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Project Based Learning: A Solution to Improve Students' Learning Achievement

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Abstract

Effective and quality education is essential in improving students' learning achievement. However, conventional learning methods often cannot meet the diverse learning needs of students. Therefore, innovative and effective learning methods are needed, such as project-based learning. This study aims to analyze how the effect of project-based learning model implementation on students' social arithmetic learning achievement. This research uses quantitative methods with the type of classroom action research, the data source is taken from thirty-four students at one of the junior high schools in Indonesia. In this study, the data analysis tool used was the Statistical Package for the Social Sciences to process quantitative data on students' test results. The analysis was carried out by calculating the average value, percentage of learning completeness, and paired sample t-test to see the improvement of learning outcomes between cycle I and cycle II. The results showed that the application of Project-Based Learning showed a significant increase in the students' completeness criteria, from 47.06% in the pre-cycle, increased to 67.65% in Cycle I, and reached 94.12% in Cycle II. This research is expected to help educators in choosing effective and contextual learning methods to create interesting, relevant, and meaningful learning experiences for students.

INTRODUCTION

Secondary school learners' motivation to participate in math learning tends to decline. Research shows that learners' perception of mathematics as a boring and difficult subject often results in negative attitudes towards the discipline (Hafiyya & Hadi, 2023; Putri & Safrizal, 2023; Said, 2021; Wijayanti & Widodo, 2021). Such attitudes are further exacerbated by unpleasant learning experiences in the early stages, which reduce learners' engagement in mathematics learning. One of the main causes of students' disinterest in mathematics is the monotonous and repetitive learning approach.

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Most educators still apply the lecture method and conventional problem exercises, which are often considered boring by students. Research shows that participatory and contextualized learning can increase learners' engagement and understanding of mathematics (Matanari, 2020). Approaches such as project-based learning and technology integration have been shown to increase the relevance and appeal of mathematics for learners.

Learning outcomes refer to the competencies obtained by students after going through the educational process. Learning is defined as a process of relatively permanent behavior change through active involvement in educational activities (Vandini, 2016). In structured learning, known as instructional activities, teachers determine the learning objectives that must be achieved. Learners who are successful in learning are those who are able to meet the educational objectives or instructional targets that have been set (Arifuddin et al., 2018; Bernard & Sunaryo, 2020; Farhan et al., 2022; Nisa & Susanto, 2022; Rahmayani & Amalia, 2020).

Learning outcomes are changes that result in individuals experiencing changes in attitude and behavior. The learning process involves active cognitive interaction with the environment, resulting in transformations in knowledge and attitudes. Based on this, learning outcomes can be interpreted as changes experienced by individuals after engaging in educational activities (Setiawati, 2018). To measure learners' performance levels, quantitative value-based evaluation is required. The learning process experienced by learners greatly affects learning outcomes, where the role of the teacher is an important element in the dynamics of learning. Learners' understanding of learning materials is measured through their exam results.

Learning objectives include increasing knowledge, developing concepts and skills, and forming attitudes. A pleasant learning process will facilitate the absorption of material by students. Evaluation of learning success is carried out through tests designed to assess the achievement of educational objectives (Engkizar et al., 2023). Learning outcomes reflect changes in the cognitive, emotional and psychomotor dimensions as a result of educational activities. Learning outcomes include aspects of knowledge, attitudes and skills. Various factors influence learning outcomes, including intelligence, learners' readiness or maturity, interest in learning, teachers' teaching methods, and a conducive learning environment. Internal and external factors equally influence learning outcomes. The learning outcomes of mathematics lessons in the 2023/2024 academic year with a Minimum Completion Criteria value of 65.00 were obtained as follows.

Table 1. The data of semester test results of students in the 2023/2024 academic year

No.	Completion Rate	Criteria	Total	Percentage
1.	< 65,00	Not complete	16	47,06%
2.	≥ 65,00	Completed	18	52,94%
Total			**34**	**100%**

Table 1 shows that the learning outcomes of students in the early stages of the study were still relatively low. Out of a total of 34 students, only 18 students (52.94%) reached the Minimum Completion Criteria, this figure is still far from the expected target, which is 75% of students successfully completing the subject.

Some of the factors that contribute to low learner learning outcomes include: i) many learners ignore the teacher's explanation of the subject matter. ii) learners tend to be passive when given the opportunity to ask questions, which indicates a lack of understanding of the material being taught. iii) intimidation

from peers when learners try to ask the teacher. iv) the majority of learners do not complete learning activities due to a lack of effort to understand the material independently or utilize help from more capable friends (Wahdah & Malasari, 2022; Fitriani, 2022; Ginanjar et al., 2019; Hasan et al., 2021; Nasri et al., 2022; Prastika, 2021; Sutriningsih, 2017).

Student learning outcomes are one of the main indicators of success in the education process. Achieving good learning outcomes is not easy if teachers lack competence in applying effective learning methods. The teacher's ability to choose a learning approach that is relevant to the subject matter greatly influences learner engagement and achievement. Therefore, the learning process must be designed in such a way as to encourage the active involvement of learners, so that learning outcomes can improve. In an effort to improve the quality of the teaching and learning process, teachers need to choose learning methods that are in accordance with the characteristics of the subject matter to be taught (Damri et al., 2023; Engkizar et al., 2018). An approach that is not relevant to the material has the potential to cause difficulties for both students and teachers, thus hindering the achievement of learning objectives (Hakim & Windayana, 2016; Savriliana et al., 2020; Setiawati & Yuni, 2021; Wati & Trihantoyo, 2020).

Project-Based Learning is a learning approach that aims to connect subject matter with real-life contexts through the implementation of relevant projects (Alhayat et al., 2023; Hidayati & Restian, 2023). In this model, learners are challenged to work on projects related to a particular topic. In addition, learners are also encouraged to discuss or develop projects that focus on specific issues or challenges. The learning process involves independent exploration, investigation and discovery, which enables learners to gain in-depth knowledge by utilizing existing theories and facts. This learning paradigm provides opportunities for learners to work independently and collaboratively to produce a product.

Project-based learning is a contextualized and effective learning strategy to increase learner engagement, while it supports the development of 21st century skills, such as critical thinking, collaboration, communication and creativity. This method not only encourages learners' active engagement in the learning process, but also contributes significantly to improved learning outcomes. By applying Project-Based Learning, learners gain academic understanding as well as the ability to apply learning in real situations, making the learning process more relevant, fun and meaningful. Based on the description that has been presented, this study seeks to answer the main question regarding the effectiveness of applying the Project-Based Learning model in improving students' learning outcomes in Social Arithmetic material (Nuha et al., 2024).

The novelty in this study lies in the project-based learning design applied in two cycles of classroom action, which not only focuses on concept understanding but also encourages independent exploration and problem solving. With this approach, the research aims to identify the extent to which the Project-Based Learning model can improve mathematics learning outcomes as well as overcome barriers to learner engagement in learning. The benefits of this research are expected to contribute to educators in choosing more effective and contextualized learning methods, so as to create a more interesting, relevant, and meaningful learning experience for students.

METHODS

This study used a classroom action research design with a Project-Based Learning approach, which aims to evaluate and improve the effectiveness of learning in a sustainable manner. This method allows teachers to actively reflect and develop teaching strategies to improve student learning outcomes (Agusti et al., 2018; Zafirah et al., 2018). The data in this study were collected through observation and documentation during the learning process, using instruments in the form of evaluation question sheets and observation sheets. Teachers, as the main practitioners in classroom action research, critically analyze the effectiveness of the teaching methods applied to increase learner engagement and understanding. Classroom action research is a methodology designed to enable teachers to systematically improve learning through cycles of reflection and continuous action (Alsokari et al., 2024; Edwards & Burns, 2016).

This research was conducted in two cycles, namely Cycle I and Cycle II, with a quantitative approach as the main method in data analysis. Information was obtained through direct observation of the learning process as well as the results of tests conducted in each cycle. The qualitative descriptive approach was used to provide an overall picture of the interaction during learning, while quantitative descriptive analysis was utilized to measure the improvement of students' learning outcomes. The structure of the classroom action research applied consists of four main stages, namely planning, implementation, observation, and reflection which are carried out iteratively to ensure optimal learning improvements (Zulfa et al., 2024).

In this study, the data analysis tool used was the Statistical Package for the Social Sciences to process quantitative data on students' test results. The analysis was carried out by calculating the average value, percentage of learning completeness, and paired sample t-test to see the improvement of learning outcomes between cycle I and cycle II. Through this combination of approaches, the research is expected to provide more accurate conclusions about the impact of project-based learning models on students' academic achievement.

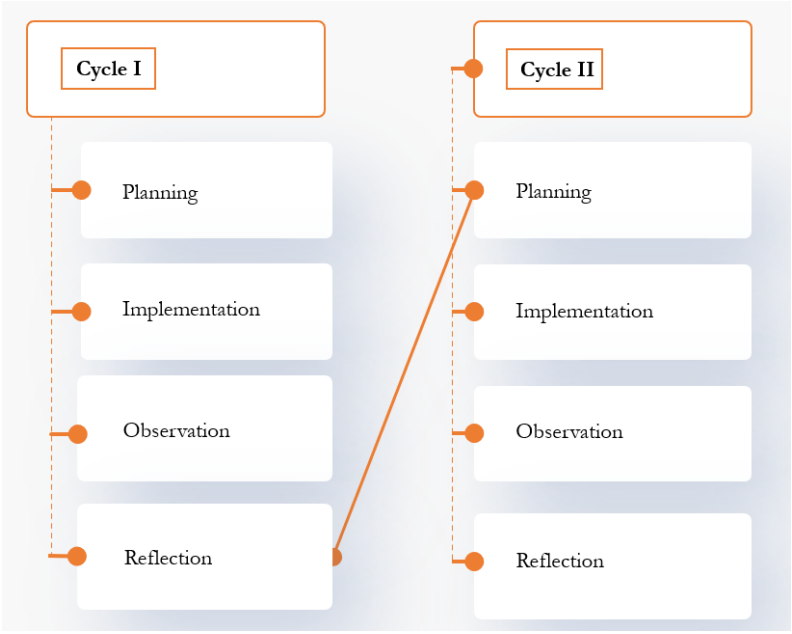

Fig 1. Classroom Action Research Procedure

To determine the learning outcomes of students after the application of the Project-Based Learning method, data was collected through formative tests conducted at the end of each cycle. This formative test is designed to

evaluate students' understanding of the material that has been taught during the learning process. The implementation of this test not only serves as a measuring tool for individual achievement, but also as a reflection on the effectiveness of the learning method applied. The results of this formative test provide a clear picture of the level of achievement of students' learning completeness criteria, as well as the basis for making improvements in the next learning cycle. Thus, this method allows researchers and educators to systematically measure the success of the implementation of Project-Based Learning, as well as take strategic steps in improving the quality of learning and overall learner learning outcomes (Lam et al., 2009; Maharani et al., 2023).

RESULT AND DISCUSSION

Project assessment is an evaluation method that assesses work that must be completed within a certain period of time. The task includes a series of investigative activities, including planning, data collection, organizing, processing, and presenting data. Project assessment allows evaluation of learners' understanding, application skills, investigative abilities, and clarity of communication about the material learned. Each learning paradigm has advantages and disadvantages. The Project-Based Learning paradigm allows learners to address challenges through project activities, giving them hands-on experience in planning and implementing projects. However, Project-Based Learning also has its challenges, especially in terms of the need for more in-depth and careful effort and planning.

The implementation of the Project-Based Learning model at the junior high school level is proven to be effective in improving learner learning outcomes. This study showed a significant increase in learner learning outcomes in cycle II after the implementation of the Project-Based Learning paradigm. In cycle I, learning completeness reached 78.6%, with an average class score of 74.3. In cycle II, the class average score increased to 81.8 with a learning completeness rate of 92.9%. The findings provide a basis for further discussion in an educational context and discussion with educators and other stakeholders. This research is part of a Classroom Action Research that aims to evaluate learners' learning outcomes through the introduction of project-based learning. Project-Based Learning involves five fundamental processes that must be implemented systematically.

The first is the identification of core questions. The first step is to identify a core question that can motivate learners' engagement in the project. This question should be relevant to learners' everyday experiences and closely related to the subject matter being studied. Second is project planning. At this stage, the teacher assists learners in organizing the project. The teacher provides the framework, while learners actively determine the methods used to complete the project. Third is timeline development. After planning, the teacher and learners develop a schedule that describes the time allocation for each phase of the project, from data collection to presentation of results. Fourth is project and progress monitoring. The teacher oversees the implementation of the project to ensure learners stay on track, as well as providing necessary support throughout the learning process. Fifth is assessment and reflection. Learners present their project results and reflect on the process. Assessment is done to assess the extent to which the learning objectives have been achieved.

Project-Based Learning is conducted with the following implementation steps.

Table 2. Stages of Project-Based Learning Model Implementation

No	Stages of Project-Based Learning	Activity
1.	Determining the fundamental question	Determining the fundamental question that can motivate learners to engage in the project
2.	Planning the project	At this stage, the teacher helps learners plan the project that will be done
3.	Developing a schedule	Developing a schedule of project activities After the project is planned, the teacher together with the learners draws up a schedule for the implementation of the project
4.	Monitoring the project and progress	The teacher monitors the implementation of the project to ensure that learners are on track and provides assistance if needed
5.	Evaluation and reflection	Learners present the results of their project and reflect on the process. Evaluation is done to measure the extent to which the learning objectives were achieved

Project-based learning is carried out with the following planning schedule.

Table 3. Project-Based Learning Classroom Action Research Schedule

Implementation	March 2024			
	Meeting Week I	Meeting Week II	Meeting Week III	Meeting Week IV
Cycle I	07 and 09 - 03-2024	14 and 16 - 03-2024		
Material P.1	Units and quantities	Profit, loss and gain		
Material P.2	Selling price, cost of goods	Percentage of profit, loss and gain and post test		
Cycle II			21 and 23 - 03-2024	28 and 30 - 03-2024
Material P.1			Bank interest and taxes	Gross, net and tare percentages
Material P.2			Gross, net and tara	Post test
Report writing			April Week 1 2024	

From the schedule that has been made, Project-Based Learning-based learning activities are then carried out in the research class, with the results as shown in the following table.

Table 4. Comparison of the range of pre-cycle and cycle I student evaluation test scores

Score	Pre Cycle		Cycle I	
	Total of students	%	Total of students	%
91 – 100	0	0	0	0
81 – 90	0	0	0	0
71 – 80	8	23,5%	15	44,1%
61 – 70	10	29,4%	8	23,5%
51 – 60	10	29,4%	11	32,4%
≤ 50	6	17,6%	0	0
Total	34	100%	34	100%
Average	55,89	-	69,26	-

Based on the results of the author's analysis of the comparison data of the evaluation test scores of pre-cycle students with cycle I, the following data were obtained.

Table 5. Comparison of student evaluation test scores Pre-cycle and Cycle I

	Pre Cycle	Cycle I
Completed students	16 (47,06%)	23 (67,65%)
Incomplete students	18 (52,94%)	11 (32,35%)

The results of the research at the pre-cycle stage revealed that as many as 16 learners, or 47.06%, managed to achieve learning completeness. In contrast, there were 18 learners, or 52.94%, who had not met the Minimum Completion Criteria. The average class score obtained was 65.00. This data shows that the learning process that takes place in the classroom so far is still ineffective. The learning approach applied has not been able to attract students' interest, and is not based on adequate problem-solving strategies. To determine the percentage of the data, researchers used the following statistical calculation formula.

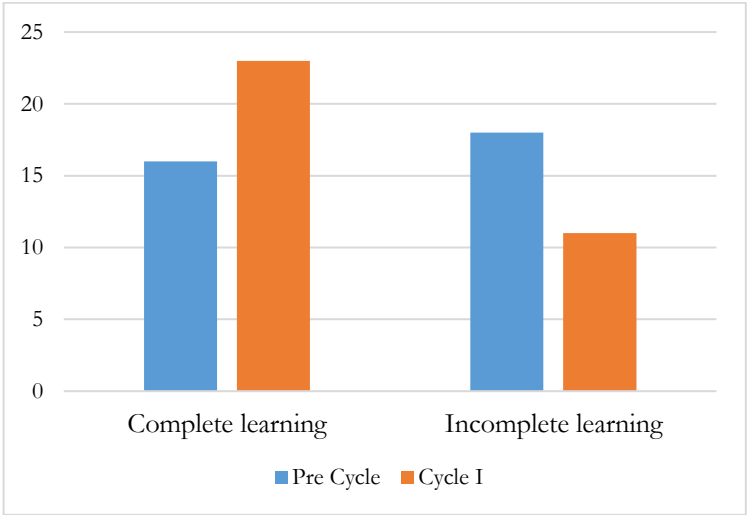

Fig 2. Graph of the development of students' learning completeness in pre-cycle and cycle I

Based on the data presented, in Cycle I there was an increase in the number of students who achieved a pass from 16 students at the pre-cycle stage to 23 students. The class average score also increased from 55.89 in the pre-cycle to 69.26, reflecting an increase in score of 13.37 points and an

increase in the percentage of passes by 20.19%. Nevertheless, the level of completeness in Cycle I only reached 67.65%, which was still below the completeness threshold of 75%. Therefore, it was necessary to implement Cycle II to achieve the expected target using the Project-Based Learning model. The learning process in Cycle I took place from March 7 to 16, 2024, with an allocation of 10 lesson hours.

The implementation of the Project-Based Learning model shows the reflection that a problem-based approach can increase learner involvement in group activities, resulting in better understanding (Ardianti et al., 2017; Banawi, 2019; Hikmah, 2020; Maulana & Mediatati, 2023; Setiawan et al., 2021). Learners' active participation in the problem-solving process allows them to retain information longer. However, some challenges still emerged during Cycle I. Some learners showed low levels of engagement in the learning process and group collaboration, which negatively impacted the understanding of the subject matter and the achievement of educational objectives.

Some learners also had difficulty in solving problems effectively due to a lack of understanding of the material and minimal practice in applying problem-solving strategies. In addition, learners' involvement in asking questions to the instructor and interacting with peers was still less than optimal. As a follow-up, improvement strategies are needed for Cycle II to increase learning effectiveness, including providing additional practice, strengthening concept understanding, and encouraging learners' active involvement both in groups and class discussions.

Furthermore, planning for improvements in cycle I. On Thursday, March 21 to 30, 2024, learning improvement was carried out for cycle II, by utilizing a project-based learning model. The results of the analysis of Cycle II compared to Cycle 1 are as follows.

Table 6. Comparison of the range of evaluation test scores of students in cycle I and cycle II

Score	Cycle I		Cycle II	
	Total of students	%	Total of students	%
91 - 100	0	0	0	0
81 – 90	0	0	10	0
71 - 80	15	44,1%	21	44,1%
61 - 70	8	23,5%	1	23,5%
51 - 60	11	32,4%	2	32,4%
≤ 50	0	0	0	0
Total	34	100%	34	100%
Average	69,26	-	79,41	-

Based on the results of the author's analysis of the comparison data of the evaluation test scores of students in cycle I and cycle II, the following data were obtained.

Table 7. Comparison of student evaluation test scores Cycle I and Cycle II

	Cycle I	Cycle II
Learners completed	23 (67,65%)	32 (94,12%)
Incomplete learners	11 (32,35%)	2 (5,88%)

The results of data analysis show that of the total students, there are two students or 5.88% who have not mastered the Social Arithmetic material with a score below 65, while 32 students or 94.12% have achieved a score of 65 or

more, resulting in a class average of 79.41. Learning evaluation data in Cycle II showed a significant increase in the level of completeness of students, where more than 75% of students managed to achieve learning outcomes in accordance with the target, and the average class score exceeded 65. Thus, the application of the Project Based Learning model on Social Arithmetic material in class VII can be considered successful in improving student learning outcomes.

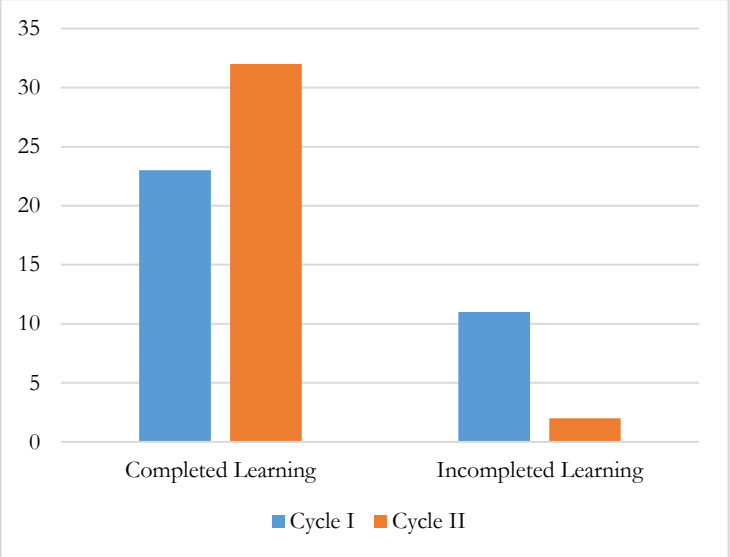

Fig 3. Graph of the development of students' learning completeness in cycle I and cycle II

The implementation of Project-Based Learning in Cycle II also showed its effectiveness in increasing learners' interest and involvement in the learning process through project activities. The activities allow learners to solve problems both independently and collaboratively, as well as utilize educational resources such as film media to strengthen their understanding of the material.

Table 8. Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	SIKLUS1 - SIKLUS2	-14.20588	9.40593	1.61310	-17.48777	-10.92400	-8.807	33	.000

From the Paired Samples Test table, the significance value (2-tailed) shown is 0.000. This value is smaller than the predetermined significance limit (usually 0.05). This shows that there is a significant difference between cycle I and cycle II. In other words, this result indicates a significant effect of the treatment (application of Project-Based Learning) given. The significant increase in students' learning outcomes after the treatment confirms the effectiveness of the project-based learning model in improving mathematics skills, especially on Social Arithmetic material.

This improvement in learning outcomes proves that the project-based approach is able to create an active and learner-centered learning atmosphere. The Project-Based Learning model provides opportunities for learners to engage in projects that are relevant to real life, so that they can integrate various knowledge and skills in the learning process. In addition, this approach encourages learners to collaborate in groups, identify challenges, design solutions and evaluate the results of their work.

The application of the Project-Based Learning model in mathematics education provides many advantages, such as increasing learner motivation and participation, fostering critical and creative thinking, and developing

communication and cooperation skills. According to Trianto in 2024, the implementation of Project-Based Learning involves several stages, starting from the identification of core questions that motivate learners, project planning, schedule preparation, monitoring project implementation, to the assessment and reflection stage. Project-Based Learning includes steps such as project selection, project completion design, development of an implementation plan, teacher-guided project implementation, dissemination of project results, and evaluation of learning outcomes and processes.

Based on the findings of this study, the implementation of the Project-Based Learning model only succeeded in improving learners' learning outcomes, but also had a positive impact on learners' engagement and problem-solving skills. With an approach that involves real projects, learners are able to actively participate in the learning process and develop collaborative skills and critical thinking abilities. This makes Project-Based Learning an innovative and effective educational approach in improving the quality of learning and learner learning outcomes in the classroom.

CONCLUSION

This research design presents a novelty in the application of Project-Based Learning with an approach that not only focuses on understanding concepts, but also encourages active engagement of learners through independent exploration and problem solving. By providing a more contextualized and meaningful learning experience, this method not only improves academic understanding, but also develops critical thinking skills, collaboration and creativity. The benefit of this research lies in its ability to assist educators in choosing more effective learning strategies as well as providing a more engaging learning experience for learners. The implication of this Project-Based Learning implementation contributes to the learning paradigm shift, where learners are not only the recipients of information, but also become an active part in the learning process that emphasizes problem solving and 21st century skills.

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