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Original Article Research

The Effect of Modified Basketball Games on the Locomotor Skills of Junior High School Students

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Abstract

The growing importance of locomotor skills in physical education has led to a need for more engaging and effective teaching strategies. This study aims to examine the effect of modified basketball games on the locomotor skills of junior high school students. A pre-experimental design with a single-group pre-test and post-test design was used in this study. Thirty-eight-grade students from Class VIII-A at SMP Negeri 47 Surabaya were selected as participants using purposive sampling. The game modification involved an 8-on-8 format combined with a maximum of 5 dribbles per possession before a pass could be made. Data were collected using an observation instrument consisting of 18 valid items ($\alpha = 0.883$) rated on a five-point Likert scale. Normality of the data was assessed using the Shapiro–Wilk test for pre-test data ($W = 0.970$, $p = 0.531$) and post-test data ($W = 0.931$, $p = 0.053$). A paired-sample t-test revealed a statistically significant improvement ($t = -3.71$, $df = 29$, $p < 0.001$), with the mean score increasing from 80.0 (SD = 9.79) to 88.8 (SD = 14.5). These findings indicate that modifications to the basketball game significantly improve students' locomotor skills. These game modifications can serve as an innovative and effective alternative in physical education, contributing to a more dynamic and participatory learning experience for junior high school students.

Keywords: basketball modification; dribble restriction; locomotor movement; physical education; junior high school

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1. INTRODUCTION

Locomotor movement skills are a fundamental component of motor development, encompassing running, jumping, hopping, single-leg stepping, skipping, and side-sliding. Globally, various studies have documented a decline in proficiency in basic motor skills among school-aged children, raising concerns about physical literacy and long-term health outcomes (Khudair et al., 2022; Lubans et al., 2010). Locomotor competence is not only related to physical fitness but also to cognitive development, social interaction, and academic engagement (Robinson et al., 2015). (World Health Organization, 2020) has emphasized the importance of structured physical activity during adolescence, underscoring the urgency of addressing motor skill deficits in the school-age population.

In Indonesia, the development of locomotor skills among junior high school students remains an area requiring greater attention. Research conducted in various regions of Indonesia has found that the majority of students exhibit suboptimal locomotor skills, partly due to limited opportunities for physical activity and a lack of variety in teaching methods in physical education (Listyana et al., 2025; Mansur et al., 2024). Inadequate mastery of locomotor skills can hinder students' ability to participate effectively in sports and is associated with reduced physical activity during adolescence (Fathihah, 2024). This situation calls for contextual and evidence-based learning approaches to stimulate the development of locomotor competencies in the school environment.

The modified games approach has emerged as a promising strategy for promoting the development of locomotor skills in students. Game modification refers to the systematic adaptation of standard game rules, equipment, spatial constraints, or player configurations to better align with students' developmental characteristics (Muzizat et al., 2023). Evidence from various studies confirms that modified games increase students' active engagement and effective learning time, both of which are essential prerequisites for the acquisition of motor skills (Hakim et al., 2025; Prastyana & Utomo, 2022). Modified sports games, in particular, have been shown to provide the contextual and varied training conditions necessary for the transfer and refinement of locomotor patterns (Dewi, 2023; Paramesthi et al., 2022).

Preliminary observations conducted at SMP Negeri 47 Surabaya revealed that physical education classes often employ conventional methods with limited variation, resulting in low student participation and a lack of opportunities to practice locomotor skills. During basketball lessons, many students stood still for extended periods, with ball possession concentrated on only a few individuals. This pattern limits the frequency and variety of locomotor movements available to most students. Teachers expressed a need for structured game modifications that can distribute participation more evenly and maximize locomotor activity time for all students during instruction.

The gap between current instructional practices and optimal conditions for locomotor development can be addressed through modifications to the basketball game. By increasing the number of players to an 8-on-8 format and limiting each player to a maximum of five dribbles before passing, these modifications redistribute ball contact and force students to engage in sustained locomotor movement to create passing and defensive opportunities. Basketball games with limited player numbers and specific rules have been shown to increase locomotor demands, aerobic workload, and tactical engagement in young players (Cao et al., 2024; Liu & Li, 2025). Dribble restrictions, in particular, have been identified as an effective constraint for shifting

players' behavior from individual ball manipulation toward spatial exploration and team movement (Bujangga et al., 2025).

Although evidence supporting the effectiveness of game-based modifications in physical education continues to grow, empirical studies specifically examining the effects of combining increased player numbers and dribble restrictions on the locomotor skills of junior high school students in Indonesia remain limited. Therefore, this study aims to investigate the effect of basketball game modifications—combining an 8-on-8 format with a five-dribble limit—on the locomotor skills of eighth-grade students at SMP Negeri 47 Surabaya. These findings are expected to contribute to the development of more creative, engaging, and effective physical education strategies in the context of junior high schools.

2. METHOD

2.1 Participants

This study involved 30 eighth-grade students from Class VIII-A at SMP Negeri 47 Surabaya as research participants. The participants consisted of 30 students aged 13 to 14 years enrolled in junior high school, comprising both male and female students who actively participated in regular physical education classes. All students were in good health and had no physical limitations that could hinder their participation in the intervention. Purposive sampling was used as the sampling technique, taking into account subject availability and class group homogeneity. Since all students in the class were selected, this constituted total sampling of the available population. All participants were grouped into a single experimental group, meaning no control group was formed. The selection of Class VIII-A was based on the consideration that students at this grade level possess sufficient physical capacity to participate in the basketball game modification intervention designed in this study (Yudatama et al., 2024).

2.2 Research Design

This study employed a quantitative approach with a pre-experimental design, specifically a single-group pre-test and post-test design. This design was chosen because the study aims to assess changes in students' locomotor skills before and after the implementation of a modified basketball game intervention, without including a control group for comparison. In this study, the modified basketball game serves as the independent variable, while students' locomotor skills serve as the dependent variable. The research design can be illustrated as follows:

Figure 1.

One-Group Pre-Test and Post-Test Design Diagram

Pre-Test (O_1)	Treatment (X)	Post-Test (O_2)
Measurement of initial locomotor movement ability	Modified basketball game (8 vs 8, max 5 dribbles)	Measurement of final locomotor movement ability

Source: Research Design Adaptation (Prastyana & Utomo, 2022)

2.3 Instruments

The research instrument used was an observation sheet for locomotor skills developed based on the locomotor movement indicators proposed by (Gallahue & Ozmun, 2006), which included running, jumping, hopping, single-leg stepping, skipping, and side-sliding. An

observation grid was designed to assess each indicator in real-game situations. The initial instrument consisted of 25 items, the validity and reliability of which were tested using Jamovi version 2.7. Of these, 18 items were deemed valid and suitable for data collection (items P1, P3, P4, P5, P7, P8, P9, P11, P12, P13, P14, P15, P16, P18, P19, P21, P22, and P24). Reliability analysis using Cronbach's Alpha yielded $\alpha = 0.883$, indicating a very high level of reliability (Ulum & Arifin, 2022). Each item was rated using a five-point Likert scale (1–5), with a maximum total score of 90.

The observation rubric covers the four main dimensions of locomotor movement, as presented in Table 1. During data collection, two trained observers independently assessed each student's locomotor performance during the play session using a validated instrument.

Table 1.

Locomotor Movement Observation Grid

Dimension	Indicators Observed	No. Items	Valid Items
Running & Movement	Running technique, speed, direction change	7	P1, P3, P4, P5
Agility	Quick positional changes, dodging	6	P7, P8, P9, P11
Foot Coordination	Step rhythm, stride consistency, footwork pattern	6	P12, P13, P14, P15, P16
Reaction Speed	Response to game situations, initiation of movement	6	P18, P19, P21, P22, P24

Source: Instrument Development Based on Gallahue et al. (2012)

2.4 Procedures

The study was conducted in three systematic phases. The first phase consisted of a pre-test, in which each student's initial locomotor ability was measured using a validated observation instrument. Two trained observers independently assessed the students' performance during a 20-minute session of standardized basic activities. The pre-test data provided a baseline measurement against which the post-test scores were compared.

The second phase was the intervention, which was conducted over six sessions (approximately three weeks). Each session lasted 70 minutes and was structured as follows: (a) a 15-minute warm-up, (b) 45 minutes of modified basketball, and (c) a 10-minute cool-down and reflection. The modifications applied included: (a) increasing the number of players to 8 vs. 8 to maximize student engagement; (b) limiting each player to a maximum of five consecutive dribbles before a pass is made; and (c) maintaining the standard scoring objective of shooting the ball into the basket. The dribble limit is enforced by an observer who counts aloud, thereby forcing students to seek open space and engage in continuous locomotor movement to create passing opportunities (Bujangga et al., 2025; Liu & Li, 2025).

The third phase is the post-test, which is conducted after the final intervention session. The same instruments and procedures used in the pre-test are employed to ensure consistency in measurement. The post-test data is then compared with the pre-test scores to evaluate the impact

of the intervention on the students' locomotor skills.

2.5 Data Analysis

Data analysis was performed using Jamovi version 2.7. Descriptive statistics—including mean, median, standard deviation, minimum, and maximum—were calculated for pre-test and post-test scores. Prior to hypothesis testing, the normality of the data distribution was assessed using the Shapiro–Wilk test. The hypothesis was then tested using a paired t-test to compare the mean locomotor scores before and after the intervention. The significance level was set at $\alpha = 0.05$, with statistically significant results indicated by $p < 0.05$ (Situmorang & Nugroho, 2022).

3. RESULTS

The results of this study are presented in two sections: (1) descriptive statistics and normality test results for the pre-test and post-test data (see Table 2), and (2) results of the paired t-test (see Table 3). An overview of the central tendency and variability of the data is provided first, followed by inferential statistical analysis.

Table 2.

Descriptive Statistics of Locomotor Movement Ability

Statistic	Pre-Test	Post-Test
N	30	30
Mean	80.0	88.8
Median	79.5	85.0
SD	9.79	14.5
Minimum	64	69
Maximum	104	123
Shapiro-Wilk W	0.970	0.931
Shapiro-Wilk p	.531	.053

Source: Primary Data (Jamovi 2.7)

Table 2 presents descriptive statistics for both measurement phases. The mean pre-test score was 80.0 (SD = 9.79), with a minimum of 64 and a maximum of 104. After the intervention, the mean post-test score increased to 88.8 (SD = 14.5), with a minimum of 69 and a maximum of 123, representing an average increase of 8.8 points. The Shapiro–Wilk test indicated a normal distribution for both the pre-test data ($W = 0.970$, $p = 0.531$) and the post-test data ($W = 0.931$, $p = 0.053$), as both p-values exceeded 0.05. Additionally, the normality test on the difference scores yielded $W = 0.951$ with $p = 0.178$, confirming that the normality assumption for the paired t-test was met. After normality was verified, a paired t-test was conducted to formally test the hypothesis (see Table 3).

Table 3.

Results of Paired Samples T-Test

Variable	t	df	p
Total Pre-Test – Total Post-Test	−3.71	29	< .001

Source: Primary Data (Jamovi 2.7)

Table 3 presents the inferential statistics from the paired-sample t-test. The analysis yielded $t = -3.71$ with $df = 29$ and $p < 0.001$. Since $p < 0.05$, there is a statistically significant difference between the pre-test and post-test locomotor movement scores. Overall, the descriptive and inferential data in Table 2 and Table 3 indicate that the basketball game modification intervention produced a meaningful and statistically significant improvement in students' locomotor skills, thereby supporting the research hypothesis.

4. DISCUSSIONS

The results of this study indicate that implementing a modified basketball game format with 8-on-8 players and a limit of five dribbles per possession significantly improved the locomotor skills of eighth-grade students at SMP Negeri 47 Surabaya. The increase in the average score from 80.0 on the pre-test to 88.8 on the post-test, with a statistically significant difference ($p < .001$), indicates that this intervention not only successfully increased the students' movement frequency but also improved the overall quality of their locomotor patterns. This progress encompasses aspects of running, changes of direction, agility, and speed of movement initiation, which are core components of locomotor competence according to the motor development framework by (Gallahue & Ozmun, 2006). Theoretically, this improvement can be explained through the principle of practice variability, wherein repeated exposure to diverse and unpredictable game situations prompts the motor nervous system to form more adaptive and flexible movement patterns (Widodo et al., 2024). These findings are consistent with previous studies confirming that game-based modifications in physical education are an effective strategy for improving students' basic motor skills, particularly at the secondary school level (Dewi, 2023; Prastyana & Utomo, 2022). The significance of these findings is even more relevant given real-world conditions, where conventional physical education often fails to provide equal movement stimulation for all students, especially in team sports such as standard basketball, which tend to be dominated by students with high skill levels (Pratama et al., 2022).

The 8-on-8 player configuration has been shown to create a game environment that structurally encourages more intense and varied locomotor activity. Mechanically, increasing the number of players on the same court reduces the available space per individual, requiring each student to constantly change positions to find open space, support teammates, or defend against opponents. These conditions directly increase the frequency of running, changes of direction, and reactive movement responses during the game. (Lau et al., 2023) reported that a basketball format with greater player involvement significantly increases the volume and intensity of locomotor movement in adolescent players, with a higher average distance covered per session compared to the standard format. (Cao et al., 2024) reinforce these findings by demonstrating that small-sided basket-based games generate higher neuromuscular demands compared to ball-possession games without a target, which directly impacts the development of strength and functional movement

patterns. In the context of this study, the 8-vs-8 game condition creates what motor ecologists refer to as a "rich movement affordance"—a situation that automatically invites and stimulates various types of locomotor responses without the need for explicit instruction from the teacher (Widodo et al., 2024). Thus, modifying the number of players is not merely a technical change to the rules of the game but rather an engineering of the learning environment that systematically encourages the even locomotor engagement of all students throughout the learning session.

The rule limiting dribbling to a maximum of five times per possession is a regulation-based constraint that fundamentally alters the tactical dynamics and movement patterns of all students during the game. Without this restriction, a common tendency in standard basketball is for ball possession to be concentrated on one or two dominant players, resulting in the majority of students moving minimally and not receiving adequate physical activity. With the five-dribble limit in place, each student is forced to immediately pass the ball, which simultaneously encourages all team members to actively move to find open positions and create available passing options. This mechanism operates through what is known in sports game theory as "task constraint manipulation," where rule modifications directly reshape movement behavior without requiring verbal instructions from the teacher (Widodo et al., 2024). (Liu & Li, 2025) documented that dribble restrictions in small-sided youth basketball games significantly increased the frequency of off-ball movement, including off-ball running, positional changes, and movement into open space. (Bujangga et al., 2025) expanded on these findings by demonstrating that manipulating dribbling rules also enhances tactical decision-making and teamwork, as students must communicate their positions and coordinate movements collectively. In this study, the equalizing effect of dribble restrictions was also shown to be pedagogically meaningful, transforming the learning experience from one that previously favored students with high skills into a participatory environment that activates the locomotor movements of all participants more equitably (Syahputri et al., 2025).

From a pedagogical perspective, the combination of increasing the number of players and restricting dribbling in this study collectively creates a learning environment that is authentic, contextual, and intrinsically motivating. Unlike conventional approaches involving repetitive movement drills isolated from real-game situations, game-based modifications place every locomotor action within a meaningful context for students namely, as part of a team strategy to win the game. This condition fosters what is termed "meaningful transfer," where the motor skills developed during the intervention are not artificial but arise from authentic responses to dynamic and unpredictable game situations (Ahmad & Saputra, 2024). (Hakim et al., 2025) emphasize that pedagogically modified games generate significantly higher affective engagement compared to conventional drill-based training formats, as students do not merely move in response to instructions but move to achieve game objectives they understand and find engaging. This aligns with intrinsic motivation theory in physical education, which states that when students experience autonomy and relevance in movement activities, the intensity and consistency of their participation tend to increase significantly. Furthermore, the game modifications in this study also align with the constraints-led approach, which has proven effective in encouraging more varied and adaptive movement patterns among adolescent students (Widodo et al., 2024). These findings reinforce the emerging view in contemporary physical education literature that modified games whether based on modern sports or traditional games serve as superior learning vehicles compared to isolated exercise-based approaches in developing students' locomotor competencies (Listyana et al., 2025; Paramesthi et al., 2022). The 8.8-point increase in the average score obtained in this

study aligns with the magnitude of improvement reported in similar studies using modified basketball, ranging from 7 to 12 points, depending on the duration and intensity of the intervention provided (Hita et al., 2024; Setiawan, 2022).

Although the findings of this study provide a meaningful empirical contribution, there are several methodological limitations that must be acknowledged and taken into account when interpreting the results. First, the use of a pre-experimental design without a control group limits the study's ability to make strong claims of causality. The statistically observed improvements cannot be fully attributed solely to the basketball game modification intervention, as external variables such as students' physical activity outside of school hours, peer influence, and variations in movement experiences outside the research context cannot be strictly controlled (Ulum & Arifin, 2022). In this regard, the use of a quasi-experimental design with a control group that is comparable in characteristics would provide much stronger internal validity for claims regarding the intervention's effectiveness (Syahputri et al., 2025). Second, a sample size of 30 students from a single class in one school carries a risk of selection bias and limits the representativeness of the findings for the broader population of junior high school students. Given that the locomotor skills of junior high school students in Indonesia vary significantly based on socioeconomic background, geographic region, and the availability of school sports facilities (Pratama et al., 2022), generalizing these findings to other contexts should be done with caution. Third, the observational instruments used are subjective despite having undergone validity and reliability testing, so the possibility of inter-rater bias cannot be fully eliminated. Future research is recommended to integrate technology-based objective measurement tools, such as accelerometers or video motion tracking systems, to obtain more accurate and measurable data. Fourth, the absence of follow-up measurements after the intervention ended means that the long-term retention of the observed improvements in locomotor ability cannot be assessed. Future research should design follow-up measurements at least four to eight weeks post-intervention to evaluate the sustainability of learning effects, as well as explore the dose-response relationship between the frequency of game modifications and the resulting locomotor development.

5. CONCLUSIONS

This study shows that the implementation of a modified basketball game—using an 8-on-8 format with a limit of five dribbles per possession—resulted in a statistically significant improvement in the locomotor skills of eighth-grade students at SMP Negeri 47 Surabaya ($t = -3.71$; $df = 29$; $p < 0.001$), with the mean score increasing from 80.0 (SD = 9.79) on the pre-test to 88.8 (SD = 14.5) on the post-test. The game modification effectively stimulated more frequent and varied locomotor activity, including running, positional changes, agility responses, and movement initiation, through the combined effects of team size expansion and dribble restrictions.

These findings have practical implications for physical education teachers at the junior high school level. Modifications to the game of basketball, such as those implemented in this study, offer an alternative that is easy to implement, resource-efficient, and pedagogically sound compared to conventional teaching methods. By redistributing ball-handling opportunities and simultaneously increasing spatial and temporal demands for all students, these modifications address a common weakness of standard game formats, where opportunities to move are unevenly distributed. Teachers are encouraged to systematically incorporate game constraints as a learning tool in their lessons to promote active locomotor engagement for all students.

This study has several limitations, including its pre-experimental design, a sample drawn from a single class, and the absence of follow-up measurements. Future research should employ a quasi-experimental design with a control group, involve multiple schools and a larger sample to enhance generalizability, and incorporate longitudinal measurements to assess whether improvements in locomotor skills persist over time. Research exploring the dose-response relationship between the frequency of game modifications and the development of locomotor skills, as well as comparisons between different types of game constraints, is also needed.

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