. Data Analysis 1

The results of tests and observations analyze through three stages, i.e. data reduction, interpretation of results and draw conclusions. Data reduction intend to sorting, selecting and grouping data into categories, then organize them into meaningful information. The data has been reduced, then interprete into a narrative form so that data can be more easily understood. Conclusions were drawn based on the results of the research conducted.

2.5. Reflection 1

After teaching and learning activities are conducted and then quantitative and qualitative data are obtained, the next step is to reflect results. The researcher can take further action planning decisions based on the obtained results in Cycle 1. When the achievement indicator has not been achieved, it is necessary to proceed to the next

cycle. Where the shortcomings and obstacles that exist in Cycle 1 to be a preparation to plan in *Cycle 2*.

Action said successful if :

- Students' Problem Solving Skill: at least 80% students are with medium category (score 65).
- Students' Activity : at least 80% students are with active category.
- Teacher's activity: at least good category.
- There is improvement between cycles when we compare.

if the criteria is not achieved then the researcher has not succeeded and will proceed to the next cycle.

3. Finding

From preliminary tests conducted prior to implementing the action, it was found that students problem solving ability was still very low and students have not understood the required prerequisite materials in the implementation of the learning process. In addition, the lessons that were applied in using conventional teaching methods not use of instructional media so that students were less able to follow the lessons well, sometimes even saturated. This study revealed that the action through implementation of Problem Based Learning (PBL) model increased learning activities and problem solving skills of mathematics students. The increase of students' activity (Table 3) and students' mathematics problem solving skills (Table 4) was inseparable from the teacher's skills in applying the Problem Based Learning model of each cycle. The result of teacher activity observation in applying learning model, can be seen in Table 2 below:

Table 2: Description of Teacher Activity Result in the Application of PBL Model

No.	Aspects of Each Component	Cycle 1		Cycle 2	
		Meeting 1	Meeting 2	Meeting 3	Meeting 4
1	Reminiscent of past learning	2	3	4	4
2	Explain the purpose of learning	2	3	4	4
3	Motivate students to actively engage in problem solving	3	3	4	4
4	Guiding students to realize the problem to be solved	2	3	3	4
5	Guiding students to formulate problems	3	3	3	3
6	Guiding students to find and describe the information needed for problem solving	3	3	3	4
7	Directing students to take or formulate appropriate conclusions	3	3	3	3
8	Guiding students makes an alternative problem solving	3	3	3	4
9	Test the students' understanding through the test	3	3	4	4
10	Assign tasks to students	3	4	4	4
<i>Total score</i>		<i>27</i>	<i>31</i>	<i>35</i>	<i>38</i>
<i>Items</i>		<i>10</i>	<i>10</i>	<i>10</i>	<i>10</i>
<i>Average</i>		<i>2.7</i>	<i>3.1</i>	<i>3.5</i>	<i>3.8</i>
<i>Category</i>		<i>Good</i>	<i>Good</i>	<i>Good</i>	<i>Very Good</i>
<i>Mean</i>		<i>2.9</i>		<i>3.65</i>	
<i>Final Category</i>		<i>Good</i>		<i>Very Good</i>	

Note: $\bar{x} \leq 1,5 \rightarrow$ "Very Less"; $1,5 < \bar{x} \leq 2,5 \rightarrow$ "Less"; $2,5 < \bar{x} \leq 3,5 \rightarrow$ "Good"; $3,5 < \bar{x} \leq 4,0 \rightarrow$ "Very Good"

Observation was done to know result of students' activity. From the analysis of the test, in the cycle 1, there was an average of 57% class activities with at least 6 active categories of active students (20%), and in the second cycle, the average grade activity was 79% (active category) with the least number of students. The active category was 28 students (93%) of 30 students.

Table 3: Description of Student Learning Activity Level on Each Cycle

Percentage of activity	Criteria	Cycle 1		Cycle 2	
		Meeting 1	Meeting 2	Meeting 3	Meeting 4
85%-100%	Highly Active	0	1	4	14
75%-84%	Active	4	6	16	15
60%-74%	Normal	5	11	9	1
0%-59%	Less Active	21	12	1	0
<i>Number of Students</i>		30	30	30	30
<i>Percentage Classical</i>		13%	23%	66%	97%
<i>Percentage Classical Each cycle</i>		20%		93%	

Table 4: Description of Student Mathematics Problem Solving Rate Every Cycle

Percentage of Mastery	Level of Skill	Initial Test	Cycle 1	Cycle 2
90%-100%	Very High	0	0	14
80%-89%	High	0	4	9
65%-79%	Medium	0	6	5
55%-64%	Low	0	4	0
0%-54%	Very Low	30	16	2
Σ		30	30	30
<i>Average</i>		1	4,87	8,38
<i>Percentage of classical mastery</i>		0%	33%	93%
<i>Unfinished percentage</i>		100%	67%	7%

To find out student problem solving abilities, students was asked to solve test. From the analysis of the test, before the action in Cycle 1, the average of initial test obtained student score was 1 (very low); no one student who get mastery in solving the problem.

In the Cycle1, after using Problem Based Learning, obtained the average student score is 4.87 (very low category) with the number of students who score greater than or equal to 65 as many as 10 students (33%) had achieved learning mastery and 20 students not yet succeeded. While in Cycle 2, after the media added with the chart, the average score of students is 8.38 (high category) with the number of students who get a score greater than or equal to 65 as many as 28 students (93%) had achieved learning mastery and 8 students not yet complete. We can see in Table 4 above.

The different actions in Cycle 1 and Cycle 2, show in the following table.

Table 5: Differences of Cycle 1 and Cycle 2

No.	Aspect	Action 1	Action 2
1	Motivation	In beginning of teaching-learning only	In the beginning and also when students learn the group
2	Using Media	No special media	Using <i>chart</i>
3	Small Group	Level of ability was not a priority to constructed small group.	Constructed by based on the level of ability of the results of the first cycle problem solving test cycle
4.	Reward	No reward	The best groups get appreciation in the form of praise and rewards.

The results of the test after performing each action showed the ability of solving math problems has increased.

4. Discussion

This study revealed that the action through implementation of Problem Based Learning (PBL) model increased learning activities and problem solving skills of mathematics students. This problem-solving capability is in accordance with the statement made by Shah which stated that learning problem-solving that basically learning using scientific methods or think systematically, logically, regularly and meticulously were able to improve the ability and cognitive to solve problems rationally, straight forwardly, and thoroughly [18]. PBL with scientific thinking characteristics will train students to improve their thinking skills; every activity in the PBL learning series, is an attempt to train students' skills in solving problems.

This result also corresponds to the theory of cognitive psychology which states that when students are faced with problems, students will use prior student knowledge to understand and solve a problem [19]. At the learning stage of Problem Based Learning Model, in the planning part of problem solving, students will be directed to develop their ability to build new knowledge to solve math problems. In the third phase, individual and group research guide phase, students will have the opportunity to use the knowledge they have gained from

previous experience to solve the problem. Scaffolding that provided by the teacher acts as a liaison between previous students' knowledge and new knowledge that to be achieved in learning.

Problem Based Learning Model (PBL), in accordance with socio-cultural theory and the flow of constructivist psychology in which students compile their knowledge with the social context, aims to train students to develop thinking skills and problem-solving skills; learning with problem solving will improve thinking skill. This result is consistent with the results of a study conducted by Crowley that stating the long-term effects of problem-based learning (PBL) on mathematical achievement of students demonstrating higher ability in the subject field than their comparable counterparts [20]. This research also reinforced that learning with problem solving ability will improve thinking ability. The reason why Finnish mathematics curriculum focuses on the role of problem solving match the results of this study [21].

The results of this study are also in accordance with the results obtained by Allevato and Onuchic which states that learning mathematics in the classroom through problem-solving activities will increase knowledge of mathematical concepts, and math material itself will be more meaningful and more effective when learned [22]. PBL based on constructivism will improve the understanding of mathematical concepts and mathematical materials will be more bermakna so that learning is more effective. The results of this study are also in accordance with research conducted by Kadir which obtained the result that the approach of learning with problem-based activity approach more effectively used to improve the problem solving ability of junior high school students in coastal areas [23].

5. Conclusion

Based on the findings of research that has been showed, it can be concluded that the implementation of Problem Based Learning (PBL) model could increased learning activity and problem solving ability of student mathematics in class VIIB of SMP Negeri 3 Medan.

6. Recommendations

The author suggests the following points to the readers:

- Because type of research is a classroom action research, the results of the study are very likely to be limited only to students in grade VIIB SMP Negeri 1 Pagaran, so the authors advise researchers to conduct research for a wider scope.
- Authors encourage teachers to always provide motivation during learning, using instructional media, Constructing small group by based on the level of ability, and providing rewards in learning.
- Authors encourage teachers to use the Problem Based Learning (PBL) model to improve student activity and problem-solving abilities.

Acknowledgements

The authors would like to especially extend their gratitude to *SMP Negeri 3 Medan* for their corporation, and

Lecturers and students of *Post Graduation Program State University of Medan* for help and their attention.

References

- [1] M. A. Akanmu & M. O. Fajemidagba. (2013). "Guided-discovery Learning Strategy and Senior School Students Performance in Mathematics in Ejigbo, Nigeria". *Journal of Education and Practice*. Vol.4, No.12, 20
- [2] Australian College of Educators. (2010). "Why teach mathematics?" *Professional Educator*. Vol. 9, No. 2
- [3] J. Pranoto. (2010). "Pengajaran Matematika Konsep". *Kompas* (Jan. 21, 2010)
- [4] Wulandari, N. Ferry, & Jailani. "Indonesian Students' Mathematics Problem Solving Skill in PISA and TIMSS" in *Proceeding of International Conference On Research, Implementation and Education of Mathematics And Sciences 2015*, Yogyakarta State University, 17-19 May 2015
- [5] Balım, Ali Günay. (2009). "The Effects of Discovery Learning on Students' Success and Inquiry Learning Skills". *Egitim Arastirmalari-Eurasian Journal of Educational Research*. Vol.35, 1-20
- [6] K. Pintér. "On Teaching Mathematical Problem-Solving and Problem Posing". PhD Thesis, University of Szeged, Szeged, 2012
- [7] NCTM. (2000). "Principles and Standards for school mathematics". Reston, VA: National Council of Teachers of Mathematics.
- [8] G. Polya. *How To Solve It*, by George Polya, 2nd ed. Princeton: Princeton University Press, 1957
- [9] O. Hamalik. *Proses Belajar Mengajar*. Jakarta: Bumi Akasara, 2001
- [10] S. B. Djamarah. *Psikologi Belajar*. Jakarta: Rineka Cipta, 2011
- [13] A. Uworwabayeho. (2009). "Teachers' Innovative Change within Countrywide Reform: A Case Study in Rwanda". *Journal of Mathematics Teacher Education*, Springer, Netherlands
- [11] E. F. Y. Yang, C. C. Y. Liao, E. Ching, T. Chang &, T. W. Chan. "The Effectiveness of Inductive Discovery Learning in 1: 1 Mathematics Classroom". *Proceedings of the 18th International Conference on Computers in Education*, Putrajaya, Malaysia: Asia-Pacific Society for Computers in Education, 2010
- [12] Yuliani, K. & Saragih, S. (2015). "The Development of Learning Devices Based Guided Discovery Model to Improve Understanding Concept and Critical Thinking Mathematically Ability of Students at Islamic Junior High School of Medan". *Journal of Education and Practice*. Vol.6, No.24

- [14] Pearson Learning Group. (2009). "Problem-Solving Experiences: Making Sense of Mathematics". Pearson Learning Group. Available:
<http://www.cimm.ucr.ac.cr/resoluciondeproblemas/PDFs/Pearson.pdf>. [Oct. 4, 2016]
- [15] M. Santos. (2008, Jul.). "Teaching Mathematics In The Classroom Through Problem Solving". TSG-19: Research and Development in Problem Solving in Mathematics Education. Available:
http://www.matedu.cinvestav.mx/~rptec/Sitio_web/Documentos_files/tsg19icme11.pdf [May 12, 2017]
- [16] Sheryl MachMath, John Wallace, & Xiaohong Chi (2009, Nov). "Problem-Based Learning in Mathematics: A Tool for Developing Students' Conceptual Knowledge". The Literacy and Numeracy Secretariat Available. Available:
http://www.edu.gov.on.ca/eng/literacynumeracy/inspire/research/WW_problem_based_math.pdf [Oct. 4, 2016]
- [17] Trianto. Mendesain Model Pembelajaran Inovatif-Progresif. Jakarta: Kencana Prenada Media Group, 2011
- [18] M. Syah. Psikologi Belajar. Jakarta: PT. RajaGrafindo Persada, 2008
- [19] D. Siegler, DeLoache & Eisenberg. (2014, Aug. 25). An Introduction to Child Development; How Children Develop: Theories of Cognitive Development. (3rd edition). [On-Line]. Available:
<http://www.psy.cmu.edu/~rakison/POCDclass1.pdf> [May 12, 2017]
- [20] Brittany M. Crowley. "The Effects of Problem-Based Learning on Mathematics Achievement of Elementary Students Across Time" Masters Theses, Western Kentucky University, Kentucky, 2015
- [21] E. Pehkonen. (2007). "Problem Solving in mathematics education in Finland". University of Helsinki. Available: <https://www.unige.ch/math/EnsMath/Rome2008/WG2/Papers/PEHKON.pdf> [May 12, 2017]
- [22] Allevato, S. G. Norma., & Onuchic, LR. (2008, Jul.). "Teaching Mathematics In The Classroom Through Problem Solving". TSG-19: Research and Development in Problem Solving in Mathematics Education. Available:
http://www.matedu.cinvestav.mx/~rptec/Sitio_web/Documentos_files/tsg19icme11.pdf [May 12, 2017]
- [23] Kadir. "Peningkatan Kemampuan Pemecahan Masalah Matematik Siswa SMP melalui Penerapan Pembelajaran Kontekstual Pesisir". Seminar Nasional Matematika dan Pendidikan Matematika, Jurusan Pendidikan Matematika FMIPA UNY, Yogyakarta, 2009