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Improving Long Jump Learning Through The Modification of Learning Tools

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ABSTRACT
Problems in teaching the squat long jump in elementary schools indicate that student learning outcomes are still relatively low, particularly in the run-up, take-off, flight, and landing phases. The limited variety of learning methods and the inadequate use of media or aids result in limited student understanding of technique and low learning motivation. This study aims to analyze improvements in squat long jump learning outcomes through modified learning tools combined with a drill method approach among students at SDN 3 Mandalasari. This study used a quantitative method with a One Group Pretest-Posttest design. The sample consisted of 20 students who were given drill training supported by modified media using used tires as visual aids and movement targets. Data collection techniques were conducted through observation, pretests, and posttests. Data analysis used descriptive statistics, the Shapiro-Wilk normality test, and a paired sample t-test. The results showed an increase in the average score from 78.00 in the pretest to 87.90 in the posttest, a difference of 9.90 points. The t-test results showed a significance value of 0.000 ($p < 0.05$), indicating a significant improvement after the application of the drill method combined with modified learning tools. Thus, it can be concluded that the drill-based learning approach integrated with tool modification is effective in improving elementary school students' squat style long jump learning outcomes.

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INTRODUCTION

Learning is a systematic process involving intellectual, physical, and mental activities to produce positive behavioral changes in students. This process is not limited to listening and note-taking but also includes observation, hands-on practice, reflection, and contextual problem-solving (Warsihna, 2012). In this context, Physical Education (PE) plays a strategic role because it provides a platform for developing motor skills, physical fitness, and character building through planned and structured physical activity (Kohl et al., 2013; Bessa et al., 2021). Conceptually, sport is understood not only as skill-based physical activity but also as an integrative medium that develops the physical, cognitive, affective, and social aspects of students (Fu et al., 2025).

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Maintaining health through regular physical activity has been shown to contribute to optimizing metabolic function and neuromotor development in school-age children (Popovic et al., 2025; Safitri et al., 2024). Therefore, basic athletics instruction in elementary schools provides a crucial foundation for building physical literacy and long-term physical readiness (Chu et al., 2022). One of the core topics in the elementary school Physical Education (PJOK) curriculum is the squat-style long jump, which aims to develop leg muscle strength, motor coordination, balance, and technical precision during the run-up, take-off, flight, and landing phases.

However, initial observations at SDN 3 Mandalasari indicate that most students have difficulty understanding and correctly practicing the basic squat-style long jump technique. Preliminary data indicate that learning outcomes remain below the Minimum Completion Criteria (KKM), with a low percentage of completion. This problem is exacerbated by the dominance of traditional demonstration approaches that lack adaptive learning media. Teachers tend to use standard athletic equipment, which can be psychologically intimidating for elementary school students and is disproportionately inappropriate for their physical characteristics (Bessa et al., 2021; Chu et al., 2022). This condition results in low motivation, passive participation, and the emergence of fear during the push-off and landing phases. These issues emphasize that the primary issue in this research is not simply low learning outcomes, but also the suboptimal learning design that adapts to the developmental characteristics of elementary school children.

Over the past decade, research in sports pedagogy has emphasized the importance of innovative, student-centered, and modification-based learning approaches (Afrouzeh et al., 2020; Brocken et al., 2020). Modification in the context of sports learning is defined as the process of adapting tools, rules, and the learning environment to suit the developmental needs of students (Sakti Adji & Wibowo, 2023).

Modification approaches have been shown to increase motor engagement, confidence, and the effectiveness of basic technique learning in various sports (Bessa et al., 2021; Afrouzeh et al., 2020). In the context of elementary athletics, the use of visual aids and specific targets has been shown to improve takeoff movement patterns and enhance postural control upon landing (Chu et al., 2022). Neuromotor learning-based studies also show that concrete visual stimuli can accelerate the development of intersegmental coordination in elementary school-aged children (Popovic et al., 2025). Empirically, modifications to learning tools, such as the use of flexible markers, colored landing zones, and soft materials, increase students' sense of safety and reduce movement anxiety (Brocken et al., 2020). Furthermore, this approach aligns with the ecological dynamics concept, which emphasizes the importance of the interaction between the individual, the task, and the environment in developing motor skills (Fu et al., 2025).

In a national context (indexed in SINTA journals), research related to modifications to learning tools in Physical Education and Health (PJOK) has shown significant improvements in learning outcomes for basic techniques, intrinsic motivation, and active participation in elementary school students (Sakti Adji & Wibowo, 2023; Safitri et al., 2024). However, most of this research focuses on ball games and has not specifically examined the implementation of equipment modifications in teaching the squat long jump at the elementary school level. Therefore, theoretically and empirically, modifications to learning tools have a strong scientific basis as a strategy to improve the quality of learning basic athletic techniques.

Although international and national literature demonstrates the effectiveness of modified approaches in sports learning, several significant research gaps remain. First, most studies focus on increasing motivation or engagement, but have not integrated a comprehensive analysis of improving mastery of biomechanical techniques in the simultaneous takeoff, takeoff, flight, and landing phases. Second, research examining the use of simple media based on recycled materials—such as used tires—as aids in long jump learning is still very limited. However, the use of locally available media is highly relevant in the context of elementary schools in Indonesia, which have limited facilities (Safitri et al., 2024). Third, there are few studies testing the effectiveness of modified learning tools in elementary school contexts using a structured and measurable quasi-experimental approach based on long jump technique learning outcome indicators. Fourth, the existing literature tends not to integrate pedagogical perspectives, child sports psychology, and basic biomechanical principles within a single, integrated analytical framework. In other words, there is still a need for research that links innovations in learning media with improvements in movement technique in an objective and measurable manner. This gap demonstrates the urgency of research that not only tests the effectiveness of modified learning tools but also systematically documents their impact on improving long jump technique based on empirical data.

Based on these research issues and gaps, this study aims to analyze and test the effectiveness of modified learning tools—specifically the use of used tires as a training medium—in improving learning outcomes in the squat style long jump among students at SDN 3 Mandalasari. Specifically, this study aims to: Improve mastery of basic long jump techniques (run-up, take-off, flight, and landing). Increase the percentage of students completing learning according to the Minimum Competency (KKM). Increase student active participation and motivation in athletics learning.

The novelty of this research lies in: The integration of modified tools based on used materials (used tires) as a contextual and economical learning medium. An analytical approach that combines the perspectives of sports pedagogy, basic biomechanics, and child development psychology. Empirically testing the effectiveness of equipment modifications in the context of elementary school long jump learning, a previously understudied topic. Contributions to an adaptive athletics learning model that can be replicated in schools with limited facilities. Thus, this research not only offers a practical solution to the low long jump learning outcomes at SDN 3 Mandalasari, but also provides a theoretical contribution to the development of a safer, more engaging, and more effective physical education (PJOK) learning model based on equipment modifications. More broadly, the findings of this study are expected to enrich the literature on sports pedagogy and support a more inclusive and contextual transformation of basic athletics learning in Indonesian elementary schools.

METHODS

This study used a quantitative approach with a One Group Pretest-Posttest Design, which falls into the pre-experimental design category. This design involves one group of subjects receiving a treatment without a control group (Sugiyono, 2013). This model is widely used in physical education research to evaluate the effectiveness of learning interventions based on modifications to specific tools or pedagogical approaches (Bessa et al., 2021; Afrouzeh et al., 2020). Conceptually, a pretest-posttest design allows researchers to directly measure changes in ability before and after treatment, thereby empirically identifying the impact of the intervention (Thomas, Nelson, & Silverman, 2015; Cohen et al., 2018). The intervention in this study involved the application of drill training methods combined with modified learning tools using used tires as the push-off medium and visual targets for the hovering phase. The drill approach is effective in improving the consistency of basic movement techniques through structured repetition (Chu et al., 2022), while equipment modifications have been shown to increase motivation and a sense of security in elementary school students (Brocken et al., 2020; Sakti Adji & Wibowo, 2023).

The study population consisted of all 20 second-grade students at SDN 3 Mandalasari. Given resource limitations and the study's focus on students who had not yet optimally mastered long jump technique, a purposive sampling technique was used. This technique was chosen because it allowed researchers to determine the sample based on specific characteristics relevant to the study's objectives (Etikan & Bala, 2017). The sample size was 10 students, with the following criteria: (1) not yet achieving the Minimum Competency (KKM) for long jump material, (2) actively participating in learning, and (3) willing to participate in the entire intervention series. This approach aligns with research on small-scale physical education interventions that focus on improving specific motor skills (Safitri et al., 2024; Popovic et al., 2025).

The instrument used was a squat long jump skills test based on a technical assessment rubric. The assessment covered four main aspects: prefix/run-up, rejection/take-off, floating/flight, and landing. Each aspect had four indicators with a scoring range of 1–4. The instrument's content validity was verified by consulting with a physical education (PJOK) expert and referring to the basic biomechanical principles of the long jump (Cohen et al., 2018; Chu et al., 2022).

Table 1.
Long Jump Skills Assessment Instrument

Aspects Assessed	Assessment Criteria	Score (1–4)
Start	10–15 steps, controlled acceleration, increasing speed, looking ahead	1–4
Push-Off	Using the strongest leg, before the takeoff board, optimal joint extension, correct push-off sequence	1–4
Flying	Body upright, feet parallel, off the sand, preparing for landing	1–4
Landing	Both feet parallel, knees flexed, arms forward, body leaning forward	1–4

The maximum total score is 16, which is then converted to a 100-point scale for learning outcome analysis.

Data was collected through four main techniques: (1) Structured Observation; Using a rubric-based observation sheet to ensure objectivity in technique assessment (Brocken et al., 2020). Teachers also used video demonstrations of correct techniques to reinforce students' visual understanding, (2) Pretest; Conducted before the intervention to measure students' initial abilities and ensure the homogeneity of the initial data (Thomas et al., 2015), (3) Posttest; Conducted after the intervention for 6 weeks (twice per week). The posttest aimed to identify changes in learning outcomes due to the treatment, and (4) Documentation; In the form of photo and video recordings during the learning process to support data validity and technique reflection (Afrouzeh et al., 2020).

Data analysis was conducted in stages:

1. Descriptive Statistics; Calculating the mean, standard deviation, highest, and lowest scores to illustrate the trend of learning outcomes (Cohen et al., 2018).
2. Normality Test (Shapiro-Wilk); Chosen due to the small sample size ($n < 30$). Decision criteria: Significant difference (Significant difference) > 0.05 = normal data; Significant difference (Significant difference) < 0.05 = abnormal data (Ghasemi & Zahediasl, 2016).
3. Hypothesis Testing (Paired Sample t-Test); Used to determine significant differences between pretest and posttest scores within the same group (Field, 2018).

The significance level was set at $\alpha = 0.05$. In addition, the Effect Size (Cohen's d) was also calculated to determine the strength of the intervention's influence, which was categorized as small (0.2), medium (0.5), and large (≥0.8) (Lakens, 2017).

RESULTS AND DISCUSSION

Result

Descriptive Analysis

A descriptive analysis was conducted to describe the students' long jump abilities before and after the implementation of the modified learning tools. The results of the data processing for 20 students are shown in Table 2 below.

Table 2.
Descriptive Statistics

	Minimum	Maximum	Sum	Mean	Standard Deviation
Pretest	4	14	169	8.45	2.012
Posttest	9	16	238	11.90	2.049

Based on Table 2, the average pretest score for students was 8.45, with a minimum score of 4 and a maximum score of 14. This indicates that before the intervention, long jump technique mastery was still low, and there was considerable variation in ability between students. The standard deviation of 2.012 indicates a difference in ability, but still within a reasonable range.

After receiving treatment with modified equipment (used tires as the takeoff medium and visual targets), the average posttest score increased to 11.90, with a minimum score of 9 and a maximum score of 16. This represents an average increase of 3.45 points. The posttest standard deviation of 2.049 indicates that the distribution of scores remained stable, but overall there was an improvement in technical ability across all phases of the movement (run, takeoff, flight, and landing).

To clarify the increase in average scores, the following is a comparison diagram of the pretest and posttest.

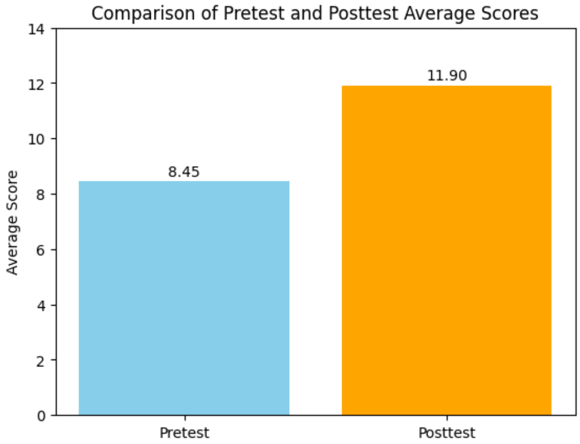

Figure 1.
Comparison of Pretest and Posttest average scores

A color bar chart has been displayed, showing a visual and proportional comparison of the average scores of Pretest (8.45) and Posttest (11.90).

Normality Test

The Shapiro-Wilk test was performed because the sample size was less than 30. The results of the normality test are shown in Table 3.

Table 3.
Normality Test (Shapiro-Wilk)

	Statistic	df	Sig.
Pretest	.937	20	.206
Posttest	.970	20	.746

The significance value for the pretest was 0.206 and for the posttest was 0.746. Since all Sig. values are > 0.05, it can be concluded that the data are normally distributed. Therefore, the assumptions for using parametric tests are met.

Homogeneity Test

The homogeneity test was conducted using Levene's Test to ensure equality of variance between the pretest and posttest data.

Table 4.
Homogeneity Test (Levene's Test)

Levene Statistic	df1	df2	Sig.
0.184	1	38	0.671

The significance value is 0.671 > 0.05, thus concluding that the data variance is homogeneous. With the assumptions of normality and homogeneity met, the analysis can proceed with parametric hypothesis testing.

Hypothesis Testing (Paired Sample t-Test)

The paired sample t-test was used to determine significant differences between pretest and posttest scores.

Table 5.

Paired Sample t-Test

	Mean	Std. Dev	Std. Error	Lower	Upper	t	df	Sig. (2-tailed)
Pretest-Posttest	3.450	.826	.185	3.064	3.836	18.689	19	.000

The test results showed a significance value (Sig. 2-tailed) of 0.000 < 0.05, indicating a significant difference between the pretest and posttest. The t-test value of 18.689 with df = 19 indicates that the improvement was not due to chance, but rather to the treatment.

The 95% confidence interval (3.064 – 3.836) was entirely in the positive range and did not cross zero, thus strengthening the evidence of significant improvement.

Summary of Score Improvements

Table 6.

Average Score Improvements

Components	Value
Pretest Average	8.45
Posttest Average	11.90
Improvement	3.45

Overall, the analysis results indicate that long jump instruction through equipment modification significantly improved students' abilities. This improvement was not only evident in the average scores but also supported by significant statistical test results. Thus, the intervention of modifying learning equipment was proven effective in improving long jump learning outcomes for students at SDN 3 Mandalasari, both empirically and statistically.

Discussion

The results of the study indicate that the implementation of modified learning tools for the squat long jump had a significant impact on improving the learning outcomes of students at SDN 3 Mandalasari. The increase in the average score from 8.45 (pretest) to 11.90 (posttest), a difference of 3.45 points, confirms the pedagogical and statistical effectiveness of the intervention. The paired sample t-test significance value of 0.000 (<0.05) and the 95% confidence intervals, all in the positive range (3.064–3.836), confirm that the improvement was not due to chance, but rather to the structured treatment.

Conceptually, these findings align with motor learning theory, which states that mastery of basic motor skills requires systematic and meaningful repetition (Lorås, 2020; Dapp et al., 2021). The drill method used in this study enabled students to consistently repeat the movement patterns of the approach, takeoff, takeoff, and landing, thus developing more stable neuromuscular coordination. In the context of elementary school physical education, a structured training approach has been shown to improve technical consistency and motor control (Kurniawati, Arifin, & Nurparisi, 2025; Afrouzeh et al., 2020).

Improved technical skills in each phase of the long jump are an important indicator of intervention success. In the takeoff phase, students demonstrated more controlled acceleration and a more stable stride rhythm. This was supported by the use of an old tire as a visual boundary and step target, which helped students understand the step pattern concretely. Recent studies have shown that concrete visual stimuli can accelerate the development of intersegmental coordination in elementary school-aged children (Moon & Lee, 2025; Popovic et al., 2025).

In the takeoff phase, improvements were seen in the use of the dominant leg and more optimal extension of the ankle, knee, and hip joints. Biomechanical principles state that the effectiveness of the takeoff is greatly influenced by triple extension coordination (ankle-knee-hip) (Chu et al., 2022). With the visual target from the modified media, students gained more confidence in executing a maximum push without fear. This is consistent with the findings of Brocken et al. (2020), who stated that modifying the learning environment can reduce movement anxiety in children.

The hovering and landing phases also showed significant improvement. Before the intervention, most students had difficulty maintaining balance while hovering and often landed in unstable positions. After using the modified media, students were better able to maintain an upright posture and land with both feet parallel. This improvement supports ecological dynamics theory, which emphasizes the importance of the interaction between the individual, the task, and the environment in developing motor skills (Davids et al., 2016; Fu et al., 2025). The modified media acted as task constraints, helping students adapt their movements to the demands of the task.

The results of the normality test (Sig. pretest = 0.206; Sig. posttest = 0.746) indicated that the data were normally distributed, allowing parametric analysis to be used. This strengthens the validity of the findings because statistical assumptions were met (Field, 2018; Ghasemi & Zahediasl, 2016). Furthermore, the t-test value of 18.689 indicates a very strong intervention effect. In relation to the concept of effect size (Lakens, 2017), a mean difference of 3.45 with a relatively small standard deviation indicates a significant influence on improving technical skills.

Pedagogically, these results reinforce the view that elementary school-aged children understand material more easily through direct experience and concrete aids (Muzizat et al., 2023; Bessa et al., 2021). Learning based solely on teacher demonstrations without supporting media tends to make students passive and less engaged. Conversely, the use of modified media creates a more interactive, challenging, and enjoyable learning experience. Students' intrinsic motivation increases because they feel safer and more capable of successfully completing movement tasks. Competence motivation theory states that early success in performing physical tasks can increase self-confidence and active participation (Ryan & Deci, 2020).

This study's findings are also relevant to SINTA-indexed national literature, which emphasizes the importance of teacher creativity in utilizing simple tools to improve the quality of physical education (PJOK) learning (Sakti Adji & Wibowo, 2023; Safitri et al., 2024). In the context of schools with limited resources, innovations based on local resources are a realistic and sustainable solution. The use of used tires in this study demonstrates that effective learning does not always depend on expensive facilities, but rather on appropriate pedagogical design.

Furthermore, the tool modification approach supports the concept of physical literacy, which is the development of competence, self-confidence, and motivation for lifelong active movement (Whitehead, 2019; Fu et al., 2025). With positive learning experiences at an early age, students have a greater chance of maintaining long-term physical activity habits. From a motor development perspective, repeated practice combined with concrete visual feedback helps accelerate the process of motor engram formation—the formation of permanent movement patterns in the nervous system (Lorås, 2020; Dapp et al., 2021). This explains why the improvements were not merely temporary but consistent across nearly all students.

Although the study results show a significant effect, there are several limitations. First, the study design did not include a control group, so comprehensive comparisons between treatments could not be conducted. Second, the sample size was relatively small, so the generalizability of the findings is still limited to the context of SDN 3 Mandalasari. The literature on educational research methodology suggests the use of quasi-experimental designs with control groups to increase external validity (Cohen et al., 2018; Thomas et al., 2015). Therefore, further research is recommended to involve larger samples and compare various types of learning tool modifications to obtain a broader picture of effectiveness.

Overall, the results of this study confirm that learning tool modifications in the squat long jump significantly improve student learning outcomes. The integration of drill methods and concrete media based on local resources has proven effective in improving mastery of the approach, takeoff, flight, and landing techniques. These findings reinforce the urgency of pedagogical innovation in Physical Education (PJOK) learning and provide an empirical contribution to the development of adaptive athletics learning models in elementary schools.

CONCLUSION

Based on the results of the study, using a One Group Pretest–Posttest design, it can be concluded that the use of modified learning tools, including used tires and cardboard, combined with the drill method, proved effective in improving learning outcomes in the squat style long jump among students at SDN 3 Mandalasari. Descriptively, there was an increase in the average score from 8.45 in the pretest to 11.90 in the posttest, a difference of 3.45 points. Furthermore, the minimum score increased from 4 to 9 and the maximum score from 14 to 16, indicating overall improvement in ability.

The results of the paired sample t-test showed a significance value of 0.000 (<0.05) with a t-value of 18.689 and a 95% confidence interval (3.064–3.836), all of which were in the positive range. This confirms that the improvement was significant and not due to chance, but rather a result of the implementation of the modified learning tools.

Technically, improvements were seen in the approach, takeoff, flight, and landing phases. Tool modifications provide a more concrete, safe, and engaging learning experience, thereby increasing student motivation, active participation, and motor skills. Therefore, tool modification-based innovations are suitable for implementation in elementary school physical education (PJOK) learning.

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