Influence of Problem Based Learning Assisted by Folding Paper Media to Mathematics Problem Solving Skill

Henry Suryo Bintoro[1], Himmatul Ulya[2]
{henry.suryo@umk.ac.id[1], himmatul.ulya@umk.ac.id[2]}

[1,2]Mathematics Education Study Program, Faculty of Teacher Training and Education, Universitas Muria Kudus Gondang Manis PO. BOX 53 Bae, Kudus, Central Java, Indonesia
Phone (+62291) 438229, Fax (+62291)437198

Abstract. This research aims to test whether mathematics problem solving skill average of students after Problem Based Learning assited by folding paper intervention was better than the conventional model. This quasi experimental research design used nonequivalent posttest – only control group design. The population took fifth graders of Gugus Pangeran Antasari in academic year 2018/2019. The sample consisted of fifth graders of SD N 1 Rendeng and SD N 2 Rendeng. The technique of collecting data was test. It was done to measure mathematics problem solving skill of the students. The data analysis covered test of two group average deviations. The findings showed improvement of mathematics problem solving skill after the intervention was better than those intervened by conventional model.

Keywords: Problem Based Learning, Folding Paper, Mathematics Problem Solving Skill

1. Introduction

Learning mathematics still uses *teacher center learning* approach and only focuses on learning material completion (cognitive aspect). It has not been focused on students so students have not been active and not been interested in learning mathematics (Ulya & Rahayu, 2018). Such paradigm causes their learning achievement not maximum. It is in contrast to learning paradigm of 2013 curriculum. It expects teacher to be capable of guiding the students in gaining learning experience through scientific learning (Ardianti, Ulya, & Ismaya, 2018). Learning experience covers observation, question, informational collection, information association, and communication. Through those learning experiences, students do not only focus on cognitive competence but also affective and psychomotor aspects.

Besides considering mathematics learning process, teacher also need to consider cognitive and psychomotor aspects which later will be the objectives of learning. 2013 curriculum, mathematics leanring in classes become independent learning. It means mathematics is not thematic lesson to other lessons. In learning mathematics, it is important to develop cognitive and psychomotor aspects of students.

One of cognitive aspects in mathematics is mathematics problem solving skill. This problem solving skill is real life skill which covers analyzing, interpreting, reasoning, predicting, evaluating, and reflecting processes (Anderson, 2009). While solving certain problem, students need to have sufficient understanding and knowledge. They must also have

various strategies to choose when they face different problems (Zevenbergen, Dole, & Wright, 2004).Problem solving skill is individual modes to correlate cognitive and psychomotor aspects owned by studetns to be integrated and implemented on new and different problems (Krulik & Rudnick, 1995). Thus, mathematics problem solving skill needed by studetns deals with capability to synthetize and implement previously owned understanding into various complex problems and to involve high order thinking skills. However, on the real field, this skill was still low. They were not habitualized to work on high order thinking questions.

Learning activeness of student is an activity which includes to psychomoro aspect. It involves student in learning process to have succesful learning achievement (Lestari & Yudhanegara, 2015). Learning activeness in mathematics covers all activity forms in mathematics learning process (Bintoro, 2014). By doing so, it can change learning pattern of the teacher from teacher center learning into *student center learning.* It has purpose to make students not passive in learning but also to invovle them in finding out knowledge because it is new thing for students. Besides that, by becoming active studetns, it can positively influence learning objective achieement. A finidng showed that there was signficant influence between activeness to mathematics learning achievement of students (Ramlah, Firmansyah, & Zubair, 2014).

Gugus Pangeran Antasari is a cluster consisting of SD 1 Rendeng, SD 2 Rendeng, SD 1 Mlati Norowito, and SD 2 Mlati Norowito. The characteristics of the students and learning nuances there had several similarities. The fifth graders of the schools had heterogeneous skills. There were some of them fast in responding to a problem given by teachers but some of them were only following their friends in responding to the teachers. Besides that, there were smart students but individualists. In learning, various activities were done. Some of them were passive in follosing learning. Several student did not focus on the learning. Some of them did many things as they pleased, such as playing game, talking to their friends, and leaning their heads on the tables. Several of them seemed stressful and had not motivaton to learn. It showed that their mathematics learning promoted there was boring and had not been able to make them active. Teacher had not used learning media to teach mathematics concept. Besides that, the students' mathematics problem solving skills were low.

The previous studies showed that mathematics problem solving skill level of the students taught by *Problem Based Learning* (PBL) assited by QR code were better thatn *direct instruction* (Santoso, Rahayu, & Ulya, 2018). On PBL learning, the model could improve learning activities and facilittated students to implement their knowledge and to solve problem of real life (Sanjaya, 2006). QR code could be implemented in this research since the students of the cluster were not allowed to bring gadget with them. Thus, the learning media was changed into *folding paper* to make the students able to practice directly multiplication material so their activeness were improved.

Other studies sowed that *folding paper* could improve understanding about fraction material and student learning materials (Angriani, 2014; Murniati, 2014). Through *folding paper* media, the students are facilitated to do mathematics experiment. It makes them enthusiastic and more interested in learning mathematics. Therefore, their activeness will be fostered and will have positive impacts on mathematics problems solving skill. In preliminary research, it had not been combined by learning model so in this current research, the media would be integrated into learning process through learning model.

Based on the real conditions on the field and those previous studies, then there is a need of joyful learning to improve mathematics problem solving skill. Learning by using PBL model would maximize reasoning skill of students since during in leanring process, there are many systematic problem learning process. It trains students to develop their mathematics

problem solving skill. Furthermore, the use of media has important role in learning. *Folding paper* media could be used as learning media to create joyful learning. By using the media, students could be involved in finding out new knowledge.

Based on the explanations, there is a need of research to improve mathematics problem solving skill through *Problem Based Learning* model assisted by *folding paper* in learning mathematics. PBL model implementatoin with the media was expected to improve the skill of the students.

2. Methodology

This quasi experimental research used experimental and control groups with samples randomly taken. The population was taken from fifth graders of Pangeran Antasari culters in academic year 2018/2019. The sample consisted of fifth graders of SD N 1 Rendeng and SD N 2 Rendeng. The design of this research refered to *nonequivalent posttest – only control group design.* In this design, the experimental group was intervened. Then, a *posttest* was also givent o both groups (Sugiyono, 2010). The research design table can be seen on Table 1.

Table 1. Research Design

Group	Intervention	*Posttest*
Experiment al	X	O
Control		O

Notes :
X : Implementing *problem based learning* assisted by *folding paper* media
O : *Posttest*

There are two variables – the independent and dependent variables. The independent variable was *problem based learning* assisted by *folding paper.* The dependent variable was mathematics problem solving skill. Test technique was used to collect research data. It was done to measure mathematics problem solving skill of the students.

Initial data analysis covered normality, homogeneity, and average equality (t) tests for both groups. The data was gained after intervention and posttest distribution for both groups through normality, homogeneity, and average deviation tests by using t-test.

3. Findings and Discussion

The initial data analysis used normality, homogeneity, and average equality (t) tests for both groups. The initial data analysis used previous mathematics test result. From normality test by using *Kolmogorov – Smirnov* showed normal data distribution. Then, to test its homogeneity of the data used *Levene* test which showed homogeneous data. Since the data was normally and homogeneously distributed, then average equality test used t-test. From t-test, it showed that both groups had equal average of mathematics learning achievements. It meant both groups could be used for research purpose. The experimental group was SD 2 Rendeng Kudus while the control group was SD 1 Rendeng.

The final data analysis used *posttest* of mathematics problem solving skill of the students on addition and subtraction of fraction materials. The used pre-requirement tests were normality and homogeneity tests. The results showed the data were normal and homogeneous.

Then, the next test used t-test. Description of *posstest* score of mathematics problem solving skill can be seen on table 2.

Table 2. Description of Mathematics Problem Solving Skill *Posttest* Data

Groups	Mean	Median	Variance	Maximum	Minimum
Experimental	78,65	80	217,12	100	40
Control	30,38	32,50	375,85	75	5

Normality test using *Kolmogorov-Smirnov* used SPSS 22. The results are shown on Table 3.

Table 3. Normality Test Result

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Experimental	.164	26	.070	.938	26	.123
Control	.136	26	.200[*]	.938	26	.123

Table 3 showed the experimental group's sig score of *Kolmogorov-Smirnov* test was 0.070 while the control group's score was 0.2000. It showed that sig > 0.05, meaning that *posttest* score of both groups were normally distributed.

Homogeneity test used *levene* test assisted by SPSS 22 as seen on Table 4.

Table 4. Homogeneity Test Results

Levene Statistic	df1	df2	Sig.
3.778	1	61	.057

Table 4 showed sig score of *Levene* test was 0.057. It showed that sig > 0.05, meaning that the data was homogeneous. Since the data was normally and homogeneously distributed then average deviation test (hypothesis test) used t-test or specifically used *independent sample t-test.*

Untuk mengetahui ada perbedaan antara kelas eksperimen dan kelas kontrol, data *posttest* kemampuan pemecahan masalah matematika dianalisis dengan *independent sample t-test* menggunakan SPSS 22. Hasil perhitungan dapat dilihat pada Tabel 5 berikut.

Table 5. *Independent Sample t-test* Results

	t-test for Equality of Means				
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	11.585	61	.000	48.66944	4.20091
Equal variances not assumed	10.954	42.667	.000	48.66944	4.44323

From Table 5, sig score was 0.000 < 0.05, meaning that there was difference of mathematics problem solving skill from both groups. The mathematics problem skill of

experimental group was better as seen on Table 2. Its average score was 78.65 higher than the control group, 30.38.

The experimental group used *problem based learning* model assisted by *folding paper* showed better mathematics problem solving skill. It was due to the model invited the students to think critically in solving problem. They with their ownn concepts tried to find problems from story typed questions. From the given problems, the first step of them was to understand the problem. It meant the students tried to understand what thing had been known and then what was being asked. The next step was arranging problem plan. With their previously owned concepts, they tried to arrange the solving steps of the given problem. The third step was to apply the plan. They worked on the problem with their already owned concepts. The last step was to check their already worked – problem solving result. They tried to recheck the steps from the beginning until the ending part of the work.

Their results by using *problem based learning* can be seen on Figure 1.
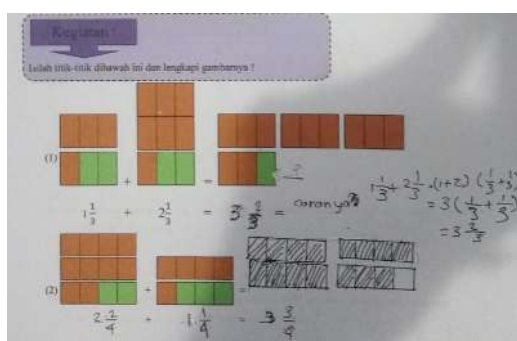

Figure 1. Problem Solving in *Problem Based Learning* Process

The findings showed that they worked systematically on the given problem. They did it constructively. This finding is supported by Fauziah (2014:47) telling that characteristics of PBL are challenging and transparent learning based problem. They worked in small collaborative group where the teacher acted as a facilitator.

Besides implementation of *problem based learning, folding paper* media had role to create better mathematics problem solving skill. The media realization was done by folding, drawing, and manipulating papers so the students could be active in learning activity. In this research, the materials taught to the students were addition and subtraction of fraction and its combination. The first step required student to fold several papers. The next was giving problems to be solved. The third step required students to try working on the problems with the media by drawing, folding, and manipulating based on information in the problems. The final step required student to analyze result of several *folded papers* to be concluded.

The media involved students to be more active in finding out a concept. They were involved to think and act in solving problem. They tried to find solution by themselves. The media created joyful learning situation so they were interested and not feeling bored. Thus, it could improve mathematics problem skill of them. It is in line with Oslon (1975) that *folding paper* triggers active experience in learning mathematics. The students' activities during implementing the media could be seen on Figure 2.
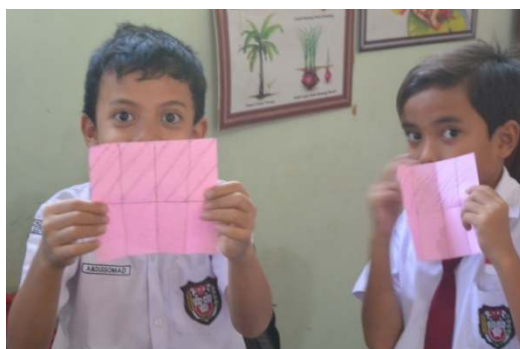
Figure 2. The Student Activity by Using *Folding Paper*

4. Conclusion

Learning mathematics by *problem based learning* model assisted by *folding paper* resulted to better mathematics problem solving than conventional learning for the fifth graders of the schools. The learning model involved them thinking critically in solving problems. The media involved the students to be more active in finding out a concept. These research findings were limited on addition and subtraction of fraction materials so it would be also better to implement it on other materials by considering its appropriateness.

References

[1]   Anderson, J.: Mathematics Curriculum Development and the Role of Problem Solving. In ACSA Conference. (2009)

[2]   Angriani, N.: Meningktkan Hasil Belajar Melalui Media Kerlip (Kertas Lipat) Pada Materi Konsep Kelipatan Bilangan Pada Siswa Kelas IV SDN Bantelan Sumenep. Jurnal Pedagogia, 3(2), 136–147. (2014)

[3]   Ardianti, S. D., Ulya, H., & Ismaya, E. A.: PAKEM dalam Kurikulum 2013. Kudus. Retrieved from Universitas Muria Kudus (2018)

[4]   Bintoro, H. S.: Eksperimentasi Pembelajaran Matematika dengan Metode Peta Konsep Ditinjau dari Aktivitas Belajar Siswa (Penelitian Dilakukan di SD Negeri 1 Gondangmanis Kudus). Kudus. (2014)

[5]   Fauziah, S., Suriani, H., $Elnetthra, F.E.: Leadership And Cooperative Learning And Its Relation Towards Students' Grade Achievement In Problem-Based Learning Environment. International Journal of Education and Research. Vol. 4, pp. 65-74. (2016)

[6]   Kesan, C., Kaya, D., & Guvercin, S.: The Effect of Problem Posing Approach to the Gifted Student's Mathematical Abilities. International Online Journal of Educational Sciences, 2(3), 677–687. (2010)

[7]   Krulik, S., & Rudnick, J. A.: The New Sourcebook for Teaching Reasoning and Problem Solving in Elementary School. Boston: Allyn and Bacon. (1995)

[8]   Lestari, K. E., & Yudhanegara, M. R. (2015). Penelitian Pendidikan Matematika. Bandung: PT. Refika Aditama. (2015)

[9]   Murniati, W.: Penggunaan Media Kertas Lipat Untuk Meningkatkan Kemampuan Belajar Matematika Materi Pokok Bilangan Pecahan. Jurnal Pendidikan Dan Humaniora, 45(1). (2014)

[10] Olson, A. T. (1975). Mathematics Through Paper Folding. Alberta: University of Alberta.

[11] Ramlah, R., Firmansyah, D., & Zubair, H.: Pengaruh Gaya Belajar dan Keaktifan Siswa Terhadap Prestasi Belajar Matematika (Survey Pada SMP Negeri di Kecamatan Klari Kabupaten Karawang). Jurnal Ilmiah Solusi, 1(3), 68–75. (2014)

[12] Santoso, Rahayu, R., & Ulya, H.: Problem Based Learning Berbantuan QR Code untuk Meningkatkan Kemampuan Pemecahan Masalah dan Karakter Tanggung Jawab Mahasiswa PGSD UMK. Kudus. (2018)

[13] Sudarman.: Problem Based Learning: Suatu Model Pembelajaran untuk Mengembangkan dan Meningkatkan Kemampuan Memecahkan Masalah. Jurnal Pendidikan Inovatif, 2(2), 68–73. (2018)

[14] Sugiyono.: Metode Penelitian Pendidikan (Pendekatan Kuatitatif, Kualitatif dan R&D). Bandung: Alfabeta. (2010)

[15] Ulya, H., & Rahayu, R.: Uji Kelayakan Perangkat Pembelajaran Open-Ended Berbasis Etnomatematika Ditinjau dari Gaya Kognitif Siswa. Journal of Medives, 2(2), 183–194. (2018)

[16] Zevenbergen, R., Dole, S., & Wright, R. J. (2004). Teaching Mathematics in Primary Schools. Sidney: Allen and Unwin. (2004)