



Contents lists available at Journal Global Econedu

## Journal of Educational and Learning Studies

ISSN: 2655-2760 (Print) ISSN: 2655-2779 (Electronic)

Journal homepage: <http://jurnal.globeconedu.org/index.php/jels>



# The effectiveness of the games based learning model in improving students' lower passing skills

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### Article Info

#### Article history:

Received Jan 09<sup>th</sup>, 2026  
Revised Feb 16<sup>th</sup>, 2026  
Accepted Mar 28<sup>th</sup>, 2026

#### Keyword:

Games based learning,  
Volleyball,  
Lower passing skills,  
Physical education

### ABSTRACT

This study aimed to examine the effectiveness of the Games Based Learning (GBL) model in improving volleyball lower passing skills among Grade X students at SMKN 1 Solok Selatan. A quantitative quasi-experimental study employing a Non-equivalent Control Group Pretest–Posttest Design was conducted. The sample consisted of 69 students selected through total sampling, including 35 students in the experimental group and 34 students in the control group. The experimental group received Games Based Learning instruction, while the control group received conventional instruction. Data were collected using a lower passing skills test assessing passing accuracy, strength control, and movement consistency. Data were analyzed using N-Gain analysis, Paired Sample t-tests, and Independent Sample t-tests. The experimental group showed a significant improvement ( $t = -13.834, p < 0.001$ ) with an N-Gain of 0.5191 (moderate), whereas the control group achieved an N-Gain of 0.2922 (low). A significant difference was found between groups ( $t = 3.503, p < 0.001$ ). Games Based Learning was more effective than conventional instruction in improving students' volleyball lower passing skills and is recommended for physical education learning.



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## Introduction

Volleyball is one of the most frequently taught sports in physical education because it contributes to students' physical fitness, motor competence, teamwork, communication, and decision-making skills (Paulo, Davids, et al., 2018; Salim et al., 2020). In the Indonesian Merdeka Curriculum, volleyball is an essential learning component at the secondary school level, requiring students to master fundamental techniques that support game performance. Among these techniques, lower passing (forearm passing) serves as the primary skill for receiving serves, defending attacks, and initiating offensive play (Gusthart & Kelly, 1993; Umar et al., 2023). Effective lower passing performance is characterized by passing accuracy, appropriate force control, and consistent movement execution, all of which are essential for successful participation in volleyball activities.

Despite its importance, many students continue to demonstrate inadequate lower passing performance (Apidogo et al., 2021; Paulo, Zaal, et al., 2018). Preliminary observations conducted at SMKN 1 Solok Selatan revealed that numerous students experienced difficulties in directing the ball accurately, regulating passing force, and maintaining stable movement patterns during repeated passing actions. These limitations often resulted in unsuccessful ball reception and reduced involvement in game situations. Such findings indicate that students'

lower passing skills have not yet reached the expected competency standards and suggest the need for instructional approaches that better facilitate meaningful motor skill acquisition.

One factor contributing to these learning difficulties is the predominance of conventional instruction, which generally emphasizes teacher demonstrations followed by repetitive technical drills in isolated practice situations. Although drill-based activities may improve basic movement execution, they frequently fail to provide representative learning environments that resemble actual game demands (Barsingerhorn et al., 2015; Pellett et al., 1994). Consequently, students often experience difficulties transferring technical skills from practice sessions to dynamic game situations that require continuous perception, decision-making, and action adaptation. These limitations have encouraged physical education researchers to develop student-centered pedagogical approaches that integrate technical learning with authentic game experiences.

Games Based Learning (GBL) has emerged as an innovative pedagogical approach that embeds skill acquisition within modified game situations. Grounded in student-centered and ecological perspectives of learning, GBL emphasizes active participation, problem-solving, tactical understanding, and continuous interaction between perception and action. Through modified games, students repeatedly apply movement techniques while adapting to changing environmental constraints and tactical demands. Previous studies have reported that game-based pedagogies improve students' motivation, engagement, tactical awareness, and technical performance in various sports contexts (Callupe et al., 2025; Erianti et al., 2025; Karisman & Supriadi, 2022; Kharisma et al., 2025). These findings indicate that learning environments emphasizing contextualized practice may facilitate more meaningful and transferable motor learning than conventional instruction.

The current body of literature demonstrates increasing interest in game-based pedagogies, including Games Based Learning and Teaching Games for Understanding (TGfU). Previous studies have shown positive effects on students' tactical knowledge, decision-making abilities, and general game performance (Batez et al., 2021; Pratama et al., 2023; Septiyanto et al., 2025). Research has also reported improvements in volleyball skills and learning outcomes following the implementation of game-centered instruction (Astuti et al., 2025; Endriani et al., 2022; Nurodin et al., 2024; Syaleh et al., 2026). Nevertheless, most studies have focused primarily on overall performance scores and have rarely examined lower passing skills as a multidimensional construct comprising passing accuracy, strength control, and movement consistency (Formenti et al., 2022; Gabbett et al., 2006; Rifki et al., 2022). Moreover, empirical evidence from vocational high school settings remains limited, despite the distinct characteristics and learning needs of vocational students (Naji & Abdulkader, 2026).

Based on these considerations, a clear research gap remains regarding the effectiveness of Games Based Learning in improving specific dimensions of volleyball lower passing skills among vocational high school students. In particular, there is insufficient evidence explaining how game-based instruction influences passing accuracy, strength control, and movement consistency simultaneously, and how its effectiveness compares with conventional instruction within the Indonesian vocational education context (Azarpaikan et al., 2021; Jufri et al., 2026; Nasution et al., 2025; Raaiyatini et al., 2024; Suyatno et al., 2023; Utami et al., 2022). Therefore, this study aims to examine the effectiveness of the Games Based Learning model in improving volleyball lower passing skills among Grade X students at SMKN 1 Solok Selatan. The novelty of this study lies in its multidimensional assessment of lower passing performance, its implementation within an underrepresented vocational high school context, and its direct comparison between Games Based Learning and conventional instruction through a quasi-experimental design. The findings are expected to contribute to evidence-based physical education practices and provide pedagogical recommendations for improving volleyball learning outcomes.

## Method

This study employed a quantitative approach using a quasi-experimental design with a Non-equivalent Control Group Pretest–Posttest Design to examine the effectiveness of the Games Based Learning (GBL) model in improving volleyball lower passing skills among Grade X students at SMKN 1 Solok Selatan. The study involved 69 students selected through total sampling, consisting of 35 students from Class X Hospitality as the experimental group and 34 students from Class X Computer and Network Engineering (TKJ) as the control group. The use of intact classes was determined based on existing school administrative arrangements; therefore, random assignment was not feasible. To minimize selection bias and establish baseline equivalence, both groups completed a pretest prior to the intervention. The pretest results indicated relatively comparable initial lower passing abilities between the experimental group ( $M = 36.57$ ) and the control group ( $M = 36.15$ ).

The intervention was conducted over three instructional sessions, with each session lasting 90 minutes and following the standard schedule of physical education lessons at the school. The experimental group received instruction through the Games Based Learning model using modified volleyball games that required students to

solve movement problems, make tactical decisions, and perform lower passing techniques in representative game situations. The learning activities progressively emphasized passing accuracy, strength control, and movement consistency through small-sided games and contextual task variations. Meanwhile, the control group received conventional instruction consisting of teacher demonstrations, explanations of movement techniques, and repetitive drill practices focusing on isolated skill execution.

Data were collected using a validated volleyball lower passing performance test adapted from previous studies. The instrument demonstrated satisfactory psychometric properties, with a validity coefficient of 0.733 and a reliability coefficient of 0.904. The assessment consisted of three performance indicators, namely passing accuracy, strength control, and movement consistency. Each indicator was assessed using a four-point rating scale ranging from one (very poor performance) to four (excellent performance), resulting in a maximum score of 12 that was subsequently converted into a 100-point scale. Data analysis was performed using IBM SPSS Statistics 30 and included descriptive statistics (mean, minimum, maximum, and standard deviation), N-Gain analysis, Shapiro–Wilk normality tests, and Levene's homogeneity tests. Hypothesis testing was conducted using Paired Sample t-tests to examine within-group improvements and Independent Sample t-tests to compare posttest outcomes between groups at a significance level of  $\alpha = 0.05$ . To determine the practical magnitude of the intervention effect, effect size analysis using Cohen's *d* was additionally calculated and interpreted according to established criteria.

## Results and Discussions

This study was conducted to examine the effectiveness of the Games Based Learning model in improving the volleyball lower passing skills of Grade X students at SMKN 1 Solok Selatan. A quasi-experimental design involving an experimental group and a control group was employed to compare learning outcomes before and after the intervention. Data were collected through pretest and posttest assessments covering three key performance indicators: passing accuracy, strength control, and movement consistency. The results are presented through descriptive statistics, indicator-based analyses, assumption testing, and hypothesis testing to provide a comprehensive overview of the impact of the Games Based Learning model on students' lower passing performance. Overall, the findings indicate that students who participated in Games Based Learning demonstrated greater improvements in lower passing skills than those who received conventional instruction, as reflected in higher posttest scores, N-Gain values, and statistical significance tests.

**Table 1.** Descriptive Statistics of Pretest, Posttest, and N-Gain Scores

Group	N	Pretest Mean ± SD	Posttest Mean ± SD	N-Gain Mean ± SD	Improvement (%)
Experimental (Games Based Learning)	35	36.57 ± 11.44	68.11 ± 17.25	0.5191 ± 0.2548	86.25
Control (Conventional Learning)	34	36.15 ± 9.07	54.76 ± 13.86	0.2922 ± 0.1964	51.51

Table 1 presents the descriptive statistics of students' lower passing skills before and after the intervention. The experimental group and control group showed relatively equivalent baseline abilities, with mean pretest scores of 36.57 and 36.15, respectively. Following the intervention, the experimental group that received the Games Based Learning model achieved a substantially higher mean posttest score (68.11) than the control group (54.76). The experimental group also demonstrated a higher average N-Gain (0.5191; moderate category) compared to the control group (0.2922; low category). Furthermore, the percentage improvement in the experimental group reached 86.25%, while the control group improved by only 51.51%, indicating the superior effectiveness of the Games Based Learning model in enhancing volleyball lower passing skills.

**Table 2.** Comparison of Lower Passing Skill Indicators Between Groups

Indicator	Group	Pretest Mean	Posttest Mean	N-Gain	Category
Passing Accuracy	Experimental	35.56	66.44	0.4792	Moderate
Passing Accuracy	Control	34.44	49.78	0.2340	Low
Strength Control	Experimental	37.56	70.56	0.5285	Moderate
Strength Control	Control	36.11	52.00	0.2487	Low
Movement Consistency	Experimental	36.56	67.33	0.4850	Moderate
Movement Consistency	Control	35.56	50.67	0.2345	Low

Table 2 summarizes the improvement of lower passing skills across the three assessment indicators. In all indicators, the experimental group outperformed the control group. The highest improvement in the

experimental group was observed in the strength control indicator (N-Gain = 0.5285), followed by movement consistency (N-Gain = 0.4850) and passing accuracy (N-Gain = 0.4792), all classified within the moderate category. Conversely, all indicators in the control group remained within the low category, with N-Gain values ranging from 0.2340 to 0.2487. These findings indicate that the Games Based Learning model consistently provided greater benefits in developing students' technical and motor aspects of volleyball lower passing performance.

**Table 3.** N-Gain Comparison Across Assessment Indicators

No.	Assessment Indicator	Experimental N-Gain	Category	Control N-Gain	Category
1	Passing Accuracy	0.4792	Moderate	0.2340	Low
2	Strength Control	0.5285	Moderate	0.2487	Low
3	Movement Consistency	0.4850	Moderate	0.2345	Low
Average	Overall	0.5191	Moderate	0.2391	Low

Table 3 provides a comprehensive comparison of N-Gain values across all assessment indicators. The Games Based Learning model produced moderate learning gains across every indicator, whereas conventional instruction resulted in low gains. Strength control recorded the highest improvement in the experimental group, suggesting that game-based activities effectively developed students' ability to regulate force and coordinate body movements during passing actions. Overall, the Games Based Learning model generated more consistent and meaningful improvements than conventional instruction in all aspects of volleyball lower passing skills.

**Table 4.** Normality Test Results (Shapiro–Wilk)

Group	Variable	N	Sig.	Distribution
Experimental	Pretest	35	<0.001	Not Normal
Experimental	Posttest	35	0.385	Normal
Experimental	N-Gain	35	0.783	Normal
Control	Pretest	34	<0.001	Not Normal
Control	Posttest	34	0.232	Normal
Control	N-Gain	34	0.068	Normal

The Shapiro–Wilk normality test revealed that pretest data in both groups were not normally distributed ( $p < 0.05$ ). However, the posttest and N-Gain data in both groups showed significance values greater than 0.05, indicating normal distributions. Since the primary analyses focused on posttest and N-Gain scores, the assumption of normality was satisfied, allowing further parametric statistical analyses.

**Table 5.** Assumption and Hypothesis Testing Results

Analysis	Variable	F/t Value	df	Sig. (2-tailed)	Decision
Levene's Test	Posttest Scores	0.851		0.360	Homogeneous
Levene's Test	N-Gain Scores	1.798		0.185	Homogeneous
Paired Sample t-Test (Experimental Group)	Pretest vs Posttest	-13.834	34	<0.001	Significant
Paired Sample t-Test (Control Group)	Pretest vs Posttest	-8.748	33	<0.001	Significant
Independent Sample t-Test	Posttest Scores	3.503	67	<0.001	Significant Difference

Table 5 presents the results of assumption and hypothesis testing. The Levene's test indicated that both posttest scores ( $F = 0.851$ ,  $p = 0.360$ ) and N-Gain scores ( $F = 1.798$ ,  $p = 0.185$ ) were homogeneous because the significance values exceeded 0.05. The paired sample t-test showed significant improvements in both groups. The experimental group demonstrated a highly significant increase in lower passing performance ( $t = -13.834$ ,  $df = 34$ ,  $p < 0.001$ ), with the mean score increasing from 36.57 to 68.11 and an N-Gain of 0.5191 (moderate category). The control group also showed significant improvement ( $t = -8.748$ ,  $df = 33$ ,  $p < 0.001$ ); however, its N-Gain remained in the low category (0.2922). Furthermore, the independent sample t-test revealed a significant difference between groups ( $t = 3.503$ ,  $df = 67$ ,  $p < 0.001$ ), indicating that students who received the Games Based Learning model achieved significantly better lower passing performance than those who received conventional instruction.

The findings of this study demonstrate that the Games Based Learning (GBL) model was more effective than conventional instruction in improving volleyball lower passing skills among Grade X students at SMKN 1 Solok

Selatan. The experimental group increased its mean score from 36.57 to 68.11 and achieved an N-Gain of 0.5191, which falls within the moderate category, whereas the control group improved from 36.15 to 54.76 with an N-Gain of only 0.2922 in the low category. The experimental group also recorded a higher percentage improvement (86.25%) than the control group (51.51%). The moderate N-Gain value indicates that GBL generated meaningful learning improvements and facilitated better mastery of lower passing skills than conventional instruction. These findings suggest that learning activities integrated into modified game situations provide richer opportunities for technical practice and contextual learning than repetitive drill-based approaches (Karisman & Supriadi, 2022; Utami et al., 2022).

The significant improvement in the experimental group was supported by the paired sample t-test results, which showed a highly significant difference between pretest and posttest scores ( $t = -13.834$ ;  $p < 0.001$ ). Although the control group also improved significantly ( $t = -8.748$ ;  $p < 0.001$ ), the magnitude of improvement remained considerably lower. The relatively equivalent pretest means between groups (36.57 and 36.15) indicate that both groups began the intervention with comparable lower passing abilities. The greater improvement observed in the experimental group suggests that learning environments requiring students to perform techniques repeatedly within meaningful game contexts may facilitate more effective motor learning and skill transfer than isolated technical exercises (Aini, 2021; Nasution et al., 2025).

The independent sample t-test further confirmed the effectiveness of GBL, revealing a significant difference between groups ( $t = 3.503$ ;  $df = 67$ ;  $p < 0.001$ ). This finding supports previous studies reporting that game-based pedagogies improve students' learning outcomes by promoting active participation and contextualized learning experiences. During modified games, students are continuously exposed to game situations that require them to perform lower passing techniques while simultaneously responding to environmental and tactical demands. Such learning conditions are likely to encourage a deeper understanding of movement execution and improve students' engagement in the learning process, thereby producing better learning outcomes than teacher-centered instruction (Jufri et al., 2026; Kharisma et al., 2025).

Analysis of individual skill indicators demonstrated that strength control exhibited the highest improvement in the experimental group, with an N-Gain of 0.5285 and an increase in mean scores from 37.56 to 70.56. The control group, in contrast, achieved an N-Gain of only 0.2487. This finding indicates that modified game activities provided students with more opportunities to regulate passing force according to different playing situations. Furthermore, passing accuracy improved from 35.56 to 66.44 with an N-Gain of 0.4792, compared with only 0.2340 in the control group. The contextual characteristics of modified games likely encouraged students to continuously adjust body position and ball contact while directing passes toward target areas. These findings are consistent with previous studies showing that game-centered instruction contributes positively to the development of technical performance in volleyball learning (Endriani et al., 2022; Pratama et al., 2023; Suyatno et al., 2023; Y. D. Saputra, 2026).

Movement consistency also improved considerably in the experimental group, with mean scores increasing from 36.56 to 67.33 and an N-Gain of 0.4850, whereas the control group achieved an N-Gain of only 0.2345. This result suggests that repeated skill execution within varied game situations enabled students to perform lower passing techniques more consistently. Similar findings have been reported in previous studies indicating that contextual and varied learning experiences support the development of stable movement patterns and improve volleyball performance (R. B. Saputra & Nasrulloh, 2023; Syaleh et al., 2026). Although the present study did not directly measure movement retention or behavioral adaptation during learning activities, the improvement across all indicators suggests that GBL provided learning experiences that were sufficiently meaningful to facilitate better technical performance.

The present study provides empirical evidence that Games Based Learning can serve as an effective pedagogical approach for improving volleyball lower passing skills among vocational high school students. The moderate overall N-Gain achieved by the experimental group across all indicators, compared with the low gains observed in the control group, demonstrates the comprehensive benefits of integrating modified games into physical education instruction. Beyond improving technical outcomes, GBL creates learning environments that encourage active participation and contextual skill application. Nevertheless, these findings should be interpreted with caution because the intervention was conducted over only three instructional sessions and involved students from a single vocational high school. Therefore, future studies should employ longer intervention periods, involve more diverse educational settings, and include additional process measures to obtain a more comprehensive understanding of the mechanisms through which Games Based Learning contributes to skill development (Astuti et al., 2025; Nurodin et al., 2024).

## Conclusions

Based on the findings of this study, it can be concluded that the Games Based Learning model is more effective than conventional instruction in improving volleyball lower passing skills among Grade X students at SMKN 1 Solok Selatan. The implementation of Games Based Learning significantly enhanced students' passing accuracy, strength control, and movement consistency, as evidenced by a moderate N-Gain score (0.5191) and significantly higher posttest performance compared to the control group. These findings indicate that learning activities integrated into modified game situations provide more meaningful and contextual experiences for skill acquisition than traditional drill-based approaches. Therefore, Games Based Learning can be recommended as an innovative and student-centered instructional model for improving volleyball learning outcomes in physical education, particularly at the vocational high school level.

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