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# Problem-based learning model to improve the ability of counting operations on fractions

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**Abstract.** This study aims to determine the improvement of student ability in the operation of fractions mathematics subject through a problem-based learning model. Participants in the study were 32 students of class V from the primary school in Bogor, Indonesia. By applying classroom action research approach, this research was carried out collaboratively with two cycles in which each cycle has stages of planning, implementation, observation, and reflection. The results show an improvement in cycle II. The results of student behavior change showed an increase in discipline, cooperation, confidence and spirit of students. The acquisition of the average value of learning outcomes increases in cycle II. Improved value seen in aspects of the implementation of learning, changes in student behavior, and the ability to calculate operations on the fraction of mathematics subjects. Result of this study indicates that the problem-based learning model can improve student ability in fractional calculation operations.

## 1. Introduction

The student's involvement in the learning process is one of the characteristics of students centered. The learning model applied by the teacher is expected to involve students in the learning process. Problem-based learning (PBL) as it is often known as inquiry-based learning can be said as a model that has characteristics of student's involvement in the learning process. It is an effective learning in building basic skills in various domains or curricular fields. Generally, this method involves students in solving a problem proposed and explained by the teacher. It is assigned to students in groups and aims to answer the problems [1]. PBL model is one of the ways to motivate students to solve the existing problems, especially in mathematics with the topic of calculating operations. The problem-based learning (PBL) model explains that students can develop problem-solving skill, creativity, and self-organization. If it uses real-time data in science and is applied consistently in the classroom, the level of interest in the task is high [2]. PBL provides an opportunity for students to be creative, skilled and have critical thinking. PBL begins when the students encounter an unstructured problem, they can develop the skills and content needed to create solutions or solve problems, and it also makes students better at doing the task [3]. Problem-based learning (PBL), initiated when learners meet an ill-structured problem, develops skills and subject-matter content needed by students to make the transition from novice to more expert problem solver [4]. And then Problem-based learning provides students with an opportunity to grapple with realistic, ill-structured problems using the same kinds of



techniques and habits of mind professionals use [5]. Problem-based learning is often characterized as an approach encompassing interdisciplinary learning; however, little attention has been explicitly paid to what a claim of interdisciplinary problem-based learning means in practice [6]. Problem-based learning (PBL) as a teaching and learning method that can be used to support evidence-based practice [7]. Learning mathematics, is one lesson that requires students to think logically in solving everyday problems with proof.

Problem Based Learning provides benefits both in improving student learning outcomes and activities in the classroom. This is supported by the previous studies that have been carried out. Problem based learning can foster an understanding of the tentative nature of scientific knowledge and the role of creativity implied in scientific efforts [8]. The research Sofie. et al. [9] results showed that the PBL group outperformed both lectures and self-study groups in the immediate post-test. These results support the hypothesis that PBL can increase the likelihood of conceptual change. Furthermore, studies that apply PBL to other subjects (English) Lung Fang Lin [10] found results that PBL groups outperformed non-PBL groups in using vocabulary levels outside the list in writing assignments. Research on PBL was also conducted Yosico et al. [11] to examine the effect of problem based learning on improving learning outcomes. The research is a quasi-experiment by giving treatment to one class and another as a control class. The results of the study found a significant influence on the class given treatment with problem based learning model. Subsequent research was carried out Joi Merrit, et al. [12] to investigate the effectiveness of the PBL model, which was implemented at elementary level students up to level 8. With the finding that no PBL model was consistent at the primary level but at level 8 there was an increase in academic achievement, including knowledge retention conceptual development and attitude. The implications and limitations are discussed. Other studies were also conducted Strobel, et al. [13] with findings showing that PBL is superior in terms and f long-term retention, skills development and satisfaction of students and teachers, while traditional approaches are more effective for short-term retention as measured by standardized exams. Implications are discussed. Further research Khotimah and Slimo [14] conducted in class V elementary school showed the application of PBL models to improve mathematics learning outcomes about fraction multiplication and division. The previous research shows that the problem based learning model has the advantage soft increasing student effectiveness both in knowledge ability, thinking skills, also effective in retention or short term recall.

The study was conducted with the aim to determine the effectiveness of the application of problem based learning models to improve students ability in number counting operations. This is based on the findings of the problem in fifth grade students in one of the elementary schools in Bogor, West Java, Indonesia. It shows the absence of student involvement in the learning process. This condition results in low ability to learn mathematics on number counting operations. The data are shown by the results of an average score of 32 students, 57.81, where eight students (25%) have reached the minimum standard, and 24 students (75%) have not reached the minimum standard. Therefore it is necessary to do research by applying the problem based learning model as one of the problem solving solutions to improve students' ability in number counting operation material.

## 2. Method

The subjects of this research are the students of VA primary school with 32 students consisting of 18 male and 14 female students. Classroom action research with two cycles, in which each cycle has steps of planning, acting, observing, and reflecting were applied. Data were collected through observation, test, and documentation study. Learning outcomes are measured through posttest score on mathematics subject.

### 3. Results and Discussion

#### 3.1. Research Results

This research was conducted in 2 cycles with three aspects studied in each cycle that is the assessment of the implementation of learning, improvement of student behaviour, and student learning outcomes in mathematics subjects. The step done in each cycle is: planning the action, acting, observing and reflecting. The following will discuss the aspects studied in the first and second cycles.

##### 3.1.1. Data on the Evaluation of the Implementation of Learning Cycle I

**Table 1.** Results of Lesson Implementation of Cycle I.

Collaborator	Final Score	Interpretation
I	71.3	Fair
II	73	Fair
Total	144.3	
Mean	72.2	Fair

The table above shows that the value of the learning process in cycle I was in the average of 72.2 with interpretation *fair*. This can be seen from the mark given by collaborator I (71.3), and collaborator II (73).

3.1.2. *Description of Learning Result.* The assessment in form of test in cycle 1 was carried out after the learning process took place, and it was followed by 32 students of VA primary school Kiarapandak 01. The result of cycle 1 test of learning result is as follows.

**Table 2.** Result of Completion of Learning Cycle I.

No	Learning Result	Frequency	Percentage
1.	Finished	19	59,37%
2.	Not Finished	13	40,63%
	Total	32	100%

The table above shows that only 19 students (59.37%) students who have achieved learning mastery, while 13 (40%) students who have not reached it.



**Figure 1.** Result of Learning Cycle I.

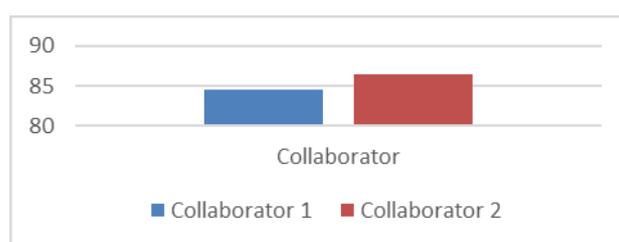
The picture above shows the completeness of learning result of mathematics subject in cycle in which 19 students have reached the minimum standard value, while 13 students have not reached it.

### 3.1.3. Data Evaluation of Learning Implementation in Cycle II

**Table 3.** Results of the Implementation of Learning Cycle II.

Collaborator	Score	Interpretation
1	84.3	Good
2	86.5	Good
Total	170.8	-
Mean	85.4	Good

The table above shows that the assessment of the implementation of learning in cycle II has increased. It can be seen from the score 84.3 which was given by collaborator I, and 86.5 from collaborator 2. The scores are interpreted as *good*, and it can be seen clearer in the graph below.



**Figure 2.** The Result of Learning Implementation.

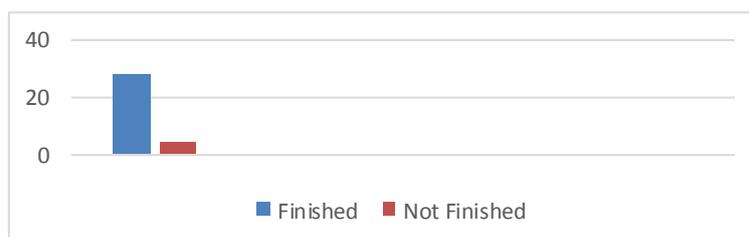
Figure 2 shows the different scores given by two collaborators. Compare to cycle 1, there is an increasing score in learning outcomes, and it is the result of applying PBL.

**3.1.4. Data Description of Research Result in Cycle II.** The assessment in form of test in cycle II was carried out after the learning process took place. The test was followed by 32 students of VA primary school *Kiarapandak 01*. From the result of cycle1 assessment, the obtained result of the mastery learning is as follows.

**Table 4.** The result of learning mastery in Cycle II.

No	Learning Mastery	Frequency	Percentage
1	Finished	28	87.5
2	Not finished	4	12.5
	Total	32	100

Table 6 shows that the result of the students learning mastery in cycle II has increased compared to the completeness in cycle I. There are as many as 28 students (87.5%) have reached the standard, however, four students (12.5%) have not. The average value obtained is 80.8, and more details can be seen in figure 6.



**Figure 3.** Learning mastery in of cycle II.

Figure 6 explains the learning mastery of 28 students who have reached the required standard in cycle II, and four of them have not.

### 3.2. Discussion

The result of each cycle is discussed, and the figure of capitulation is shown in table 5 below.

**Table 5.** Recapitulation result of cycle I and II

Observed aspect	Result Cycle				Description
	I		II		
	Score	Meaning	Score	Meaning	
Learning process assessment	72.2	Fair	85.4	Good	Increase 13.2
Mastery Learning	59.37	Has not reached that criteria	87.5	Success	Increase 28.13
The average of learning outcome	67.54	Fair	80.86	Good	Increase 13.32

The table above shows that all aspects studied has increased. In the first cycle, the implementation of learning implementation reaches 72.2% with *fair* category, and in cycle II, it improves to be 85.4% with good category. Similarly, student behavioral improvements in cycle I reached 69.4%, and in cycle II, it increases up to 81.13% with good interpretation. Another aspect of research that also increases is in student learning outcomes. In the first cycle it reached 59.37% and increases 28.13% in cycle II to 87.5%. It was successfully complete the cycle.

Thus it can be said that the problem-based model can provide students motivation to improve learning so that learning outcomes can be achieved according to the expected criteria mastery. The result of this study has similarities with [15] Vitasari study in 2016. Her research result shows the application of Problem-Based Learning model improves the activity and the results of learning mathematics in grade V primary school students. Another study that examined PBL was done by [16] Fadlillah (2014) with the result of shows average students score in first cycle was 66.7, with student who got value  $\geq 70$  was 70%, while cycle II the average is 75 in which 56 students get  $\geq 70$  (77.4%).

The improvement of learning outcomes through the PBL model is also found in Okayana et.al [17], with research finding that applying PBL model can improve students' mathematics learning outcomes. PBL is one of the learning models that have characteristics to make students more active and have higher-thinking, besides increasing teacher activity in the learning process. It was supported by Suryani [18] who emphasizes that PBL not only increases the learning outcomes, but also increases teacher activity. PBL can be regarded as a learning model in accordance with the subjects of mathematics, where the output of the learning process can be applied in Suh-Jenq Yang and Dar-Li Yang [19]. In addition, the improvement of mathematics learning outcomes was also found in the research of Rahmadani and Anugraheni [20] that there is an increase in the learning outcomes of cycle 1 to cycle 2 with the application of PBL model. In line with the previous researchers above, Julita [21] shows that there is an increase in the completeness of student learning outcomes reaching 94% and increasing the activity of students and teachers. PBL is able to enhance students' thinking and soft skill, which are necessary to fulfill the requirement of education in the twenty-first century [22]. PBL had effect in teaching mathematics and improve students understanding, ability to use concepts in real life [23].

All in all, PBL model increases the results of learning on mathematical calculation of the math subjects. Furthermore, it also increases student learning activities as well as teachers. PBL can be used as a solution for other learning in terms of student activeness and critical power in students thinking.

#### 4. Conclusion

Based on the discussion of the results of research done, it can be drawn that the application of cooperative learning model PBL not only improves the learning process and but also improve the results of learning material counting operations on the fractional in Mathematics grade V primary school students of *Kiarapandak 01Bogor*, academic year 2017/2018.

#### References

- [1] Gabriel Gorghiu, Luminița Mihaela Drăghicescu, Sorin Cristea, Ana-Maria Petrescu, Laura Monica Gorghiu 2015 Problem-Based Learning - An Efficient Learning Strategy In The Science Lessons Context *J. Procedia-Socil Behavioral*. Volume **192**, 2 June 2015. Pp. 1865-1870
- [2] Sonmi Jo dan Ja-Ok Ku 2011 Problem based learning using real-time data in science education for the gifted. *J. Gifted Education International. Sage Journal*. pp 263-273
- [3] Stephen, William J. Dan dan Pyke, Sharon L 1997 *J. Education of the Gifted. Sage Journal*. Vol. **20**(4), pp. 380-400.
- [4] William J Stepien, Sharon L Pyke 1997 Designing Problem-Based Learning Units. *J. Education of the Gifted*, vol. **20**(4): pp. 380-400, First Published Jun 1
- [5] William J. Stepien, Shelagh A. Gallagher, David Workman. 1993. Problem-Based Learning for Traditional and Interdisciplinary Classrooms. *J. Education of the Gifted*, vol. **16**(4): pp. 338-357. First Published Jul 1, 1993.
- [6] Diana Stentoft 2017 From saying to doing interdisciplinary learning: Is problem-based learning the answer?. *J. Active Learning in Higher Education*, vol. **18**(1): pp. 51-61., First Published February 1, 2017
- [7] Victoria Halliwell 2008 Challenging Knowledge Reproduction: Problem-Based Learning for Evidence-Based Practice *J. British Journal of Occupational Therapy*, vol **71**(6): pp. 257-262., First Published June 1.
- [8] Sara Moutinho, Joana Torres, Isabel Fernandes, Clara Vasconcelos 2015 Problem-Based Learning And Nature of Science: A Study With Science Teachers. *J. Procedia - Social and Behavioral Sciences*. Volume **191**, 2 June 2015, Pages 1871-1875
- [9] Sofie M M Loyens, Suzanne H Jones, Jeroen Mikkers, Tamaravan Gog 2015 Problem-based learning as a facilitator of conceptual change. *J. Learning and Instruction*. Volume **38**, August 2015, Pages 34-42.
- [10] Lu-Fang Lin 2015 The impact of problem-based learning on Chinese-speaking elementary school students' English vocabulary learning and use *J. System*. Volume **55**, December 2015, Pages 30-42
- [11] Yosico Indagiarmi dan Abd Hakim S 2016 Effect Of Problem Based Learning (PBL) Model and Learning Motivation On Learning Outcomes Of Class XI Semester II Subject Matter Of Fluid Dynamics In SMA. *J. Pendidikan Fisika*. p-ISSN 2252-732X. e-ISSN 2301-7651. Vol **5** No 1
- [12] Joi Merritt, Mi Yeon Lee, Peter Rillero, Barbara M. Kinach 2017 Problem-Based Learning in K–8 Mathematics and Science Education: A Literature Review. *J. The Indiciplinary Journal of Problem-Based Learning. IJBL*. Vol **11**
- [13] Johannes Strobel, Angela van Barneveld 2009 When is PBL More Effective? A Meta-synthesis of Meta-analyses Comparing PBL to Conventional Classrooms. *J. The Indiciplinary Journal of Problem-Based Learning. IJBL*. Vol **3**
- [14] Khotimah, Khusnul. Suhartono., Moh. Salimi 2017 *J. Kalam Cendekia* Vol **5**, Nomor 2.1, Hlm.182–186.
- [15] Vitasari, Rizka 2016 Peningkatan Keaktifan Dan Hasil Belajar Matematika Melalui Model Problem Based Learning Siswa Kelas V SD Negeri 5 Kutosari. *J. Kalam Cendekia*. Vol **4** (3). 2226

- [16] Fadlillah, Hayuu Nur 2014 Peningkatan Hasil Belajar Matematika Melalui Metode Problem Based Learning. *J. Penelitian Kependidikan Sainifik*. 1950. ISSN:2356-1769 EISSN: 2356-3095
- [17] Okayana, Komang, Muncarno, Hamdani, Yulina 2016 Penerapan Model Problem Based Learning (PBL) untuk Meningkatkan Hasil Belajar. *J. Pedagogi*. Vol 4(4). 11227
- [18] Suryani, Yenni Fitra 2017 Penerapan Model Pembelajaran Problem Based Learning Untuk Meningkatkan Hasil Belajar Matematika Siswa Kelas IV SDN 016 Langgini Kabupaten Kampar. *J. Cendekia: Jurnal Pendidikan Matematika*. Vol 1(1). ISSN 2579-9258
- [19] Suh-Jenq Yang and Dar-Li Yang 2010 Note on “A note on single-machine group scheduling problems with position-based learning effect”. *Applied Mathematical Modelling* 34 (2010) 4306–4308.
- [20] Rahmadani N and Anugraheni I 2017 Peningkatan Aktivitas Belajar Matematika Melalui Pendekatan Problem Based Learning Bagi Siswa Kelas 4 SD *Scholaria: J. Pendidikan Dan Kebudayaan*, Vol 7(3), 241-250.
- [21] Julita 2018 Peningkatan Kemampuan Pemecahan Dan Hasil Belajar Matematika Melalui Problem Based-Learning. *J. Mosarafa*. Vol. 7 No. 1. 147.
- [22] Najihah Mustaffa, Zaleha Ismail, Zaidatun Tasir, and Mohd Nihra Haruzuan Mohamad Said 2016 The Impacts of Implementing Problem-Based Learning (PBL) in Mathematics: A Review of Literature. *J. International Journal of Academic Research in Business and Social Sciences 2016*, 6(12) ISSN: 2222-6990.
- [23] R D Padmavathy and Mareesh K 2013 Effectiveness of Problem Based Learning In Mathematics. *J. International Multidisciplinary e-Journal* ISSN 2277 – 4262. Vol-II, Issue-I, Jan -2013. Pp.45-51.