

Improving Mathematics Achievement of Special Sports Class Students Through Project-Based Learning: A Quasi-Experimental Study

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Abstract

This research aims to determine the effect of Project-Based Learning on mathematics learning achievement in Special Sports Class (SSC) students. This quasi-experimental study uses a posttest-only control design. Sampling was conducted using random sampling, with two classes selected as the experimental and control groups. The instruments used were validated learning achievement tests and observation sheets to measure the implementation of learning. Data analysis was performed using the t-test with normal and homogeneous assumptions. The results of the analysis of the implementation of learning were in the very good category with an average of 98.25%. Based on the hypothesis test, it was found that $p\text{-value} = 0.000 < 0.05$, so H_0 was rejected. This shows that the mathematics achievement of SSC students at SMA Negeri 1 Sewon is more influenced by the project-based learning model than the cooperative model.

Keywords: cooperative, kelas khusus olahraga, parametric, PjBL, self-regulated

Introduction

Schools play an important role in developing logical, analytical, and problem-solving skills. Mathematics is one of the subjects that forms the basis of interdisciplinary studies. However, not all students have the same competence in learning mathematics. One group of students that requires special attention is students in the Special Sports Class (SSC). SSC is a special class aimed at developing students' potential in sports (Ramadhan et al., 2021). SSC students receive comprehensive sports training in addition to academic education. The main objective of SSC is to improve students' achievements in sports and academics achievements in sports.

The sports program organized at the school has the main objective of improving students' competence in sports so that they can achieve success in sports. SSC activities cover various sports and are adjusted to the goals and needs of students. Social skills such as teamwork, communication, and leadership are expected to be developed so that students' abilities in sports can be facilitated through SSC (Annifa'ari & Noor, 2025). Students are also required to learn discipline and hard work.

Interviews with mathematics teachers revealed that one of the main problems in the mathematics learning process is time constraints. Sufficient time is needed to understand concepts and solve problems. Several factors contribute to the limited learning time for SSC students, such as a busy training schedule, matches and competitions, and physical tiredness. These conditions result in suboptimal academic achievement, especially in mathematics. A busy schedule, the demand for athletic achievement, and a different focus in learning affect academic achievement (Dwi Fatmawati & Robertus Budi Sarwono, 2025).

Based on the results of observations, the problems in mathematics learning that occur in SSC are: (1) Limited learning time; (2) Inappropriate learning methods; and (3) Difficulties in understanding the material. The use of inappropriate teaching methods can make it more difficult for students to understand the material and reduce their desire to learn. The teaching methods used rarely relate sports issues to mathematics learning material, making learning less meaningful.

Mathematics learning for SSC students requires a model that can connect academic expectations with students' experiences in sports. Project-Based Learning (PjBL) is considered relevant because it places students as active subjects in solving contextual problems through projects that are integrated with real life. Through PjBL, mathematical concepts can be presented in the context of sports, such as calculating speed and distance or modeling game strategies. This is expected to increase the meaningfulness of learning, motivation, and conceptual understanding of SSC students.

One innovative learning method that relates to contextual problems is Project-Based Learning (PjBL)(Larsen, 2025). The PjBL measurement domain includes creativity, collaboration, critical thinking, communication, conceptual understanding, innovative thinking, motivation, problem solving, and self-confidence (Yusri et al., 2024). PjBL is a learning method that takes into account students' knowledge and understanding by connecting contextual issues (Lin et al., 2025). The PjBL process includes initiation (providing spark questions to link the project to learning objectives), knowledge building (metacognitive), investigation and collaboration, and facilitation (Hanham & Hendry, 2024). PjBL emphasizes student activities directly. Students are encouraged to take a step forward in their thinking process so that they can strengthen their understanding of concepts through experimentation (Al-Thani & Ahmad, 2025).

PjBL syntax consists of 5 stages such as teamwork, project management,

communication, interpersonal skills, and problem solving (Musa et al., 2012). Some also mention that the PjBL syntax consists of four phases, including information search and analysis, designing collaborative learning, presenting projects, and reflection and follow-up (Retno et al., 2025).

Several studies show that the application of PjBL has a positive impact on mathematics learning achievement. Research by Rahmawati (2024) states that PjBL can significantly improve student achievement and student activity. In addition, PjBL is also able to improve creative thinking skills (Sinurat et al., 2025). However, most of these studies were conducted on regular students and not on students with special characteristics such as SSC students. In fact, the characteristics of student athletes differ in terms of learning patterns, motivation levels, and physical conditions, so they may require a different approach to achieve optimal learning outcomes.

This research was done to solve the low mathematics learning achievement of students in SSC caused by limited learning time, inaccurate learning methods, and students' difficulties in understanding mathematics material. Therefore, this research aims to examine the effectiveness of applying the Project-Based Learning (PjBL) in improving the mathematics learning achievement of KKO students.

This research is unique because it specifically focuses on students in SSC, a group of students who have different academic, physical, and learning time characteristics compared to regular students. Unlike most PjBL studies conducted in regular classes, this research was carried out in the context of a sports-based school, where students experience academic learning together with intensive sports training programs. In this context, this research tests PjBL as a pedagogical strategy that is not only oriented to improving mathematics learning achievement, but also increases meaningful learning, time efficiency, and integration between academic activities and students' real experiences in sports. Thus, these results are hoped to provide contextual pedagogical implications, both as a reference for teachers in designing mathematics learning that is responsive to the needs of SSC students, and as a basis for sports schools in formulating academic learning policies that are in line with the demands of sports performance coaching.

Method

This research is an experimental study with a quasi-experimental research design in the form of *an* Experimental Posttest-Only Control Design. Quasi-experimental research is a type of research in which the researcher takes action and observes how that action changes things. This design was chosen because the sample was not selected randomly and the data collected was posttest data. The research was conducted at SMA Negeri 1 Sewon, Yogyakarta. The sample in this study was grade X SSC students. There were only two SSC in this school. Both classes were selected as research samples, one as an experimental class and the other as a control class. Each class consisted of 30 students. The experimental class used the PjBL model, while the control class used the cooperative model.

Data collection was carried out using two types of instruments, namely observation and tests. These instruments had been validated by two experts. The validation results were processed using Aiken with an estimated result of 0.9. This indicates that the instruments are content valid and ready for use. In PjBL learning, students were asked to conduct an investigation into a real problem, then end with the creation of a product as a learning outcome. For example, students were asked to collect data and then estimate running times, number of goals, or practice scores. Meanwhile, in cooperative learning, students were asked to form groups and then complete practice questions or problems given by the teacher.

Tests were given in both the experimental and control classes to compare which learning model was more effective. Observations were conducted to assess the implementation of learning activities in both the experimental and control classes. Data analysis used a t-test with the conditions of normality and homogeneity, with a significance level of 5% (α).

Results and Discussion

In the experimental class, the implementation of learning was assessed through observation sheets filled out by observers. The aim was to determine whether learning had been carried out in accordance with the learning implementation plan or not. Table 1 shows the results of the learning implementation data calculation.

Table 1. Results of the Implementation of the PjBL Learning Model

Class	Meeting	Percentage/Category
Experiment	1	96.5% (Excellent)
	2	96.5% (Very Good)
	3	100% (Excellent)
	4	100% (Excellent)
	Average	98.25% (Excellent)

The data in Table 1 shows that the implementation of PjBL learning has an average of 98.25% and is classified as very good. Thus, it can be said that the implementation of PjBL has been carried out in accordance with the syntax. The PjBL syntax used includes: 1) determining topics and problems; (2) project planning; (3) group formation; (4) project implementation; (5) supervision and evaluation; (6) project refinement; and (7) presentation and reflection. The results show that students were able to carry out learning applied with the PjBL model well at each stage.

The statistical description of the SSC students' mathematics achievement test results can be seen in Table 2. Based on Table 2, it can be seen that the posttest results for the experimental class were 87.93, with the lowest score being 76 and the highest score being 100. Meanwhile, the posttest results for the control class had an average of 65.93, with the lowest score being 42 and the highest score being 84.

Table 2. Posttest Results of the Experimental Class and Control Class

Data	N	Minimum	Maximum	Mean	Std. Deviation
Posttest Experimental Class	30	76	100	87.93	7,511
Posttet Control Class	30	42	84	65.93	12.357

Before conducting the t-test, the assumptions of normality and homogeneity of data distribution must first be met. Table 3 shows the results of the normality test. The estimates show that the p-value in the experimental class = 0.075 and the p-value in the control class is 0.064. These values are greater than 0.05, so H_0 is accepted. This indicates that the data (both in the experimental class and the control class) are normally distributed.

Table 3. Normality Test Results

Learning Model	Kolmogorov-Smirnov ^a		
	Statistic	df	Sig
Experimental Class (<i>PjBL</i>)	0.152	30	0.075
Control Class (Conventional)	0.155	30	0.064

After that, the data homogeneity test was conducted. The estimation results of this test can be seen in Table 4. The analysis results show that the data is consistent with the assumption of homogeneity. This is proven by the $p\text{-value} = 0.001 < 0.05$, H_0 is rejected.

Table 4. Homogeneity Test Results

Mathematics Learning Achievement Test		Levene Statistic	df ₁	df ₂	Sig
	Based on Mean	13.355	1	58	0.001
	Based on Median	10,507	1	58	0.002
	Based on Median and with adjusted df	10,507	1	47.894	0.002
	Based on trimmed mean	13,044	1	58	0.001

The next step is hypothesis testing to answer the research objectives. Table 5 shows the results of the t-test analysis. The estimation results indicate that $p\text{-value} = 0.000 < 0.05$. The p-value used is an estimate of the t-test result with equal variance not assumed, because the results of the homogeneity of variance test indicate that the data does not have the same variance. This indicates that the null hypothesis (H_0) is rejected, meaning that the PjBL model produces a different average learning achievement than the cooperative model. Based on the averages in Table 2, it can be said that PjBL is more effective than the cooperative model.

Table 5. T-test Results

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Mathematics Learning Achievement Test	Equal variances assumed	8.333	58	0	22.000	2.640
	Equal variances not assumed	8.333	47.855	0	22.000	2.640

Based on the observation results, it can be seen that by using the PjBL, students have a greater interest, are more motivated, and are more active, so that the creativity of SSC students is more stimulated in mathematics learning. In addition, they can learn mathematics through contextual problems in the world of sports. PjBL places students as active subjects who must design, implement, and present projects. This process requires them to use mathematical concepts meaningfully, not just do routine problems. For SSC students who are familiar with sports activities in their daily lives, projects can be easily contextualized, for example, statistical analysis of match scores or calculation of speed and distance in certain sports. It is this direct link between mathematics and the world of sports that is strongly believed to increase engagement and conceptual understanding. PjBL is in line with the constructivist approach, which emphasizes that knowledge is constructed through active interaction between experience and abstract concepts. Thus, PjBL can bridge the gap between academic demands and students' identities as student athletes.

This is in line with research findings that say PjBL provides opportunities for students to work together with friends so that they feel challenged to complete projects according to their abilities (Rijken & Fraser, 2023). PjBL contributes to increasing student engagement, creativity, communication, and conceptual understanding in Mathematics and Science (Ukobizaba et al., 2025; Selimi et al., 2025). PjBL provides flexibility that supports independent learning, time management for SSC students who have busy physical training schedules, and teamwork skills. An important point in PjBL teamwork is confidence in the ability of group members to fulfill their roles in completing the project (Taiebine et al., 2025). Students will contribute according to their respective abilities, whether in mathematical calculations (Wu et al., 2026), data visualization, or communication of results. The role of the teacher as a facilitator is an important aspect in providing clear feedback so that learning objectives are achieved. These findings support previous research showing that PjBL is effective in improving students' self-regulation, creativity, and collaboration.

In general, PjBL studies have been conducted more in regular, vocational, or general STEM contexts, rather than with students who have high physical activity intensity. SSC students face a double challenge, such as physical and academic training. A busy training schedule and physical fatigue often reduce their focus when attending mathematics lessons. In these conditions, PjBL can facilitate independent learning and time management. Students can divide the project workload according to their training schedule, as long as the teacher

provides clear deadlines and structure. This is in line with findings that PjBL supports self-regulated learning and students' creative thinking skills (Luthfi et al., 2021). In the field of physical education and sports, several quasi-experimental studies also show that PjBL can improve learning outcomes and increase self-confidence, thereby enhancing the learning experience in sports education (Safitri et al., 2024). The use of PjBL in learning will certainly yield good results because students play a more active role.

In addition, PjBL in mathematics will not only have an impact on increasing learning engagement but also play an important role in strengthening higher-order thinking skills. Through project activities, students are required to use mathematical concepts in an applied and reflective manner. Students will build a deeper conceptual understanding.

Conclusion and Suggestion

Based on the research results, it can be concluded that mathematics learning for X SSC students is more effective when using the PjBL learning model. The advantages of PjBL are demonstrated through statistical test results that indicate a significant difference between the experimental class and the control class, where students who participated in project-based learning achieved higher learning outcomes.

This finding suggests that PjBL can provide a more meaningful and contextual learning experience that actively involves students, making it very suitable for SSC students who need learning that is applied and relevant to their activities. Thus, the application of PjBL can be recommended as an alternative mathematics learning strategy to improve the academic achievement of SSC students.

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