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Research Article

Project Based Learning (PjBL) For Improving Elementary School Mathematics Learning Outcomes in Banyumas Regency, Indonesia

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ABSTRACT

The purpose of this study was to improve students' mathematics learning outcomes through the implementation of the PjBL model. This research is a Classroom Action Research with the Kemmis & McTaggart model with stages: planning, action, observation, and reflection carried out in 2 cycles. Research procedure with stages: preparation, implementation, data analysis using descriptive qualitative data analysis, and drawing conclusions. The research was carried out in class VI MI Muhammadiyah Karanglo. The results of the study concluded that: 1) The application of the project based learning (PjBL) learning model can improve student learning outcomes seen from the increase in student mathematics learning outcomes which has increased from an average of 75.08 in cycle I to 85.68 in cycle II, the score the median increased from 74 to 85, the standard deviation decreased from 10.26 to 7.21, the lowest score of 54 increased to 70, the highest score from 94 to 100, and the range of scores decreased from 40 to 30; 2) The distribution of frequency and percentage levels of achievement scores of learning outcomes from cycle I to cycle II shows that there is an increase in the category of student learning outcomes in the high category increasing from 22.58% to 54.84% and the very high category also experiencing an increase from 9.68 % to 32.26%.

Keywords: Project Based Learning, Mathematics Learning

Introduction

Mathematics is a universal science that has an important role in various disciplines and develops human thinking power, and underlies the development of modern technology. Therefore, mathematics subjects are given to all students from elementary to secondary/advanced education. This mathematics subject will equip students to have the ability to think logically, analytically, systematically, critically and creatively and be able to solve the problems they face in everyday life. (Mashuri, 2019). In the Minister of Education and Culture Regulation Number 7 of 2022 it is stated that the scope of mathematics lessons at the basic education level includes a) the concept of numbers, the relationship between numbers and the properties of numbers to express quantity in various appropriate contexts; b) arithmetic operations (addition, subtraction, multiplication, and division) on whole numbers, fractions, and decimals are performed efficiently to solve contextual problems; c) identification of patterns both numerical and non-numeric to explain things that are repeated; d) spatial regarding flat and spatial shapes and their characteristics to describe the surrounding environment; e) measurement and estimation of object attributes that can be measured using various units (both standard and non-standard) and compare the results; and f) interpretation of data that shows diversity based on the display of data to draw conclusions (Permendikbudriset, 2022).
Learning mathematics in schools/madrasas must provide learning experiences that can equip students in the future. This learning is expected to direct students to have the ability to think critically so that they are able to

solve various problems that will be encountered, not only providing information in the form of theories or concepts that are rote only, but need to be oriented towards developing the skills needed in solving problems. Azizah, and friends. states that students need to be equipped with skills to solve problems because in essence learning is not just memorizing information but a process in solving problems (Azizah et al., 2018). Teachers must have the ability to make learning mathematics as interesting as possible by using innovative learning models and concrete media. Teachers do not have to rely on the media that are already available in class such as LKS (Student Worksheets) but teachers can use the media around students. So that students can understand a concept not just memorize it (Solekhah & Hoesein Radia, 2018).

However, the reality of learning mathematics in schools is not at an ideal level to achieve the learning objectives that should be. Teachers have difficulty developing learning because there is too much material to be taught and teachers only use conventional learning approaches. While other realities that arise are the lack of interest in learning students in mathematics, an understanding of concepts that are not mature, the enthusiasm for learning is lacking and students are not motivated when studying mathematics, many students view mathematics as a difficult and boring subject, students often solve problems by using general formulas or rules and the inability of students to learn independently. And the last is the environmental aspect of the classroom atmosphere which is less conducive (Nisa et al., 2021).

Other problems experienced by teachers, students and parents of students in learning mathematics in elementary schools, namely students do not understand the material presented by the teacher, the teacher only explains the material briefly, the teacher participates in helping students work on the exercises they provide, the teacher does not ask students' understanding of the material being taught, the teacher does not use good learning media, students cannot think mathematically even though they have been in high grades, students' ideas do not come out and become latent, students do not ask questions about the material explained by the teacher, the method used by the teacher is still the old method, and the interest and abilities of students are not increasing (al Husna et al., 2021).

The domination of the teacher in the learning process also influences the learning outcomes of students' mathematics. Teachers who are too dominant in the learning process result in students not growing in their ability to think critically as an effort to solve problems. This will automatically greatly affect the achievement of student scores as a whole so that the target of student learning completeness will be difficult to achieve (Fitriyani et al., 2023).

The various of problems in learning mathematics, teacher creativity is needed in developing strategies, models, and learning approaches. With the teacher's creativity, it is hoped that the achievement of the goals of learning mathematics will increase. And one of the teacher's efforts that can be done is to apply the Project Based Learning (PjBL) learning model. According to Thomas in Aksela stated that Project Based Learning (PjBL) is a model that regulates learning around projects. It is also defined as a student-centered interdisciplinary activity with a clear project outcome. PjBL is characterized by student autonomy, constructive investigation, goal setting, collaboration, communication, and reflection in real-world practice (Aksela, 2019). Colley explained that the PjBL model is synonymous with science-based learning (Insyasiska et al., 2017), that is, students are involved in the project as a whole starting with selecting topics, deciding on approaches, conducting experiments, drawing conclusions and communicating the results of the project being worked on. PjBL as a cooperative and accommodative learning model for students' ability to think freely and creatively (Destian, 2018).

The problem of learning mathematics as the background of the problem above, is also experienced at MI Muhammadiyah Karanglo. The writer and teacher of class VI MI Muhammadiyah Karanglo found that the level of mastery of students in learning mathematics was still low. And as an effort to solve these problems, the author will apply a project based learning model in class VI mathematics learning. In accordance with this description, the author will conduct research with the title "Project Based Learning Model as an Effort to Improve Mathematics Learning Outcomes."

Literatur Review

In previous studies it was stated that the implementation of the PjBL model had a positive impact on teachers and students. These positive impacts include students being enthusiastic about participating in mathematics learning, students' creativity being awakened by the projects they have to work on, increasing the ability to organize groups because students must be able to manage the division of tasks so that projects can be completed properly, fostering a competitive spirit among students efforts to become groups the best, and learning is more meaningful and provides deep meaning for students and teachers (Setyowati & Mawardi, 2018).

Ummah, and friends stating that the implementation of project-based learning is based on notes on learning syntax for one semester. Then, students' products were compared to measure the increase in their creativity in the aspects of originality, novelty, and flexibility (Ummah et al., 2019). The results of this study indicate that there is an increase in student creativity in the implementation of project-based learning. Improvement is measured in manipulative manufacture. Students' flexibility and novelty are good, while their originality is sufficient. With the research that the author did, Ummah's research, and friends. these have similarities in reviewing the implementation of PjBL. However, there is a difference, that is, the research that the authors conducted was an experiment which, in turn, had an influence on the learning outcomes of class VI students.

Kristiyanto in his research also stated that the application of the PjBL learning model can improve students' critical thinking skills. This increase in ability is also directly proportional to the increase in students' mathematics learning outcomes (Kristiyanto, 2020b). The application of the PjBL model also influences the increase in understanding of mathematical concepts compared to students who are taught by not using this PjBL model.(Komarudin et al., 2020). Based on several expert opinions and some of the research above, it can be concluded that the project based learning model is a learning model that is student-centered and departs from a background problem to work on a real project or activity that will make students experience various obstacles. contextual so that they have to carry out investigations and problem solving to be able to complete the project so that they can achieve attitude, knowledge and skill competencies.

Method

This research is a Classroom Action Research (CAR) which aims to improve students' mathematics learning outcomes through the implementation of the PjBL learning model. The research steps used the Kemmis & McTaggart model (Susilo et al., 2022) with the stages: planning, implementing actions, observing, and reflecting which were carried out in 2 cycles. The research was conducted in class VI MI Muhammadiyah Karanglo, Cilongok District, Banyumas Regency. Research procedure with stages: preparation, implementation, data analysis, and drawing conclusions. Collecting data using tests and observations which are then analyzed using qualitative descriptive data analysis techniques. As for classifying learning outcomes by using categories of student mastery levels as according to Nurkacana (Wahyuddin, 2017) which is described in table I below

Table I Categories Of Classification Of Student Learning Outcomes

Score	Category
90 – 100	Very high
80 – 89	High
65 – 79	Currently
55 – 64	Low
0 – 54	Very Low

Results and Discussion

Results

This classroom action research was conducted in two cycles, the first and second cycles consisted of two meetings with one test, while the research results are described as follows. The results of the mathematics learning tests cycle I and cycle II are described in table 2 below.

TABLE 2.Learning Results Of Students In Cycle I And Cycle Ii

Description	Cycle I	Cycle II
Mean	75,08	85,68
Median	74	85
Mode	77	90
Stdev	10,26	7,21
Variance	105,31	52,05
Range	40	30
Minimum	54	70
Maximum	94	100
Sum	2.327	2.656

The data shows that there was an increase in learning outcomes from cycle I of 75.08 increasing to 85.68 in cycle II, as well as in terms of the range of cycle I of 40 decreasing to 30 in cycle II, this indicates that students' understanding of the material is not there is a huge discrepancy. The minimum score obtained by students increased from 54 to 70 while the highest score also increased from 94 to 100. So in general it can be explained that there was an increase in learning outcomes from cycle I to cycle II.

Furthermore, if student learning outcomes are described in the distribution of frequencies and percentage levels of achievement scores of students' mathematics learning outcomes, described in table 3 below.

TABLE 3 Frequency Distribution And Percentage Of Study Outcome Scores

Score	Category	Cycle I		Cycle Ii	
		Frek	(%)	Frek	(%)
90 – 100	Very High	3	9,68	10	32,26
80 – 89	High	7	22,58	17	54,84
65 – 79	Currently	14	45,16	4	12,90
55 – 64	Low	6	19,35	0	0
0 - 54	Very Low	1	3,23	0	0
	Sum	**31**	**100**	**31**	**100**

The data shows that there was an increase in the category of student learning outcomes in the high and very high categories which was explained by data that a significant increase, especially in the high category students increased from 22.58% to 54.84% and the very high category also experienced an increase from 9, 68% to 32.26% in cycle II.

Results of Learning Completeness Analysis

If student learning outcomes in cycles I and II are analyzed, then the percentage of learning completeness is described in Table IV below.

TABLE IV LEARNING COMPLETENESS CATEGORIES

Score	Category	Cycle I		Cycle II	
		Frek	(%)	Frek	(%)
0 – 69	Not Finished	8	25.81	0	0
70 – 100	Complete	23	74.19	31	100
	Sum	**31**	**100**	**31**	**100**

Based on table IV, it can be described that in cycle I there were still 25.81% of students who were in the incomplete category and the complete category was 74.19%. Whereas in cycle II, as many as 100% of students have fulfilled the minimum completeness.

Discussion

In general, the results of this study found that the application of the project based learning (PjBL) learning model can improve student learning outcomes, as well as in the learning process it is found to be able to increase student activity in the learning process. The results of this study are in line with the results of Surya et al.'s research which found that there was an increase in student learning outcomes, namely in the pre-cycle of student completeness by 46%, then increased by 72% in Cycle I and increased again in Cycle II by 92% of student learning completeness. Apart from the initial student creativity learning outcomes of 80% meeting 1 and increasing to 90% at meeting 2 cycle II (Surya et al., 2018). The relevant research results also explain that the application of the project based learning learning model is effectively applied with evidence that the increase in the average student creativity from the initial conditions or pre-cycle shows an average score of 52% with the low category to 68% the average score with the category being in cycle I and in cycle II the average score was 81% in the high category. The increase also occurred in student learning outcomes with an average student score of learning outcomes in the initial conditions of 65 with 15 students (48%) experienced an increase in cycle 1 with an average student score of 72 with 21 students (66%) and in cycle 2 the average -the average student score is 79 with the number of students completing as many as 27 or (87%) students completing (Adony Natty et al., 2019).

Furthermore, relevant research has also found that the Project Based Learning (PJBL) model is effective in improving critical thinking skills and student learning outcomes, and there are differences in critical thinking skills between students who are taught using the Project Based Learning (PJBL) model and conventional models. (Kristiyanto, 2020a). The project based learning learning model shows that there is evidence that increases the effectiveness of learning outcomes and increases students' solving abilities, there is an increase in students' understanding of lessons and an increase in good attitudes towards mathematics and an increase in collaboration. In this way it can be concluded that student learning can hone and explore each material received with its previous cognitive (Diva & Purwaningrum, 2022).

The project based learning (PjBL) model is an innovative learning model that uses projects as learning media, actively involves students in problem solving processes, students can work in groups and produce valuable products. Project-based learning (PjBL) projects are learning that focuses on questions or problems, which require students to follow the concepts and principles of discipline ((Mawaddah & Anisah, 2015)). Several studies have proven that the use of the project based learning (PjBL) model in learning can improve students' mathematical communication skills (Kumalaretna & Mulyono, 2017).

The application of the project based learning (PjBL) model was also found to be able to improve students' mathematical communication skills in the learning process, because the application can provide positive benefits for students during the learning process. Learning using the project based learning (PjBL) model can also improve problem solving skills, students become active, increase collaboration, practice decision making,

responsibility, tolerance, discipline, and confidence as well as improve students' mathematical communication skills (Melinda & Zainil, 2020) .

Project based learning (PjBL) is a form of student-centered instruction based on structivist principles, namely students are actively involved in the learning process and they achieve their goals through social interaction and sharing knowledge and understanding (Abdiyah & Subiyantoro, 2021). This learning is based on inquiry where the learning context is provided through authentic questions and problems in real practice (Mashudi, 2021); lead to meaningful learning experiences (Daulay & Daulay, 2021); as well as providing opportunities for students to construct knowledge by solving real problems through asking and correcting questions, designing and conducting investigations, collecting, analyzing, and interpreting information and data, drawing conclusions, and reporting findings (Ahmad & Muslimah, 2021). In implementation of PjBL its involves students in knowledge construction by: asking students to complete meaningful projects and develop real-world products (Fithriani et al., 2022). PjBL is a constructivist pedagogy that intends to bring about deep learning by enabling students to use an inquiry-based approach, rich in questions, real and relevant to the topic being studied (Verianita et al., 2022). There are six advantages of PjBL, namely focusing on learning objectives, participation in educational activities, collaboration between students, the use of scaffolding technology, and the creation of real artifacts.

Furthermore, the results of this study also support research findings which found that the application of the project based learning model can improve student learning outcomes in the cognitive and psychomotor domains of students based on the conclusions of the study which found that mathematics learning outcomes in the cognitive domain were based on the percentage of pre-cycle, cycle I and cycle II of 20.8%; 54.2%; 91.8%. While the results of learning mathematics in the psychomotor domain based on the percentage of learning completeness in the pre-cycle, cycle I and cycle II were 41.6%; 70.8%; 95.8%. (Nurul 'azizah & Wardani, 2019). In addition to contributing to improving mathematics learning outcomes, the application of the project based learning model was also found to be able to increase student creativity as research findings explained that the application of project based learning learning models was found to be able to increase completeness in learning creativity with research data that the pre-cycle percentage obtained 36.36%. , the percentage increased in cycle I to 72.73%, and the percentage in cycle II to 90.91% (Ariawan et al., 2018).

Likewise in increasing student learning motivation, the application of the Project Based Learning model was found to be able to increase student learning motivation as proven from the results of research which found that students' motivation to learn mathematics increased by 8%, namely 77% in cycle 1 and increased by 85% in cycle 2. Therefore, project based learning is recommended to be applied in learning mathematics (Hapsari & Airlanda, 2018).

Conclusion

In general, the results of this study found that: 1) The application of the project based learning (PjBL) learning model can improve student learning outcomes seen from the increase in student mathematics learning outcomes which has increased from an average of 75.08 in cycle I to 85.68 in cycle II, the median value increased from 74 to 85, the standard deviation decreased from 10.26 to 7.21, the lowest value 54 increased to 70, the highest value from 94 to 100, and the range of scores decreased from 40 to 30; 2) The distribution of frequency and percentage levels of achievement scores of learning outcomes from cycle I to cycle II shows that there is an increase in the category of student learning outcomes in the high category increasing from 22.58% to 54.84% and the very high category also experiencing an increase from 9.68 % to 32.26%. From these data it can be concluded that Project Based Learning (PjBL) can improve the mathematics learning outcomes of class VI MI Muhammadiyah Karanglo students. Therefore, it is recommended for teachers to apply the project based learning (PjBL) learning model as an alternative to improve the results and quality of the learning process.

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