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Game-Based Training Approach to Improving Performance Skills in Handball Extracurricular Activities

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ABSTRACT

This study aims to analyze the effect of the Game-Based Training (GBT) approach on improving students' basic skills and handball playing skills in extracurricular activities. The research method used a quantitative approach with a Pretest-Posttest Control Group experimental design, involving 20 students who were all sampled using total sampling techniques and randomly divided into experimental and control groups. The research instruments included handball basic skills tests (passing, catching, dribbling, shooting) and playing skills tests using the Game Performance Assessment Instrument (GPAI). The results showed that the experimental group experienced a much more significant improvement than the control group; on the variable of basic handball skills, a t-test value of Sig. 0.000 was obtained with an average increase of 22.4 points, while on playing skills (GPAI), there was also a significant difference between the groups with a value of Sig. 0.000 and an average increase of 13.8 points. These findings indicate that Game-Based Training is effective in improving students' technical abilities and playing performance in handball. Thus, GBT is suitable to be applied as a training model to improve handball skills in schools.

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INTRODUCTION

Sports are an integral part of education that serve not only to improve physical fitness, but also to instill social values, discipline, and cooperation. Through extracurricular sports activities, students have the opportunity to develop their physical and psychomotor potential (Meester et al., 2014), as well as their social skills (Sembiring et al., 2025), outside of formal class hours. One sport that is now being introduced in various schools is handball. Handball is a team sport that requires a combination of technical skills such as throwing, catching, dribbling, and shooting the ball, all of which are performed at a fast and dynamic pace (Nicolosi et al., 2023). This game also emphasizes tactical thinking, quick decision-making, and good team coordination (Bonnet et al., 2020). Therefore, handball has great potential to be an effective means of shaping students' character and motor skills.

Opid[1D*], Z.Arifin[2A-C], Asep Angga Permadi[3E], Azhar Ramadhana Sonjaya[4D]
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However, the implementation of handball training at the school level often faces a number of challenges. Many coaches and physical education teachers still rely on traditional approaches that focus on repetitive technical training (drill-based training), with an emphasis on mastering basic movements through direct instruction (Bessa & Hastie, 2021). Although this method has advantages in the formation of specific motor skills (Barus et al., 2025), Various studies show that overly technical and monotonous training can reduce student motivation and limit their ability to apply these techniques in real game contexts (Chu et al., 2022). In addition, traditional approaches often neglect the cognitive and affective aspects of sports learning, even though both aspects are very important in improving tactical understanding and creativity in play.

To address these issues, Game-Based Training (GBT) has emerged as an alternative model for modern sports education. This approach places students as active learners who learn to solve problems, make decisions, and adjust strategies according to the game situation (Sutriawan & Syafruddin, 2025). Several studies show that the application of GBT can improve playing skills (Suryaji et al., 2025), tactical understanding (Sampaio et al., 2017), physical fitness (Gabbett et al., 2015), s as well as motivation (Ihwanto, N., & Mashud, 2021).

However, research on the application of GBT in the context of school handball is still very limited. In fact, the complex, dynamic characteristics of handball, which requires intensive team interaction, are very suitable for application through a game-based approach (Espoz-lazo, 2025). In addition, extracurricular activities in schools often have short training times and varying numbers of participants in terms of basic skills (Meester et al., 2014). n this context, Game-Based Training has the potential to be an effective solution because it can optimize training time while increasing the active involvement of all students in training activities (Wubale, 2023).

Previous research by Lubay et al., (2024) shows that a game-based approach to handball training can significantly improve students' decision-making and tactical understanding compared to conventional methods. However, this research was conducted primarily in the context of sports clubs or young professional athletes, not in a school environment. This raises a research gap regarding the effectiveness of the GBT approach in extracurricular activities, which have different educational goals and characteristics from performance training. Therefore, research is needed to empirically assess how the Game-Based Training approach can be effectively applied to improve handball skills in a secondary school environment.

Based on the above description, this study aims to analyze the effect of the Game-Based Training approach on improving students' playing skills in handball extracurricular activities. This study is expected to contribute to the development of a game-based training model that not only improves technical and tactical abilities but also builds motivation, creativity, and active participation of students in school sports activities. The results of this study are expected to serve as a reference for physical education teachers and coaches in designing innovative, enjoyable, and effective sports coaching programs in educational settings.

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METHODS

This study used a quantitative method with an experimental design, which aimed to determine the effect of Game Based Training on handball playing skills. An experimental method is a research method conducted through experiments to observe the effect of independent variables (treatment) on dependent variables (results) under controlled condition (Sugiyono, 2013). In this study, the independent variable is the application of the Game Based Training approach, while the dependent variable is handball playing skills. To ensure objective results, the study was conducted by controlling other variables that could affect the results and using a control group as a comparison.

The research design used was a Pre-test-Post-test Control Group Design, in which there were two randomly selected groups, namely the experimental group and the control group (Asmawi, 2024). Both groups were given a pre-test to determine their initial conditions before the treatment was given. The experimental group was then given treatment in the form of a Game-Based Training approach, while the control group received conventional learning without treatment. After the treatment was completed, both groups were retested through a final test (posttest) to see the changes in learning outcomes that occurred. A comparison between the pretest and posttest results of the two groups was used to determine the effectiveness of the Game Based Training approach in improving handball playing skills.

The population of this study consisted of all male students participating in the handball extracurricular activity at Wiraguna Limbangan Junior High School during the semester in which the study was conducted, totaling 20 students. Due to the relatively small population size (N = 20), this study employed total sampling (census), whereby the entire population served as the research sample (Sugiyono, 2013). Furthermore, the sample was divided into two groups, namely the experimental group and the control group, each consisting of 10 people, through a simple randomization procedure (Asmawi, 2024) , so that each participant had an equal chance of being assigned to one of the groups.

The handball skills test used to measure students' basic technical abilities includes: passing, catching the ball, dribbling, and shooting (flying shoot). Meanwhile, the handball playing skills test uses the Game Performance Assessment Instrument (GPAI), which consists of seven main components, namely base (returning to position), adjust (adjusting to the game), decision making, skill execution, support (supporting the team), cover (covering teammates), and guard/mark (guarding opponents) (M. W. Metzler, 2000). Each indicator is assessed using a Likert scale with a range of 1–5, where 5 indicates excellent ability and 1 indicates very poor ability.

The research procedure consists of several stages, including: First, a pretest is conducted before the treatment begins on both groups, namely the experimental group and the control group. The aim is to measure the participants' initial abilities in basic handball skills such as passing, dribbling, shooting, and playing strategies. The instruments used for the pretest are the same for both groups so that the results can be compared objectively. This pretest data will be the basis for assessing the effectiveness

Opid[1D*], Z.Arifin[2A-C], Asep Angga Permadi[3E], Azhar Ramadhana Sonjaya[4D]
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of the treatment given in the next stage. Second, treatment - given only to the experimental group for 4 weeks with a total of 12 meetings, each lasting 60 minutes. The focus of the treatment is game-based training designed to improve handball playing skills through a game-based approach. Each session is divided into three parts: warm-up (15 minutes) which includes light running, dynamic stretching, agility exercises such as shuttle runs and zig-zag runs, and small games to build team spirit; core activities (30 minutes) which in weeks 1 and 2 focus on basic exercises such as throwing and catching, passing, dribbling, shooting, one-on-one or zone marking games, and 5-on-5 game simulations; while in weeks 3 and 4, the core activities focus on advanced strategies such as fast breaks, quick and accurate passing, crossing, feints, pivot plays, zone defense, man-to-man defense, and shot blocking in full 5-on-5 game simulations; and a cool-down (15 minutes) consisting of light games or cool-down games, static stretching, and a brief discussion about the training experience and lessons learned. The control group did not receive game-based training, but instead carried out routine extracurricular training consisting of basic technical training and regular games without tactical modifications. Third, posttest - conducted after completing the treatment, both groups took a posttest using the same instruments as in the pretest. The posttest data was then analyzed and compared with the pretest data of each group to see the improvement in skills. In addition, a comparison between the experimental group and the control group was made to assess the effectiveness of game-based training in improving handball skills.

The data analysis techniques in this study used descriptive and inferential statistical approaches. Descriptive analysis was used to describe data trends through mean values, sum of scores (ΣX), standard deviation (σ), and comparisons of pretest, posttest, and gain scores in each group. Furthermore, inferential analysis was used to test the research hypothesis through a series of assumption tests and difference tests. The assumption tests included a normality test (using Shapiro–Wilk) to ensure normal data distribution and a homogeneity test (using Levene's Test) to test the similarity of variance between groups. Once the assumptions were met, an independent t-test (Independent Samples t-Test) was conducted to determine the difference between the experimental and control groups, as well as a paired t-test (Paired Samples t-Test) to analyze the improvement in ability from the pretest to the posttest in each group.

RESULTS AND DISCUSSION

Descriptive Analysis

Table 1 presents a summary of descriptive statistics for pretest, posttest, and gain scores on two main variables, namely Basic Handball Skills and Playing Skills (GPAI), for the control group and the experimental group. The statistics shown include the sample size (N), mean score (M), total score (ΣX), and standard deviation (σ). This data provides an initial overview of the students' abilities before and after the treatment, as well as the differences between the control and experimental groups.

Opid[1D*], Z.Arifin[2A-C], Asep Angga Permadi[3E], Azhar Ramadhana Sonjaya[4D]
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Table 1.
Descriptive Analysis

Variable	Source Statistics	Control group			Experimental group		
		Pree	Post	Gain	Pree	Post	Gain
Basic Skills Handball	N	10	10	10	10	10	10
	M	15,5	27,3	11,8	15,5	31,3	15,8
	ΣX	155	273	118	155	313	158
	σ	1,080	1,337	0,789	1,080	1,889	2,616
Playing Skills (GPAI)	N	10	10	11	10	10	11
	M	49,1	64,4	15,3	50,2	50,2	79,7
	ΣX	491	644	153	502	502	797
	σ	2,685	2,591	1,418	2,616	2,616	2,497

Based on Table 1, it can be seen that both groups had the same pretest GPAI score of 15.5, indicating equal initial abilities. After the treatment, the average posttest GPAI score increased to 27.3 in the control group (gain of 11.8) and 31.3 in the experimental group (gain of 15.8), with standard deviations of 1.337 and 1.889, respectively. For the KBH variable, the average pretest score for the control group was 49.1 and for the experimental group was 50.2. After the treatment, the control group increased to 64.4 (gain of 15.3), while the experimental group experienced a greater increase to 79.7 (gain of 29.5), with standard deviations of 2.591 and 2.497, respectively. This shows that the treatment given to the experimental group was more effective in improving handball skills than the control group

Normality Test

Before conducting inferential analysis, researchers first test the assumption of data normality. The normality test is conducted to ensure that the pretest and posttest data on basic handball skills in the experimental and control groups follow a normal distribution, so that parametric statistical analysis can be used. The results of the normality test using Shapiro-Wilk are presented in Table 2.

Table 2.
Tests of Normality

		Shapiro-Wilk		
	Group	Statistic	df	Sig.
Pretest	Experimental	.852	10	.061
	Control	.923	10	.383
Posttest	Experimental	.991	10	.998
	Control	.915	10	.315

Based on the Shapiro–Wilk test results, all data in both the experimental and control groups, both for the pretest and posttest handball skills, had a significance value greater than 0.05. Thus, the data in this study were normally distributed.

Furthermore, a normality test was conducted on the GPAI scores on the pretest and posttest for both groups to ensure that the data met the normality assumption before parametric statistical analysis. The results are presented in Table 3.

Opid[1D*], Z.Arifin[2A-C], Asep Angga Permadi[3E], Azhar Ramadhana Sonjaya[4D]
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Table 3.
Tests of Normality

		Shapiro-Wilk		
	Group	Statistic	df	Sig.
Preetest GPAI	Experimental	.907	10	.258
	Control	.907	10	.258
Posttest GPAI	Experimental	.878	10	.125
	Control	.932	10	.466

Based on the Shapiro–Wilk test results, all variables (both pretest and posttest) in the experimental and control groups had a Sig. value > 0.05, so it can be concluded that all data were normally distributed.

Homogeneity Test and Hypothesis of Basic Handball Skills

Before comparing the basic handball skills of the experimental and control groups, a test of variance homogeneity was first conducted to ensure the similarity of data variability between groups. This test used Levene's Test. Next, to determine whether there were significant differences between the two groups, an Independent Samples t-Test was conducted on the pretest and posttest scores. The results of the analysis are presented in the following table.

Tabel 4
Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pre-test	Equal variances assumed	.398	.536	-.928	18	.366	-1.100	1.186	-3.591	1.391
	Equal variances not assumed			-.928	17.988	.366	-1.100	1.186	-3.591	1.391
Post-test	Equal variances assumed	.004	.952	-13.448	18	.000	-15.300	1.138	-17.690	-12.910
	Equal variances not assumed			-13.448	17.976	.000	-15.300	1.138	-17.691	-12.909

Based on the Independent Samples Test table, a Sig. Levene value > 0.05 was obtained for both variables (0.536 and 0.952), so it can be concluded that the variance between the experimental group and the control group is homogeneous.

Furthermore, the results of the independent samples t-test show that in the pretest there was no significant difference between the experimental and control groups (Sig. = 0.366 > 0.05), which means that both groups had equivalent initial abilities. However, in the posttest, there was a significant difference between the two groups (Sig.

= 0.000 < 0.05) with a mean difference of -15.3, indicating that the group that received the Game-Based Training approach had better handball skills than the control group.

To determine the effect of the treatment on the improvement of basic handball skills, a Paired Samples t-Test analysis was conducted by comparing the pretest and posttest scores in the experimental group. The results of this test are presented in Table 5.

Tabel 5

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Pretest - Posttest of handball skills	-22.400	7.366	1.647	-25.847	-18.953	13.600	19	.000

Based on the results of the Paired Samples t-Test, a Sig. (2-tailed) value of 0.000 < 0.05 was obtained, which means that there is a significant difference between the pretest and posttest handball skill scores. The average posttest score was 22.4 points higher than the pretest score, so it can be concluded that there was a significant improvement in handball skills after the treatment was given.

Homogeneity Test and Handball Skills Hypothesis

Before presenting the results of the comparison test between the experimental and control groups on the GPAI scores, a homogeneity of variance test was first conducted using Levene's Test to ensure the equality of variance between groups. Next, an independent samples t-test was conducted to determine whether there was a significant difference between the pretest and posttest GPAI scores in both groups. The results are presented in the following table.

Table 6.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Preetest GPAI	Equal variances assumed	.000	1.000	.000	18	1.000	.000	.483	-1.015	1.015
	Equal variances not assumed			.000	18.000	1.000	.000	.483	-1.015	1.015
Posttest GPAI	Equal variances assumed	.578	.457	5.466	18	.000	4.000	.732	2.463	5.537
	Equal variances not assumed			5.466	16.213	.000	4.000	.732	2.450	5.550

Based on the Independent Samples Test table, the Levene's Sig. value for the GPAI pretest is 1.000 (> 0.05), so it can be concluded that the variance between the experimental group and the control group in the pretest is homogeneous. Similarly, in the

Opid[1D*], Z.Arifin[2A-C], Asep Angga Permadi[3E], Azhar Ramadhana Sonjaya[4D]
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GPAI posttest, the Levene's Sig. value of 0.457(> 0.05) also shows homogeneous variance between the two groups.

The results of the independent samples t-test for the GPAI pretest show a Sig. (2-tailed) value of 1.000 (> 0.05), which means that there is no significant difference between the experimental group and the control group before the treatment, so that the initial abilities of the two groups are considered equivalent. However, in the GPAI posttest, there was a very significant difference between the two groups with a Sig. (2-tailed) value of 0.000 (< 0.05) and a mean difference of 4.000. This shows that the group that received the treatment (e.g., a specific learning method) had a higher GPAI score than the control group after the treatment.

As a continuation of the intergroup comparison test, a Paired Samples t-Test was conducted to determine the change in GPAI scores from the pretest to the posttest in each group. The results are presented in Table 7.

Table 7.
Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Preetest - Posttest GPAI	-13.800	2.783	.622	-15.103	-12.497	-22.173	19	.000

Based on the results of the Paired Samples t-Test, a Sig. (2-tailed) value of 0.000 < 0.05 and a t-value of -22.173 were obtained, which means that there is a significant difference between the pretest and posttest GPAI scores. The average posttest score increased by 13.8 points after the treatment was given, with a 95% confidence interval of -15.103 to -12.497. Thus, it can be concluded that treatment using Game-Based Training has a significant effect on improving student playing performance.

The results showed that there was a significant difference between the experimental group and the control group in both basic skills and handball playing skills after the treatment was given. Based on the results of the Independent Samples t-Test on basic handball skills, a significance value of 0.000 (< 0.05) was obtained, which means that the experimental group experienced a higher increase in ability than the control group. The Paired Samples t-Test results also showed a Sig. (2-tailed) value of 0.000 with an average difference of 22.4 points between the pretest and posttest. This indicates that the application of the Game-Based Training approach is effective in improving students' basic handball skills.

This improvement in skills can be explained through the principle of contextual learning promoted by the game-based approach, in which students learn techniques and tactics through real game situations (Johnson, 2002; M. Metzler, 2017). Game-Based Training emphasizes the integrated development of tactical understanding, decision-making, and technical skills. Challenging game activities encourage students to actively think, adapt, and apply the skills they have learned in a competitive context (Chris North, 2015).

Opid[1D*], Z.Arifin[2A-C], Asep Angga Permadi[3E], Azhar Ramadhana Sonjaya[4D]
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On the playing skill variable (GPAI), the Independent Samples t-Test results show a significant difference between the experimental and control groups with a Sig. (2-tailed) value = 0.000 (< 0.05) and a mean difference of 4.000. In addition, the Paired Samples t-Test resulted in an average increase of 13.8 points with a Sig. value of 0.000. Theoretically, playing performance in team sports, including handball, is influenced by tactical abilities, decision-making skills, and understanding of game dynamics (Chris North, 2015). The Game-Based Learning model is conceptually designed to develop these three aspects through context-rich gaming activities. By placing students in real game situations, they learn to read situations, choose the right tactical solutions, and execute technical skills effectively.

In addition, Memmert, (2015) asserts that varied and challenging games facilitate the development of tactical creativity, which is the ability of players to produce flexible, innovative, and adaptive tactical solutions. Within the framework of tactical creativity, games are used as a vehicle to increase variation in perception, information processing, and decision making—all of which are important components of handball performance.

Overall, these findings indicate that the Game-Based Training approach not only improves technical skills but also the cognitive and affective aspects of learners. Learning that emphasizes real-world experiences, decision-making, and tactical problem-solving has proven to be more effective than traditional methods that focus on repetitive technical exercises without a game context. Thus, the application of a game-based approach provides a strong theoretical and practical foundation for improving the quality of team sports learning.

Although the results of the study show a significant effect, there are several limitations that need to be considered. First, the sample size of the study was relatively small (N = 20), so the generalization of the results is still limited to similar populations. Second, the duration of the treatment and frequency of training may not have been long enough to see the long-term effects of the learning approach used. Third, this study only focused on two main variables (basic skills and playing skills), without considering other factors such as learning motivation, fitness level, or students' sports experience background, which could also affect learning outcomes.

The results of this study have practical implications for physical education teachers and school sports coaches. The Game-Based Training approach can be used as an alternative effective learning strategy to improve overall handball skills. Teachers are advised to integrate elements of play, decision making, and tactical reflection into each training session so that students not only master the techniques but also understand the strategic context of the game.

CONCLUSION

Based on the results of data analysis and discussion, it can be concluded that the application of the Game-Based Training approach has a significant effect on improving students' basic skills and handball playing skills. The results of the Independent Samples t-Test show that the experimental group had a higher increase than the control group, both in terms of basic technical skills and playing performance (GPAI). Meanwhile, the

Paired Samples t-Test results show a significant increase between the pretest and posttest scores in the experimental group, which indicates the effectiveness of the learning treatment.

The findings of this study provide a basis for researchers to offer several suggestions that are expected to contribute to handball learning and training practices, as follows:

1. For teachers and coaches, it is recommended to integrate the Game-Based Training approach into handball learning or training activities at school. This approach not only improves technical skills but also strengthens tactical understanding and cooperation between players.
2. For schools, it is necessary to provide adequate facilities and training time so that the implementation of the game-based learning model can run optimally.
3. For future researchers, it is recommended to expand the sample size, extend the duration of the treatment, and add variables such as learning motivation, fitness level, or social aspects to gain a more comprehensive understanding of the influence of the Game-Based Training approach on student performance.

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