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Training Method on the Passing Accuracy of Basketball by Modified Small-Sided Games for Physical Education Senior High School

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Abstract: This study was motivated by the low level of basketball passing accuracy among students in Physical Education classes at Senior High Schools in Magelang Regency, Central Java. Passing is a fundamental technical skill in basketball that significantly influences offensive organization and overall team performance. Therefore, this study aimed to examine the effect of Small-Sided Games (SSG) modifications, specifically the 2×2 and 4×4 formats, on students' basketball passing accuracy and to compare the effectiveness of both formats. This study employed a quasi-experimental method with a Two-Group Pretest–Posttest Design. The participants were 32 tenth-grade students selected via convenience sampling and assigned to two groups using a matched-subjects procedure based on pretest scores. The intervention was conducted over eight weeks with two training sessions per week. Passing accuracy was measured using a validated basketball passing accuracy test. Data were analyzed using descriptive statistics, Shapiro–Wilk normality tests, Levene's homogeneity tests, paired-sample t-tests, independent-sample t-tests, and Cohen's d effect size analysis. Both SSG formats significantly improved students' passing accuracy. In the 2×2 SSG group, the mean score increased from 8.8 to 16.6 ($p < 0.001$), while in the 4×4 SSG group, the mean score increased from 11.0 to 13.9 ($p = 0.008$). Furthermore, the independent-samples t-test revealed a significant difference between groups ($t = 4.55$, $p < 0.001$), indicating that the 2×2 format produced greater improvement than the 4×4 format. Effect size analysis also showed a large effect for the 2×2 group ($d = 1.84$) and a moderate-to-large effect for the 4×4 group ($d = 0.77$). Small-Sided Games training significantly improves basketball passing accuracy among high school students. However, the 2×2 format is more effective than the 4×4 format in enhancing individual technical performance, particularly passing accuracy, due to increased ball contacts and decision-making opportunities.

Keywords: accuracy, basketball, small-sided games.

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INTRODUCTION

Basketball is a sport that can be categorized as both aerobic-based and anaerobic because it requires players to perform high-intensity movements such as running, jumping, sprinting, changing direction, and reacting quickly during gameplay (Hudain et al., 2023; Islam et al., 2025; Oktavia et al., 2024). Basketball performance is influenced not only by physical conditioning but also by technical skills, tactical understanding, perceptual-cognitive ability, and decision-making under pressure. Modern basketball games demand rapid transitions between offensive and defensive situations, requiring players to maintain high levels of concentration and coordination throughout the match (S. Cao et al., 2024; Sukarmin & Jumareng, 2023; Uludağ et al., 2021). In basketball, several fundamental techniques are essential to master, including shooting, dribbling, defending, pivoting, rebounding, and passing (Chen et al., 2022; Kim & JeongJun, 2023). Among these techniques, passing is considered one of the most important technical skills because it directly influences

offensive organization, ball circulation, and team coordination during matches (Michal et al., 2025).

In offensive situations, players are required to maintain possession of the ball and collaborate effectively to create optimal scoring opportunities and improve offensive efficiency (Canuto & Bezerra de Almeida, 2022). Previous studies have shown that successful basketball teams tend to produce more assists and commit fewer turnovers than losing teams (Supola et al., 2022). According to Zhou et al. (2024), passing effectiveness is also a major indicator differentiating high- and low-performing basketball players. The ratio between passing success and passing errors significantly differentiates starting players from reserve players in both elite and amateur basketball competitions (Gomez et al., 2025). These findings indicate that passing ability contributes substantially to individual performance and overall team success throughout a competitive season.

Passing movements in basketball serve not only as a technique for transferring the ball from one player to another but also as a strategic component for maintaining offensive rhythm, creating space, and organizing tactical movement during gameplay. Accurate passing is critical because passing errors often lead to turnovers, creating counterattack opportunities for opponents (Supola et al., 2023). Research conducted by Courel-Ibáñez et al. (2016) demonstrated that accurate passing, particularly deep passing, contributes significantly to offensive continuity and scoring opportunities in professional basketball matches. In recent years, Small Sided Games (SSG)-based training methods have become popular in team sports (Castro et al., 2022; Hoffmann et al., 2014; Kristiono et al., 2024). Previous research results explained that efficient ball movement and passing precision are strongly associated with offensive effectiveness and game productivity in modern basketball (F. Clemente et al., 2023; Karahan, 2020; Sal-de-Rellán et al., 2025). Therefore, improving passing accuracy is essential not only for elite athletes but also for students involved in basketball learning activities in school settings.

However, despite the importance of passing skills, many students still have difficulty performing accurate passes during basketball learning activities. One of the primary causes is the implementation of conventional training methods that emphasize isolated technical drills without integrating realistic game situations and tactical decision-making. Such approaches often reduce student engagement and limit opportunities to apply technical skills under actual game pressure (Sansone et al., 2024). As a result, students may understand passing techniques in theory but still demonstrate poor passing accuracy in gameplay. This condition underscores the need to implement more innovative, game-based training approaches that simultaneously improve technical execution, tactical understanding, and decision-making.

One training approach that has recently gained considerable attention in team sports is the Small-Sided Games (SSG) method. Small-Sided Games are modified game formats with fewer players, adjusted playing areas, and altered rules to achieve specific learning objectives (Zhou et al., 2024). SSG-based training is widely used because it creates representative learning environments that closely resemble actual competition while increasing player involvement and the frequency of technical repetition (Feng Li et al., 2024). Ecological dynamics theory and constraints-led approaches explain that modifying constraints such as player numbers, field dimensions, and game rules can significantly influence technical behavior, tactical adaptation, and perceptual-cognitive responses during gameplay (Russell et al., 2025). Through SSG implementation, players experience more ball contact, increased technical repetitions, and

greater decision-making demands than with traditional drill-based approaches.

Previous studies have shown that Small-Sided Games training significantly improves physical endurance, technical performance, tactical awareness, and decision-making ability in various invasion sports (Huyghe et al., 2021; Alonso et al., 2024). In addition, SSG training can enhance physiological intensity, agility, reaction speed, and cognitive engagement as players continually adapt to rapidly changing game situations (Rui Dong et al., 2025). Research in basketball contexts also demonstrated that smaller game formats increase players' opportunities to perform technical actions such as passing, dribbling, and shooting because each participant interacts with the ball more frequently (Liu et al., 2025). Consequently, SSG-based training has become increasingly popular in physical education and sports coaching due to its ability to integrate technical, tactical, physical, and cognitive development simultaneously.

Several studies have investigated the influence of player-number modifications in Small-Sided Games. Research in soccer has found that smaller player configurations increase the number of technical actions each player performs, whereas larger formations tend to emphasize tactical organization and collective movement patterns (Carlsson et al., 2025; Dios-Álvarez et al., 2024). Similar findings were also identified in basketball-related studies showing that reducing the number of players increases ball possession frequency, passing repetitions, and decision-making opportunities for each player (Klingner et al., 2022; Machado et al., 2024). However, contradictory findings remain regarding the most effective SSG format for improving technical performance. Some studies have reported that smaller formats, such as 2v2, provide greater opportunities for technical repetition and skill acquisition. In contrast, other studies have suggested that larger formats, such as 4v4, facilitate tactical adaptation and collective understanding during gameplay more effectively (de Souza et al., 2024).

Although many studies have investigated the benefits of Small-Sided Games, several important gaps remain evident in the literature. First, most previous studies focused primarily on physiological responses, tactical behavior, or general technical performance rather than specifically examining passing accuracy as an isolated technical outcome. Second, limited studies have directly compared the effects of 2v2 and 4v4 Small-Sided Games formats on basketball passing accuracy, particularly among senior high school students in physical education contexts. Third, inconsistent findings on whether smaller or larger player configurations yield superior technical benefits underscore the need for further investigation. Therefore, this study aims to evaluate the effect of 2v2 and 4v4 Small-Sided Games modifications on improving basketball passing accuracy among senior high school students in Magelang Regency, Central Java.

Based on the background and research gaps described above, this study aims to determine the effect of modifications to Small-Sided Games on improving basketball passing accuracy among senior high school students. Specifically, this study compares the effectiveness of 2v2 and 4v4 Small-Sided Games formats in improving students' basketball passing accuracy. The research questions proposed in this study are as follows:

1. Does the 2v2 Small-Sided Games format significantly improve basketball passing accuracy?
2. Does the 4v4 Small-Sided Games format significantly improve basketball passing accuracy?
3. Which Small-Sided Games format provides greater improvement in basketball passing accuracy?

The hypotheses of this study are as follows:

H_1: The 2v2 Small-Sided Games format significantly improves basketball passing accuracy.
H_2: The 4v4 Small-Sided Games format significantly improves basketball passing accuracy.
H_3: The 2v2 Small-Sided Games format provides greater improvement in basketball passing accuracy compared to the 4v4 format.

METHOD

Participants

The participants in this study were 32 tenth-grade students selected from one senior high school in Magelang Regency, Indonesia. The population targeted in this research comprised senior high school students who participated in basketball activities during physical education classes. Due to accessibility considerations and the study's limited scope, the researchers employed a convenience sampling approach, selecting students who were available and willing to participate. Therefore, the findings of this study should be generalized cautiously to broader populations beyond the selected school context. The participants were then divided into two balanced groups using a matched-subjects design based on their pretest scores.

The participants were then divided into two balanced groups using a matched-subject assignment procedure based on their pretest scores. First, all participants were ranked from highest to lowest by their pretest passing accuracy score. Participants with similar scores were paired, and one participant from each pair was assigned to the 2×2 modified small-sided games group while the other was assigned to the 4×4 modified small-sided games group. This matched-pair assignment procedure was applied to ensure comparable baseline abilities between groups before the intervention.

Research Design and Procedures

This study employed a quasi-experimental method using a Two-Group Pretest–Posttest Design. The design was selected because the researchers intended to compare the effectiveness of two modified small-sided games (SSG) training methods on students' basketball passing accuracy. Before the intervention, all participants completed a pretest using the basketball passing accuracy test to determine their initial skill levels. Participants were then ranked from highest to lowest pretest score and paired based on similar performance levels. One participant from each pair was assigned to the 2×2 modified small-sided games group, and the other to the 4×4 modified small-sided games group. This matched-subject assignment procedure was used to ensure comparable baseline passing abilities between groups before the intervention.

Group A received treatment using the 2x2 modified small-sided games method, while Group B received treatment using the 4x4 modified small-sided games method. The intervention program was conducted over eight weeks, with two training sessions per week, for a total of 16 meetings. Each training session lasted approximately 90 minutes and consisted of three stages: warm-up (15 minutes), core training activities (60 minutes), and cooldown (15 minutes).

In the 2x2 modified SSG group, students practiced passing in smaller playing areas with fewer players, emphasizing frequent ball contact, rapid decision-making, short passing combinations, and close-range teamwork interactions. Meanwhile, the 4x4 modified SSG group practiced in relatively wider playing spaces involving more players, focusing on team coordination, spatial awareness, tactical passing distribution, and collaborative offensive play. Both training programs were conducted at moderate-to-high intensity under the supervision of the physical education teacher and the researchers.

To ensure comparable training loads between groups, both the 2×2 and 4×4 modified small-sided games programs were implemented using the same training frequency, session duration, number of sets, playing time, and recovery intervals throughout the intervention period. Each training session consisted of nine sets of five-minute games interspersed with two-minute rest intervals, resulting in equivalent training volume across both groups. Therefore, the primary difference between the interventions was the game format, not the amount of training exposure.

After completing the intervention program, all participants underwent a posttest using the same basketball passing-accuracy procedure to evaluate improvements in passing performance.

Instruments

The instrument used in this study was a basketball passing accuracy test adopted from previously validated assessment procedures reported in international studies (Quílez-Maimón et al., 2021; Fisek & Agopyan, 2021). No substantial modifications were made to the core testing procedures, scoring system, passing distance, or test duration. Therefore, the instrument's original validity and reliability were considered applicable to the present study. The selection of this instrument was based on previous international studies that reported acceptable validity and reliability in measuring basketball passing skills among adolescent athletes and students (Maimon et al., 2021; Fisek et al., 2021). Recent studies have emphasized the importance of assessing basketball passing skills through performance-based tasks that reflect players' ability to execute accurate passes under game-related conditions.

The assessment in this study focused on students' overall basketball passing accuracy, particularly their ability to execute accurate chest passes toward a designated target within a limited time period. The instrument generated a single composite score representing overall passing performance. This score was calculated based on the number of successful passes that hit the designated target area during the testing period, providing an overall measure of passing accuracy.

In the testing procedure, students were instructed to perform chest passes toward a target positioned 10 meters away. Each participant completed three trials, with each trial lasting 30 seconds. Every successful pass hitting the designated target area received three points, while unsuccessful passes received zero points. The final score was determined by averaging the scores across the three trials. An example of the test instruction was: "Perform as many accurate chest passes as possible toward the target within 30 seconds while maintaining proper passing technique."

The instrument's validity and reliability were supported by findings from previous international studies. Quílez-Maimón et al. (2021) reported that basketball skill assessment instruments demonstrated acceptable reliability coefficients, with coefficient variation values ranging from 4.3% to 10.2% among adolescent basketball players. In addition, Fisek and Agopyan (2021) reported that basketball passing accuracy tests demonstrated strong validity and reliability coefficients ranging from 0.84 to 0.97 when applied to youth basketball athletes. Therefore, the instrument used in this study was considered appropriate for assessing overall basketball passing accuracy among senior high school students.

Data Analysis

The data analysis in this study was conducted using IBM SPSS Statistics version 22. Descriptive statistics were first calculated to determine the mean and standard deviation of the pretest and posttest scores in each group. Before hypothesis testing, prerequisite analyses were

performed through normality and homogeneity tests. The normality of the data was assessed using the Shapiro–Wilk test. In contrast, the homogeneity test employed Levene's Test to assess the equality of variances between groups (Cho et al., 2020).

To determine the effect of the training interventions on basketball passing accuracy, paired sample t-tests were used to compare pretest and posttest scores within each group. In addition, an independent-samples t-test was conducted to compare the effectiveness of the 2x2 and 4x4 modified small-sided game methods. To complement the statistical significance testing, Cohen's d effect size was calculated to determine the magnitude of the intervention effects. According to Cohen's criteria, effect sizes were interpreted as small (d = 0.20), medium (d = 0.50), and large (d = 0.80) (Cohen, 1988). All statistical analyses used a significance level of 0.05.

The study was conducted over 16 sessions consisting of a pretest, 14 treatment sessions, and a posttest. During the initial session, participants completed measurements of hand-eye coordination, passing accuracy, body height, and weight. The treatment sessions were conducted using small-sided games (SSG) formats on a reduced basketball court. Each training session applied a game-based format consisting of nine sets of five-minute play with two-minute rest intervals between sets. The final session was conducted to reassess hand-eye coordination and passing accuracy after the treatment period.

■ RESULT AND DISCUSSION

Descriptive Statistics of Basketball Passing Accuracy Scores

Table 1 presents the descriptive statistics for basketball passing accuracy scores before and after the intervention for both groups in the modified small-sided games.

Table 1. Descriptive statistics of pretest and posttest basketball passing accuracy scores in the 2×2 and 4×4 modified small-sided games groups

Group	N	Min	Max	Mean	Standard Deviation
Pre					
SSG 2x2	16	3	15	8.8	3.6
SSG 4x4	16	3	19	11.0	4.07
Post					
SSG 2x2	16	8	27	16.6	5.0
SSG 4x4	16	8	20	13.9	3.5

The descriptive statistics presented in Table 1 indicate that both groups experienced improvements in basketball passing accuracy scores following the intervention. In the SSG 2×2 group, the mean score increased from 8.8 during the pretest to 16.6 in the posttest, representing an improvement of 7.8 points. Similarly, the SSG 4×4 group demonstrated an increase in mean score from 11.0 in the pretest to 13.9 in the posttest, reflecting an improvement of 2.9 points. These findings suggest that both modified small-sided game training methods contributed to improvements in students' basketball passing accuracy.

To provide a clearer visualization of score distributions and individual changes from pretest to posttest, scatter plots and paired-score plots were constructed for both groups.

Figure 1 illustrates the relationship between pretest and posttest scores for individual participants in both intervention groups. In the SSG 2×2 group, most data points are located

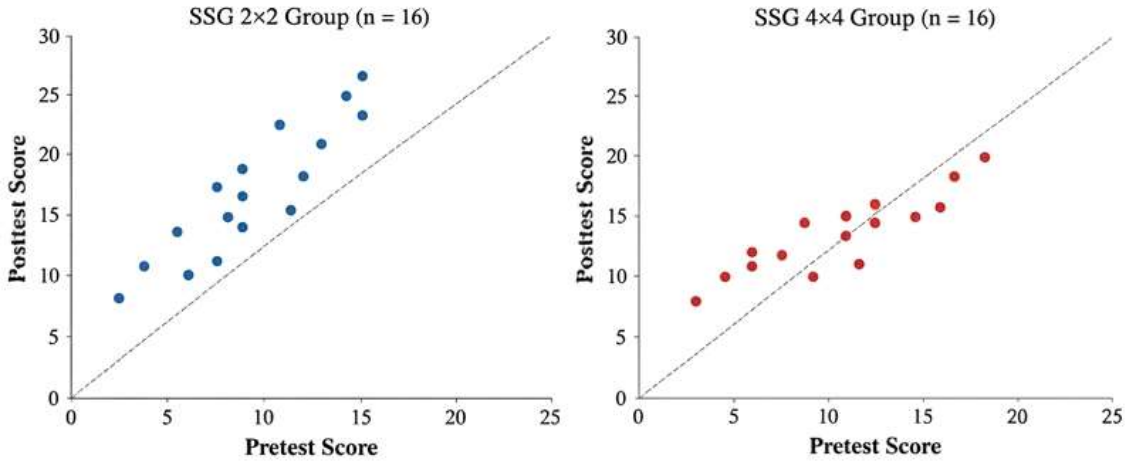


Figure 1. Scatter plot of pretest versus posttest basketball passing accuracy scores in the SSG 2×2 and SSG 4×4 groups

above the diagonal reference line, indicating that posttest scores were generally higher than pretest scores. The distribution of points also demonstrates substantial improvements among several participants, suggesting a strong positive effect of the intervention on passing accuracy performance. In the SSG 4×4 group, posttest scores also tended to be higher than pretest scores; however, the magnitude of improvement appeared smaller, and the distribution of points was more clustered. These visual patterns support the descriptive findings presented in Table 1, indicating greater improvements in passing accuracy in the SSG 2×2 group than in the SSG 4×4 group.

The paired-score plots further demonstrate that the majority of participants in both groups experienced increases in passing accuracy following the intervention. However, the upward trend was more pronounced in the SSG 2×2 group, with larger score gains observed for most participants. This visual evidence suggests that reducing the number of players in small-sided games may increase opportunities for ball contact and passing repetitions, thereby improving passing performance.

Before conducting hypothesis testing, normality and homogeneity assumptions were examined.

Assumption Testing

The results of the normality test using the Shapiro-Wilk test in Table 2 show that all data groups, both pretest and post-test, have significance values (Sig. > 0.05). In the pretest, the 2x2 SSG group had a significance value of 0.228, and the 4x4 SSG group had a significance value of 0.757. Meanwhile, in the post-test, the 2x2 SSG group had a significance value of 0.839 and the 4x4 SSG group 0.517.

Table 2. Normality test results of pre-test and post-test performance scores

Group	Statistics	Df	Sig
Pre			
Pre 2x2	.928	16	.228
Pre 4x4	.965	16	.757
Post-Test			
2x2	.970	16	.839
4x4	.952	16	.517

Table 3. Homogeneity test results of performance scores

Group	Levene statistic	DF 1	DF 2	Sig
2x2	1.736	1	30	.198
4x4	0.114	1	30	.738

Comparison of the Effectiveness of 2×2 and 4×4 Modified Small-Sided Games

The paired-sample t-test results presented in Table 4 indicate significant differences between pretest and posttest basketball passing accuracy scores for both training groups. In the SSG 2×2 group, the significance value was 0.000 ($p < 0.05$) with a t-value of -7.347, indicating a statistically significant improvement after the intervention. The mean difference ranged from -10.159 to -5.590. Similarly, the SSG 4×4 group demonstrated a significant improvement ($p < 0.05$), with a t-value of -3.061 and mean differences ranging from -4.877 to -0.729.

Table 4. Paired t-test results of pre-test and post-test performance scores

Group	Lower	Upper	T	Df	Sig
2x2	-10.159	-5.590	-7.347	15	.000
4x4	-4.877	-0.729	-3.061	15	.008

An independent-samples t-test was conducted to compare the gain scores for basketball passing accuracy between the 2×2 and 4×4 modified small-sided games (SSG) groups. As shown in Table 5, the 2×2 SSG group (M = 7.80, SD = 3.25) demonstrated a significantly higher mean gain score compared to the 4×4 SSG group (M = 2.90, SD = 2.85), $t(30) = 4.55$, $p < .001$. The mean difference between the groups was 4.90 points, with a 95% confidence interval ranging from 2.70 to 7.10. These findings indicate that students participating in the 2×2 modified SSG intervention achieved significantly greater improvements in basketball passing accuracy than those in the 4×4 format. Therefore, the third hypothesis is supported, confirming that the 2×2 modified SSG format is a more effective intervention for enhancing students' passing accuracy.

The results of this study indicate a significant effect of implementing training methods using the 2v2 and 4v4 small-sided game formats on

Table 5. Independent sample t-test results of gain scores between the 2×2 and 4×4 modified small-sided games groups

Group	n	M	SD	Mean Diff	t	df	p	95% CI
SSG 2×2	16	7.80	3.25	4.90	4.55	30	<.001	[2.70, 2.10]
SSG 4×4	16	2.90	2.85					

improving basketball players' passing accuracy. *Small-sided games* are a training method often used by coaches to implement an ecological dynamics approach during training sessions (Riboli et al., 2022). This training method combines various performance domains, including physical, physiological, technical, and tactical aspects (Ferreira-Ruiz et al., 2022; Li et al., 2024).

In practice, *the Small-Sided Games* (SSG) training method modifies game conditions by reducing the number of players, reducing the field size, and adjusting the rules. The goal is to create a higher intensity of play so that every player

is actively involved during training. This training format allows players to have more contact with the ball, make quick decisions, and increase the frequency of individual involvement in game situations that mimic real matches (Halouani et al., 2014; Santos et al., 2024).

These findings are supported by Klusemann et al. (2012), variations in the number of players and court size in basketball can improve players' tactical behavior, decision-making abilities, and technical skills. This condition also increases the frequency and effectiveness of player movements in both attack and defense, creating a more intense training environment that resembles a real match situation (Carter & Liu, 2023; Silva et al., 2021). These findings not only support previous studies conducted by Khoirudin et al. (2023) and Pamungkas et al. (2023), which reported that game-based training approaches improve basketball performance, but also extend the existing literature by demonstrating that smaller game formats, particularly the 2×2 modified small-sided games, may provide greater improvements in passing accuracy compared to larger-sided formats. The present study suggests that the number of players in training situations influences the intensity of ball interaction, the number of passing repetitions, and the decision-making opportunities each player experiences.

The small-sided game training method improves players' abilities, particularly in passing. This training format provides high-intensity play in a limited space, forcing players to make quicker decisions, improving passing accuracy, and strengthening teamwork in game situations that mimic real-life match conditions (Presto et al., 2024; Zaenudin et al., 2025). Furthermore, compared to larger game formats, small-sided games with fewer players can increase the frequency and effectiveness of individual technical moves. This smaller format allows players to engage more frequently in game situations, thus encouraging a greater number of technical moves, both successful and unsuccessful (Jose Figueiredo de Souza et al., 2024).

The analysis indicates that the 2×2 modified Small-Sided Games training method was more effective than the 4×4 format at improving students' basketball passing accuracy. This finding was reflected not only in the greater increase in mean scores but also in the effect size analysis. The 2×2 group demonstrated a large effect size (Cohen's d = 1.84), whereas the 4×4 group showed a moderate-to-large effect size (Cohen's d = 0.77). These results suggest that the 2×2 format produced a stronger practical impact on students' passing performance. From a practical perspective, the 2×2 format enabled students to experience more frequent ball contact, more passing repetitions, and greater involvement in decision-making during gameplay. Consequently, students had more opportunities to practice accurate passing under active game conditions. This finding indicates that smaller-sided game formats may be more suitable for developing technical passing skills in physical education basketball learning contexts.

In terms of physiological burden on the body, the 2v2 training method format provides a higher intensity of body movements because it involves more individual actions in a more open space, thereby increasing heart rate, movement frequency, and active involvement of players in training sessions (Wang et al., 2024). The frequency of individual basic techniques, such as passing, dribbling, and shooting, gradually increases in the small-sided games training format. The more limited space and time encourage players to remain continuously engaged in both attacking and defensive situations (Perdima et al., 2024).

Applying the 2v2 training method leads players to reach or exceed 90% of their maximum heart rate (HRmax). As the number of players increases (as in the 4v4 format), the average heart rate tends to decrease (F. M. Clemente et al.,

2021; Rampinini et al., 2007). The high physiological stress on players' bodies impairs concentration, neuromuscular adaptation, and decision-making speed (J. Cao et al., 2024). Regarding locomotor demands, this small format increases the frequency of acceleration and deceleration but minimally impacts high-speed running or sprinting (Castellano & Casamichana, 2013; Castillo et al., 2020).

In addition to imposing high physiological stress, the 2v2 training format in Small-Sided Games also shows a significant increase in the frequency of technical actions per individual, including passing, dribbling, and shooting. Narrower, more intense game situations require players to make more technical decisions quickly and under pressure, thereby accelerating adaptation to real game conditions (Aguiar et al., 2012; Sampaio et al., 2014).

In improving *passing skills*, the 2v2 format provides a highly conducive playing environment for increasing accuracy and efficiency. This is due to the high ratio of ball-to-ball interactions and the increased number of decisions that must be made quickly. This situation encourages players to repeatedly practice passing skills in dynamic and competitive conditions, which can strengthen motor memory and improve the accuracy of basic techniques (F. M. Clemente et al., 2014; Davids et al., 2013; Práxedes et al., 2018).

In contrast, in formats with larger numbers of players, such as 4v4, although physiological intensity is slightly reduced, there is an increase in aspects of teamwork and tactical awareness (Köklü et al., 2012). The larger field size and the larger number of teammates provide opportunities to practice basic principles such as spacing, timing, and support (Zhang, 2024). However, they can reduce the frequency of individual involvement in specific technical actions such as *passing*.

The proper small-sided game format must be tailored to the desired training objectives. If the primary goal is to develop individual technical skills, such *as passing accuracy,* then a format with fewer players (e.g., 2v2) will be more effective. Conversely, a format like 4v4 is more suited to strengthening tactical aspects and teamwork.

CONCLUSION

The findings of this study indicate that both the 2×2 and 4×4 modified Small-Sided Games training formats improved basketball passing accuracy among senior high school students participating in physical education activities. However, the 2×2 format showed greater improvement in passing accuracy than the 4×4 format. This finding suggests that smaller-sided game formats may provide more effective learning conditions for developing technical passing skills because students experience more frequent ball contact, greater player involvement, and faster decision-making during gameplay. These results contribute to the field of physical education by providing evidence that modified Small-Sided Games can serve as an effective instructional strategy for improving basketball passing skills in school-based learning contexts.

The findings of this study have practical implications for physical education teachers and basketball coaches in designing training sessions and learning activities. The 2×2 modified Small-Sided Games format may be more appropriate when the primary objective is to improve technical skills such as passing accuracy, ball control, and rapid decision-making. Meanwhile, the 4×4 format may be more suitable for developing teamwork, tactical awareness, spatial positioning, and the application of game strategies. In practical implementation, coaches and teachers may integrate both formats into a weekly training program by using 2×2 activities during technical skill-focused sessions and 4×4 activities during tactical or game-simulation sessions. Nevertheless, this study has several limitations,

including a relatively small sample size and the use of participants from a single senior high school, which may limit the generalizability of the findings to broader populations. Therefore, future studies are recommended to include larger, more diverse samples and additional performance variables to obtain more comprehensive findings on the effectiveness of modified Small-Sided Games training methods.

While the modified small-sided games intervention was designed to simulate authentic game situations involving tactical decision-making and player interactions, the outcome measure focused solely on technical passing accuracy in a controlled environment. As a result, the present study may not fully capture the influence of small-sided games on tactical passing behaviors and decision-making processes during actual gameplay. Future research should combine technical skill assessments with game-based performance indicators to obtain a more comprehensive understanding of the effects of small-sided games training.

■ DECLARATION OF GENERATIVE AI USAGE IN THE WRITING PROCESS

During the writing of this manuscript, the authors used ChatGPT (OpenAI) to assist with language refinement, grammar checking, and improving the clarity of academic writing. The authors carefully reviewed, edited, and verified all generated content and assume full responsibility for the accuracy, integrity, and originality of the final manuscript.

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