The Effectiveness of Problem-Based Learning Model on Geometry Theory

Hidayatulloh[1(✉)], Saleh Haji[2], Nurul Astuty Yensy[2], and Dina Apryani[3]

[1] Universitas Muhammadiyah Pringsewu, Pringsewu, Lampung, Indonesia
hidayatulloh@umpri.ac.id
[2] Universitas Bengkulu, Bengkulu, Indonesia
[3] UIN Fatmawati Sukarno, Bengkulu, Indonesia

Abstract. This study aims to find out whether the Problem-Based Learning Model is effective on the geometry theory. To obtain the data done in three ways, namely description test, observation and questionnaire. Then the data is analyzed by calculating the percentage of teachers' ability, the number of active students, student responses and the completeness of student learning outcomes. Based on data analyzed and discussion, obtained percentage of teacher ability 77,61%, student activity 76,25%, student response 83,55%, and student learning result 80%. Thus, the Problem Based Learning Model is effective on the geometry theory in terms of the process and the student learning outcomes.

Keywords: Geometry Theory · Model · Problem based learning

1 Introduction

Mathematics is one of the subjects that occupies a significant role in the world of learning. Mathematics has significant role towards the development of human thoughts [1]. As the proof, mathematics lessons are given to all levels of learning, from lower schools to major academies. One of the roles of mathematics is to prepare students to be able to face the changing circumstances or challenges in life and in an expanding world [2]. The objectives of learning mathematics are: (1) to prepare students to be able to experience changing conditions in life through training to play a role in logical, rational, thorough, honest, and efficient thinking; (2) prepare students to be able to use mathematics and mathematical thinking patterns in daily life in pursuing various sciences; (3) developing and improving numeracy skills with fields as equipment in everyday life; (4) improving thinking skills and (5) developing logical, critical, creative, thorough, and disciplined behavior. The essence of efficient education is all the efforts of teachers to be able to share new experiences with students and bring students to study well to achieve the goals to be achieved optimally. The lack of reasoning ability towards the basic principle of mathematics is causing the students to create mistakes in solving mathematical problems [3].

Problem-based learning (PBL) is a student-centered pedagogy in which students learn about a subject by attempting to find a solution to an open-ended problem [4]

M. Kristiawan et al. (Eds.): OCERI 2023, ASSEHR 775, pp. 281–287, 2024.
https://doi.org/10.2991/978-2-38476-108-1_27

whereas [5] maintain that PBL enhances learning by providing a highly motivational environment for acquisition of knowledge, which is well received by those who take part in it. Problem Based Learning is one of the teaching models that require students to be active, collaborative, student-centered, develop their problem-solving skills, and independent learning [6] with Problem-Based Learning (PBL) students are faced with problems of irregularity, then students work in groups to formulate problems that have been given. [7] stated that PBL could be trusted to help the development of creative thinking skills among students in various fields of education, especially in learning physics.

The teacher guides students and facilitates learning, organizes learning assignments, mediates problem formulation, and formulates hypotheses. Students work in groups to solve problems that have been given previously. Problem solving activities can be used to improve and evaluate the creative thinking ability. One of the problems that can be used is an open-ended problem, which is a problem that has a variety of solutions or strategies [8]. According to Arends that: "Model problem-based learning is an approach learning in which students work on problems that authentic with a view to organize their knowledge themselves, develop inquiry and higher-level thinking skills high, develop independence and confident. PBL such as structure in learning, and offer potential multimedia based solutions [9].

This research examines the core topics in geometry where the problems of teaching and learning occurs most in mathematics with learning problem based learning [10]. Geometry is an aspect of mathematics which deals with the study of different shapes. These shapes may be plane or solid. A plane shape is a geometrical form such that the straight line that joins any two points on it wholly lies on the surface. A solid shape on the other hand is bounded by surfaces which may not wholly be represented on a plane surface. According to [11] there are five reasons on how important to learn geometry is. They comprise (1) Geometry can provide a more complete appreciation of the world, (2) Geometric explorations can develop problem-solving skills, (3) Geometry plays a crucial role in the study of other areas of mathematics, (4) Geometry is used daily by many people, and (5) Geometry is enjoyable [11]. The application of problem-based learning models can improve students' mathematical skills with indicators of direct observation, indirect observation, law of cause and effect, logical inference, and principle-compliant framework. The purpose of this study was to determine the effectiveness of the problem-based learning model in geometry theory.

2 Methods

This type of research is descriptive research through questionnaire analysis. [12] aims to find out whether the Problem-Based Learning Model is effective on geometry theory. To obtain the data done in three ways, namely description test, observation and questionnaire. Then the data is analyzed by (1) Calculating the percentage of teachers' ability, (2) The number of active students, (3) student responses and (4) the completeness of student learning outcomes [13, 14]. Analysis technique data to obtain data results student learning through essay tests and for student and teacher activity data through observation, and student responses through a questionnaire. Then the data is analyzed

with calculating percentage ability teacher, show the number of active students and the percentage of student responses as well as percentage of mastery learning.

The sampling technique of this research used purposive sampling technique at [15] deep sample. This research is the students of class VIII SMP N 27 Pesawaran Lampung totaling 20 students. Because the researcher feels that the sample taken knows the most about the problem to be studied by the researcher. The use of purposive sampling in this study aims to determine that is intended to investigate circumstances, conditions, situations, events, activities, etc., the results of which are presented by describing and interpreting natural objects as they are through observation/observation including qualitative research methods [16]; This study aims to describe students' self-esteem in mathematics after using learning problem based learning.

3 Results and Discussion

Teacher ability data obtained from the results of the observation sheet that carried out by an observer who record and assess ability teacher starts from the beginning of learning until finished. The observation sheet that filled by the observer consisting of 8 items. Based on observations obtained the average ability of teachers' carry out learning with problem-based learning model by 77.61%.

Student activity data obtained from the results of observations made by two observers taking notes student activity whose domain appears specified in the sheet observation. From observational data student activity is known that student learning activities at meetings first to fourth meeting has reached the indicator expected or in other words students are active in learning. Thing this is shown by the result Table 1 student activities are as follows:

Student response data to math learning with apply the learning model problem based for broad material and the volume of the flat-sided shape attended by 20 students can seen in the Table 2:

Based on the table above obtained the results of student responses are equal to 83.55%. This means model problem-based learning able to give a good response positive towards learning. Response This student was obtained because the student feels happy, motivated and challenged in doing the problem. In addition, students also acknowledged that faster assignments done and be responsible for the assigned task. Students are also not awkward anymore in asking and putting forward opinion.

Table 1. Recapitulation of Observations Student Activities

No	Student activity, meeting to							
	I		II		III		IV	
	A	B	A	B	A	B	A	B
The number of students	14	6	15	5	17	3	15	5
percentage	70%	30%	75%	25%	85%	15%	75%	25%
Average student activity: 76,25%								

Table 2. Student response data to math learning with apply the learning model problem based for broad material and the volume of the flat-sided shape attended.

No	SD	D	NA	A	SA	∑	%
1	0	2	0	52	30	84	84%
2	0	0	3	48	35	86	86%
3	0	0	0	44	45	89	89%
4	0	2	0	56	25	83	83%
5	0	4	9	60	0	73	73%
6	0	0	3	56	25	84	84%
7	0	2	3	44	35	84	84%
8	0	0	0	60	25	85	85%
9	0	0	0	64	20	84	84%
10	0	0	3	60	20	83	83%
11	0	0	3	64	15	82	82%
12	0	0	0	60	25	85	85%
13	0	0	3	60	20	83	83%
14	0	0	0	64	20	84	84%
15	0	0	0	60	25	85	85%
16	0	0	3	64	15	82	82%
17	0	0	3	64	15	82	82%
18	0	0	0	64	20	84	84%
19	0	0	0	68	15	83	83%
20	0	0	0	56	30	86	86%

Data on student learning outcomes obtained from the test results. This test is a test the entire material that has been taught to students to see student's ability to mastery of geometry theory followed by 20 students can be seen in Table 3.

Based on Table 3, it is obtained student learning outcomes by 80% or there are 16 students meet the minimum completeness criteria (KKM) or complete from 20 students. So based on effectiveness criteria can be said that the problem-based learning model is effective on geometry theory on class VIII even semester SMP N 27 Pesawaran Lampung.

Table 3. Student Learning Outcomes Obtained from the Test Results

No	Name	M/F	Mark	Information
1	Agus J	M	72	Complete
2	Anti v	F	80	Complete
3	Anjur F	M	75	Complete
4	Beni R	M	40	Not Complete
5	Dita a	F	85	Complete
6	Dwi I	F	75	Complete
7	Edi P	M	30	Not Complete
8	Ferdianto	M	75	Complete
9	Fito A	M	75	Complete
10	Jesika	F	100	Complete
11	Luk'lu'ul	F	75	Complete
12	Nuflihatun	F	80	Complete
13	Nadia J	F	83	Complete
14	Nurfika	F	75	Complete
15	Refki H	M	76	Complete
16	Riki A	M	65	Not Complete
17	Siti H	F	90	Complete
18	Thomas O	M	35	Not Complete
19	Wildi P	F	88	Complete
20	Zahra A	F	100	Complete

4 Conclusion

Results based on data analysis discussion, interesting writer the conclusion that the Learning Model Problem Based effectively applied on theory geometry This is shown from the results of the analysis research that refers to indicators of learning effectiveness as follows: 1) teacher's ability in managing learning with Based Learning Model Problems reached 77.61%, 2) student activities during the process learning achieves the indicators that expected with a percentage of 76.25%, 3) students who respond good towards learning people with the percentage obtained that is 83.55%, 4) students get value above the minimum completeness criteria or classical completion by 80%.

References

1. Tawachai Rattanatumma & Vichian Puncreobutr, "Assessing the Effectiveness of STAD Model and Problem Based Learning in Mathematics Learning Achievement and Problem Solving Ability," *J. Educ. Pract.*, vol. 7, no. 12, pp. 194–199, 2016.

2. E. Z. Jamaan, D. N. Musnir, and Z. Syahrial, "The effect of problem-based learning model on students' geometry achievement by controlling mathematics initial ability," *J. Phys. Conf. Ser.*, vol. 1554, no. 1, 2020, https://doi.org/10.1088/1742-6596/1554/1/012034.
3. S. Heleni and Z. Zulkarnain, "The Influence of Mathematical Thinking Ability with Modified MOORE Method on Learning Outcomes of Basic Mathematic II Chemical Education Students," *J. Educ. Sci.*, vol. 2, no. 2, p. 33, 2018, https://doi.org/10.31258/jes.2.2.p.33-41.
4. R. Phungsuk, C. Viriyavejakul, and T. Ratanaolarn, "Development of a problem-based learning model via a virtual learning environment," *Kasetsart J. Soc. Sci.*, vol. 38, no. 3, pp. 297–306, 2017, https://doi.org/10.1016/j.kjss.2017.01.001.
5. D. A. Kilroy, "Problem based learning," *Emerg. Med. J.*, vol. 21, no. 4, pp. 411–413, 2004, https://doi.org/10.1136/emj.2003.012435.
6. R. E. Dibyantini, R. D. Suyanti, and R. Silaban, "The Effectiveness of Problem Based Learning Model through Providing Generic Science Skill in Organic Chemistry Reaction Subject," *J. Phys. Conf. Ser.*, vol. 1819, no. 1, 2021, https://doi.org/10.1088/1742-6596/1819/1/012073.
7. M. P. Simanjuntak, J. Hutahaean, N. Marpaung, and D. Ramadhani, "Effectiveness of problem-based learning combined with computer simulation on students' problem-solving and creative thinking skills," *Int. J. Instr.*, vol. 14, no. 3, pp. 519–534, 2021, https://doi.org/10.29333/iji.2021.14330a.
8. A. M. Nasir and H. Hadijah, "The Effectiveness of Problem Based Learning Model With The Assistance of Animation Media on Tetragon Material To The Students Mathematic Learning Achievement of Grade Vii Smp Negeri 5 Mandai," *Malikussaleh J. Math. Learn.*, vol. 2, no. 1, pp. 13–18, 2019, https://doi.org/10.29103/mjml.v2i1.2126.
9. A. D. Mcphee, "Problem-based learning in initial teacher education: taking the agenda forward," *J. Educ. Enq.*, vol. 3, no. 1, pp. 60–78, 2009.
10. T. Adolphus, "Problems of Teaching and Learning of Geometry in Secondary Schools in Rivers State , Nigeria," *Int. J. Emerg. Sci.*, vol. 1, no. 2, pp. 143–152, 2011.
11. D. P. Astuti, S. Sutopo, and F. Nurhasanah, "An Analysis of Students Geometry Skills with Different Visual-Spatial and Logic-Mathematic Intelligence in Solving the Problem of Solid Plane Geometry," *J. Math. Math. Educ.*, vol. 10, no. 1, p. 19, 2020, https://doi.org/10.20961/jmme.v10i1.37732.
12. R. Watrianthos, "Jurnal Pendidikan MIPA," *J. Pendidik. MIPA*, vol. 20, no. 1, pp. 23–29, 2019.
13. H. C. Hill, B. Rowan, and D. L. Ball, "Effects of teachers' mathematical knowledge for teaching on student achievement," *Am. Educ. Res. J.*, vol. 42, no. 2, pp. 371–406, 2005, https://doi.org/10.3102/00028312042002371.
14. A. Kothiyal, R. Majumdar, S. Murthy, and S. Iyer, "Effect of think-pair-share in a large CS1 class: 83% sustained engagement," *ICER 2013 - Proc. 2013 ACM Conf. Int. Comput. Educ. Res.*, pp. 137–144, 2013.
15. S. K. Safril Karie and B. Husain, "an Analysis of the Sixth Semester Students' Mixing Code Between American English and British English At English Education Study Program of Universitas Pasifik Morotai," *J. English Educ. Linguist.*, vol. 1, no. 2, pp. 84–96, 2020, https://doi.org/10.56874/jeel.v1i2.279.
16. J. A. Moreira-Párraga and E. J. Alcívar-Castro, "Cognitive development of students in solving mathematical problems," *Int. J. Health Sci. (Qassim).*, vol. 13, no. 2, pp. 12655–12665, 2022, https://doi.org/10.53730/ijhs.v6ns2.8415.