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RESEARCH ARTICLE

Effectiveness of Training Programme Models and Hand-Eye Coordination on the Skills of Children's Badminton Players

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ABSTRACT

Research findings indicate that children's badminton players in Semarang City generally exhibit moderate to low technical skills, largely due to training methods and the neglect of personal factors such as hand-eye coordination. This study analyzes the effectiveness of linear and nonlinear training program models and examines the impact of hand-eye coordination on the skills of young badminton players. The research employed a quasi-experimental method with a quantitative approach, using a 2x2 factorial design that involved dependent, moderator, and independent variables. A total of 56 out of 82 children's badminton players were selected purposively as the sample, divided into linear and nonlinear training groups with high and low hand-eye coordination. The training was conducted over 20 sessions. Hand-eye coordination was assessed using Ashok's ball toss to the wall test, and technical skills were evaluated through lob, drop shot, and smash tests. Data analysis included Lilliefors and Levene parametric tests for assumptions, while hypothesis testing used Mann-Whitney and Wilcoxon tests for effectiveness, along with Tukey's Post Hoc test to evaluate interaction effects. The results revealed a significant difference in effectiveness between linear and nonlinear training, with an asymptotic significance (2-tailed) of 0.016. Linear training (mean score 51.448) proved more effective than nonlinear training (mean score 46.118). Additionally, a significant difference in effectiveness was observed between high and low hand-eye coordination, with an asymptotic significance (2-tailed) of 0.000, where high hand-eye coordination (mean score 52.681) outperformed low coordination (mean score 44.884). There was also a significant interaction between the training program model and hand-eye coordination, with an asymptotic significance of 0.000, impacting the skills of young badminton players. In conclusion, the linear training program model is more effective for skill improvement, and high hand-eye coordination significantly enhances the skills of young badminton players. The linear training program model combined with high hand-eye coordination is the most effective approach.

INTRODUCTION

Badminton has achieved the status of one of the most popular sports due to its characteristics of having few restrictions on the court and ease in the learning process (Ma, Yu, & Feng, 2021; Panda et al., 2022). In the game of badminton, there are various important technical aspects, such as basic techniques, stroke techniques, stroke patterns, training methods, match strategies, and the physical and mental capacity of players. Badminton is a fast-paced sport and requires a strategic combination of spatial, temporal, and technical tactics (Lin et al., 2024). Common characteristics of a match include a rally time of 7 seconds and a rest time of 15 seconds, with an effective playing time of 31% (Phomsoupha & Laffaye, 2015). Badminton is a sport that involves high-intensity activity with short rest breaks, which requires physical fitness, skills, and specific game strategies (Chia, Chow, Barrett, & Burns, 2019). Technical skills refer to the ability to perform a variety of strokes effectively. Skills are the ability to utilise reason, thought, and creativity in completing or creating something to make it more meaningful, adding value to the work done (Akbar, Hidasari, & Haetami, 2020). Skills are significantly correlated with sports performance (Deng, Soh, Abdullah, & Huang, 2024). Some important technical skills in badminton include service, overhead, clear, decrease shot, smash, and drive (Grice, 2008).

Overhand is a stroke made when the shuttlecock is overhead such as a lob, drop shot, and smash. A study in Africa recorded the average frequency of shots in badminton matches as follows: drive - 122.1, clear - 118, smash - 56.2, net stroke - 54.3, drop shot - 24.2, and round-the-head stroke - 1.2 (Abdullahi & Coetzee, 2017).

A lob is a shot that leads to the back of the opponent's field with a soaring trajectory (Phomsoupha & Laffaye, 2015), serving to control the opponent's game, prepare attacks, or improve position. The body position when performing a lob must be ideal so that the shot is difficult to predict and can be used to defend, improve position, and force the opponent to hit from behind the court.

A drop shot is a basic shot performed with advanced techniques, aiming to drop the shuttlecock close to the opponent's net (Gusrinaldi, Irawan, Kiram, & Edmizal, 2020). The drop shot is performed with a gentle push, with racket position and body movements that must be considered for its effectiveness. This shot must hit the area near the net and not exceed the double line. Effective drop shots are often combined with feints.

One of the dominant skills in badminton is the forehand overhead smash. (Li, Zhang, Wan, Wilde, & Shan, 2017). Smash is an overhead shot performed with full force to attack with a downward trajectory of the shuttlecock (Phomsoupha & Laffaye, 2015). This stroke requires muscle strength, especially in the legs, shoulders, arms, and wrist flexibility, and can be performed either in a standing position or while jumping. The smash technique involves a relaxed body position, arm swing, and wrist flexion to achieve maximum accuracy and power.

Badminton is a fast-paced game and is considered the fastest racket sport (Pardiwala, Subbiah, Rao, & Modi, 2020). Shuttlecock flight can reach speeds of up to 426 km/h (Chen, Hsu, Tai, & Yao, 2022), and the ability to execute effective return shots requires good eye-hand coordination (Rizzo et al., 2020). Eye-hand coordination, which is a complex biometric ability, is closely related to speed, strength, endurance, and flexibility. Training programs for badminton involve principles such as overload, reversibility, progression, individualisation, periodisation, and specificity (Kasper, 2019), and include both linear and nonlinear training models (Fleck, 2011).

Badminton matches are highly discontinuous, with short high-intensity work sessions (approximately 7 seconds) alternating with rest periods that are twice as long (approximately 15 seconds) over long periods (17 minutes to 1 hour) (Phomsoupha & Laffaye, 2015). These high-intensity sessions (including punches, rapid direction changes, accelerations, and decelerations) require fast energy, which is mainly obtained through anaerobic metabolism such as ATP and creatine phosphate (CrP). Since these energy sources are depleted within a few seconds and prolonged use of the lactic pathway leads to acidity, players rely on rest for recovery. Therefore, a high aerobic capacity is important to recover anaerobic energy and eliminate lactate during rest (Edel, Weis, Ferrauti, & Wiewelhove, 2023; Fuchs, Faude, Wegmann, & Meyer, 2014;Fernandez-Fernandez, Mendez-Villanueva, Fernandez-Garcia, & Terrados, 2007).

Good training contributes to the improvement of athletes' physical, psychological, attitudinal and social qualities, and can help reach and maintain peak performance. Short- and medium-term training is organised into training programmes, which are systematic approaches to planning training and competition over a specific time cycle, related to the preparation of players towards a specific goal, such as peak competition or a major tournament. Plans are hierarchical and structured in a series of interrelated stages (Afonso, Clemente, Ribeiro, Ferreira, & Fernandes, 2020). Training programmes are tailored to the player's preparation, competition, and recovery phases, and may include systematic approaches such as linear or nonlinear models, focusing on training volume, intensity, and density. In the nonlinear group, trainees are divided into three blocks, each lasting four weeks. (Afonso et al., 2020). In the linear training programme, different volumes and intensities last about 4-6 weeks (Fleck, 2011).

Badminton coaching divides players by age group, from early childhood to adulthood (Karyono, 2020). Young players' performances have little predictive value for future success, other solutions are sought to assess young players' potential (Faber, Bustin, Oosterveld, Elferink-Gemser, & Nijhuis-Van der Sanden, 2016). Basic technical skills and eye-hand coordination are important areas that need attention, especially in the younger age groups, to improve performance and game effectiveness (Haekal & Basri, 2021; Thieschäfer & Büsch, 2022; Zalindro, 2021).

METHODS

Research Design

This study used a quasi-experimental design with a 2x2 factorial approach. This design was chosen because it allows analysis of moderator variables that can affect the relationship between treatment and outcome.

Table 1 Factorial Design 2x2 Effectiveness of training programme models and hand-eye coordination on the skills of children's badminton players

Hand-eye	**Training Programme Model (A)**	
coordination (B)	**Linear (A^1)**	**Non-linear (A^2)**
High (B^1)	A^1B^1	A^2B^1
Low (B^2)	A^1B^2	A^2B^2

Description:

A^1B^1 High hand-eye coordination sample group and linear training programme model

A^1B^2 Sample group of low hand-eye coordination and linear training programme model

A^2B^1 High hand-eye coordination sample group and non-linear training programme model

A^2B^2 High hand-eye coordination sample group and non-linear training programme model.

POPULATIONS AND SAMPLES

The study population included all children's badminton players (under 13) from various badminton clubs in Semarang City, with a total of 82 players. The research sample was selected using a purposive sampling technique, resulting in 56 players who fulfilled the specific criteria that had been determined.

Table 2. Research Population

No	Badminton Club	Children's age players (Under13)
1	Pendowo	22
2	Tugu Muda	11
3	Gemilang	15
4	Sehat	16
5	Matahari Terbit	18
Total		82

Source: research data

Data Collection Techniques

Data was collected through tests and measurements of eye-hand coordination, lop tests, drop shot tests and smash tests. Data from the lop, drop shot and smash tests were used as initial test data.

Research Procedure

Group division is based on the results of the eye-hand coordination test, the sample is divided into two groups with matching subject design so that experimental group 1 and experimental group 2 are formed.

Each experimental group was further divided into high (rank 1-14) and low (rank 15-28) subgroups for further analysis. Thus, four sample groups were formed.

After the formation of four research sample groups, the samples then underwent an exercise programme for 20 sessions with different exercise programme models, namely linear and nonlinear and before the final test according to each exercise programme model.

Data Analysis

At the end of the study, lop, drop shot and smash skills were tested on the sample. The data was then tested to check its prerequisites through normality and homogeneity tests. If the data met the prerequisites, parametric tests were conducted; otherwise, if it did not meet the prerequisites, the data was tested using non-parametric methods. A significance level of 0.05 was used to test hypotheses regarding differences in effectiveness between linear and nonlinear training models, and low and high hand-eye coordination. If interactions were found, Tukey's Post Hoc test was conducted to identify the variables that showed significant differences.

Research Instruments

This study uses several instruments, namely: an eye-hand coordination instrument developed by Ashok 2008 which has a validity of 0.751 and a reliability of 0.689 which is a modification of the Hand Wall Toss Test. The lob shot skill instrument obtained from Tatang Muchtar (2008) has a validity of 0.68 for men and a reliability of 0.84; the drop shot instrument developed by Rustandi and Safitri (2019) modified from James Poole's drop shot test (1986) which has a validity of 0.874 and reliability of 0.720 and a smash shot instrument made by M. Nasution et al. (1993) which has a validity of 0.802 and reliability of 0.927.

RESULT

Data description

Table 3. Data description

High Coordination Linear							**High Coordination Nonlinear**					
Lob		**Drop Shot**		**Smash**			**Lob**		**Drop Shot**		**Smash**	
Pretest	Posttest	Pretest	Post test	Pretest	Post-test		Pretest	Posttest	Pretest	Post test	Pretest	Post-test
14	19	35	51	20	25		23	28	33	82	40	50
20	16	32	64	20	20		18	21	43	43	45	50
18	30	53	60	25	30		18	29	70	45	40	55
24	24	67	79	15	20		27	30	54	62	45	65
32	29	65	73	15	30		19	24	55	81	30	40
34	31	65	73	30	65		26	28	60	73	10	40
26	34	51	71	35	45		16	23	52	59	25	30
28	30	33	49	25	45		10	13	47	61	10	20
24	25	54	71	35	45		29	25	80	88	30	45
12	16	52	62	10	25		23	23	53	63	30	45
8	12	47	72	15	30		20	25	67	67	25	30
30	33	54	58	10	20		13	17	36	59	15	20
19	27	21	42	10	10		11	18	47	49	10	30
24	32	65	68	60	45		15	17	30	48	25	35
Linear Low Coordination							Non-Linear Low Coordination					
Lob		Drop Shot		Smash			Lob		Drop Shot		Smash	
Pretest	Posttest	Pretest	Post test	Pretest	Post-test		Pretest	Posttest	Pretest	Post test	Pretest	Post-test
14	14	23	46	20	21		9	18	31	35	41	45
11	12	23	30	15	30		14	14	31	73	30	45
18	19	28	33	25	30		16	17	32	80	45	45
16	20	51	54	30	30		6	11	39	41	40	42
16	20	41	52	25	30		9	20	39	51	20	35
26	29	30	38	30	30		15	24	39	42	15	32
20	22	52	62	25	31		16	29	31	68	35	37
22	24	40	62	45	43		25	27	32	81	20	20
22	27	74	77	21	28		17	29	34	75	40	41
26	27	49	70	40	49		10	14	39	55	35	37
25	22	53	61	25	41		13	19	38	57	35	40
13	17	23	41	35	45		16	24	35	84	35	39
18	25	29	41	20	50		20	24	42	50	15	19
24	24	30	41	25	55		22	25	47	69	35	39

Source: Research data

Data Prerequisite Test

To check data prerequisites with parametric methods, normality and homogeneity tests were conducted on the skill data. The normality test used Kolmogorov-Smirnov and

Shapiro-Wilk, while the homogeneity test used Levene's test to assess the similarity of variance between groups.

Table 4. Data normality test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	**df**	**Sig**	**Statistic**	**df**	**Sig.**
Linier_tinggi_rendah	.125	28	.200*	.952	28	.221
Nonlinier_tinggi_rendah	.147	28	.125	.956	28	.272

This is a lower bound of the true significance

a. Lilliefors Significance Correction

1) For the Linear_tinggi_rendah data, the Kolmogorov-Smirnov test results show a Sig value. = 0.200, which is greater than 0.05, so the data is considered normally distributed. In addition, the Shapiro-Wilk test also shows a Sig value. = 0.221, which is also greater than 0.05, indicating that the data is normal.

2) For the Nonlinear_tinggi_rendah data, the Kolmogorov-Smirnov test yields a Sig. = 0.125, which is higher than 0.05, so this data is also considered normal. The Shapiro-Wilk test shows a value of Sig. = 0.272, which is also greater than 0.05, indicating that the data follows a normal distribution.

Both Linear_high_low and Nonlinear_high_low data sets fulfil the normality assumption based on the Kolmogorov-Smirnov and Shapiro-Wilk test results.

The homogeneity of variances test aims to determine whether the variances between groups are uniform. In this case, Levene's test was used to test the null hypothesis that the population variances across groups are identical.

Table 5 Test of Homogeneity of Variances Class

Levene Statistic	df1	df2	Sig.
11.863	1	54	.001

Source: research data processing

As the p-value (.001) is less than 0.05, the null hypothesis is rejected, indicating a significant difference in variance between the groups. In other words, the variances between groups are not homogeneous.

Hypothesis Test

Since the data on children's badminton players' skills were normal but not homogeneous, this study used nonparametric statistical tests. Wilcoxon univariate test was applied to compare pretest and post-test results within the same group, while Mann-Whitney univariate test was used to compare post-test results between different groups as an alternative.

1.1.1 Differences in effectiveness between linear and nonlinear training programme models on children's badminton player skills

To evaluate the effectiveness of linear compared to nonlinear training programme models on the skills of children's badminton players, Mann Whitney U and Wilcoxon tests were conducted.

Table 6. Statistical tests of differences in effectiveness between linear and nonlinear training programme models on badminton player skills

	Comparison of linear and nonlinear training programme models
Mann-Whitney U	245.000
Wilcoxon W	651.000
Z	-2.409
Asymp. Sig. (2-tailed)	.016
a. *Grouping Variable:* Kelas	

A look at the results of the statistical analysis comparing the linear and nonlinear programmes shows that the Mann-Whitney U test yielded a value of 245,000, which indicates a significant difference between the two independent groups. A lower value indicates a significant difference. In addition, the Wilcoxon W value of 651,000 also indicates a significant difference. The Z value of -2.409 confirmed the statistically significant difference between the linear and nonlinear groups.

The asymptotic (two-way) significance level was 0.016, indicating a statistically significant difference between the linear and nonlinear programme models. This value is sufficient to reject the null hypothesis that there is no difference between the two models in terms of the skills of children's badminton players. In other words, the effectiveness between the linear and nonlinear programmes is significantly different. Based on the average, the linear programme model showed a mean value of 51.44818, which is higher than the mean of the nonlinear programme model of 46.11807, indicating that the linear training programme is more effective in improving the skills of children's badminton players.

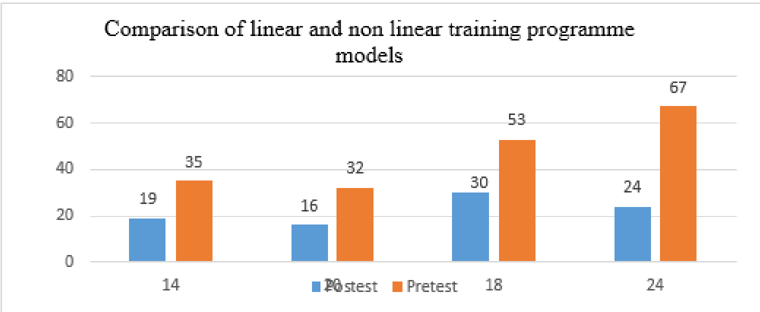


Figure 1. Diagram of the difference in effectiveness between linear and nonlinear training programme models on the skills of children's badminton players. Source: research data processing

1.1.2 The difference in effectiveness between high and low hand-eye coordination on the skills of children's badminton players

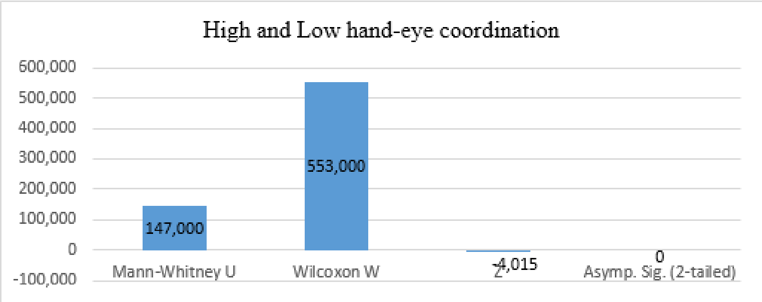
To identify differences in the effectiveness of high and low hand-eye coordination on the skills of children's badminton players, the Mann-Whitney U statistical test was used to compare two independent groups.

Table 7. Statistical tests of differences in the effectiveness of high and low hand-eye coordination on badminton player skills

	High and low coordination
Mann-Whitney U	147.000
Wilcoxon W	553.000
Z	-4.015
Asymp. Sig. (2-tailed)	.000
a. *Grouping Variable*: kelas	

Table 7 shows that the Mann-Whitney U value of 147,000 represents the combined ranking of the two groups. A smaller U-value indicates a greater difference between the groups. A Z value (-4.015) away from zero indicates a significant difference between the high and low coordination groups. The Asymp. Sig. (2-tailed) of 0.000 indicates a highly significant difference. In statistics, a p-value < 0.05 is considered significant, while a p-value < 0.01 is considered highly significant.

The value of 0.000 < 0.05 indicates that the probability of this result occurring by chance is very low. Therefore, the hypothesis that there is no difference between the groups with high and low hand-eye coordination is rejected, while the hypothesis that there is a difference is accepted. In other words, the Mann-Whitney test results show that there is a highly significant difference between the high and low hand-eye coordination groups. This indicates that the variable 'class' has a significant influence on the difference in hand-eye coordination. The high-hand-eye coordination group had a mean of 52.68139, which was higher than the low-hand-eye coordination group which had a mean of 44.88486.



Picture 2. Diagram of the difference in the effectiveness of high and low hand-eye coordination on the skills of children's badminton players
Source: research data processing

The interaction of training programme models and hand-eye coordination on the skills of children's badminton players

Table 8. Statistical test of the interaction of training programme model and hand-eye coordination on badminton player skills

	Result
Chi-Square	23.392
df	3
Asymp. Sig.	.000

Source: research data processing

Table 8 shows the results of the Chi-Square test with a value of 23.392, which means there is a significant difference between the data obtained and the expected data. The degree of freedom (df) is 3, and the Asymp. Sig. value of 0.000 indicates this result is highly statistically significant (p < 0.05 is considered significant, p < 0.01 is considered highly significant). With p = 0.000, the chance of this result occurring by chance is very small. The Chi-Square test showed a significant difference between the observed and expected data, so the null hypothesis (H0) was rejected. The conclusion is "There is a significant interaction between the training programme model and hand-eye coordination."

Because there is an interaction, it is followed by Tukey's Post Hoc test to find which combination has an interaction.

Table 9. Multiple Comparisons of the interaction of training programme model and hand-eye coordination on badminton player skills

Dependent Variable: Tukey HSD Results						
(I) Class	(J) Class	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
High coordination linear programme	Low coordination linear programmes	11.372929*	2.012878	000	6.03055	16.71531
	High coordination nonlinear programme	8.906500*	2.012878	000	3.56412	14.24888
	Low coordination nonlinear programme	13.126643*	2.012878	000	7.78427	18.46902
Low coordination linear programme	High coordination linear programmes	-11.372929*	2.012878	000	-16.71531	-6.03055
	High coordination nonlinear programme	-2.466429	2.012878	614	-7.80881	2.87595
	Low coordination nonlinear programme	1.753714	2.012878	820	-3.58866	7.09609
High coordination nonlinear programme	High coordination linear programmes	-8.906500*	2.012878	000	-14.24888	-3.56412
	Low coordination linear programmes	2.466429	2.012878	614	-2.87595	7.80881
	Low coordination nonlinear programme	4.220143	2.012878	168	-1.12223	9.56252
Low coordination nonlinear programme h	High coordination linear programmes	-13.126643*	2.012878	000	-18.46902	-7.78427
	Low coordination linear programmes	-1.753714	2.012878	820	-7.09609	3.58866
	High coordination nonlinear programme	-4.220143	2.012878	168	-9.56252	1.12223

*. *The mean difference is significant at the 0.05 level.*

Tukey's Post Hoc test provides details on the mean differences between pairs of groups in the study, including the mean difference, standard error, significance, and 95% confidence interval.

1) Linear training model with high vs. low hand-eye coordination: There was a mean difference of 11.372929 with a standard error of 2.012878 and a significance of 0.000. This difference is significant with a 95% confidence interval between 6.03055 and 16.71531.

2) Linear training model with high hand-eye coordination vs. nonlinear model with high hand-eye coordination: The mean difference was 8.906500 with a standard error of 2.012878 and a significance of 0.000, indicating a significant difference with a 95% confidence interval between 3.56412 and 14.24888.

3) Linear training model with high hand-eye coordination vs. nonlinear model with low hand-eye coordination: The mean difference was 13.126643 with a standard error of 2.012878 and a significance of 0.000, indicating a significant difference with a 95% confidence interval between 7.78427 and 18.46902.

4) Linear training model with low hand-eye coordination vs. linear model with high hand-eye coordination: Mean difference -11.372929 with a standard error of 2.012878 and a significance of 0.000, indicating a significant difference with a 95% confidence interval between -16.71531 and -6.03055.

5) Linear training model with low hand-eye coordination vs. nonlinear model with high hand-eye coordination: Mean difference -2.466429 with standard error 2.012878 and significance 0.614, indicating no significant difference with 95% confidence interval between -7.80881 and 2.87595.

6) Linear training model with low hand-eye coordination vs. nonlinear model with low hand-eye coordination: Mean difference 1.753714 with standard error 2.012878 and significance 0.820, indicating no significant difference with 95% confidence interval between -3.58866 and 7.09609.

7) Nonlinear model with high hand-eye coordination vs. linear model with high hand-eye coordination: Mean difference -8.906500 with a standard error of 2.012878 and a significance of 0.000, indicating a significant difference with a 95% confidence interval between -14.24888 and -3.56412.

8) Nonlinear model with high hand-eye coordination vs. linear model with low hand-eye coordination: Mean difference 2.466429 with standard error 2.012878 and significance 0.614, indicating no significant difference with 95% confidence interval between -2.87595 and 7.80881.

9) Nonlinear model with high hand-eye coordination vs. nonlinear model with low hand and-eye coordination: Mean difference 4.220143 with standard error 2.012878 and significance 0.168, indicating no significant difference with 95% confidence interval between -1.12223 and 9.56252.

10) Nonlinear model with low hand-eye coordination vs. linear model with high hand-eye coordination: Mean difference -13.126643 with a standard error of 2.012878 and a significance of 0.000, indicating a significant difference with a 95% confidence interval between -18.46902 and -7.78427.

11) Nonlinear model with low hand-eye coordination vs. linear model with low hand-eye coordination: Mean difference -1.753714 with standard error 2.012878 and significance 0.820, indicating no significant difference with 95% confidence interval between -7.09609 and 3.58866.

12) Nonlinear model with low hand-eye coordination vs. nonlinear model with high hand-eye coordination: Mean difference -4.220143 with standard error 2.012878 and significance 0.168, indicating no significant difference with 95% confidence interval between -9.56252 and 1.12223.

DISCUSSION

Based on the results of statistical tests, there is a significant difference between the effectiveness of linear and nonlinear training programmes on the skills of children's badminton players. The linear training programme proved superior in improving these skills. The higher mean scores of the linear programme confirmed its effectiveness compared to the nonlinear programme. This finding is important for choosing more effective training methods for children in badminton.

The Mann-Whitney U test results showed highly significant differences between the groups with high and low hand-eye coordination. The group with high hand-eye coordination had a mean value of 52.68139, higher than the group with low hand-eye coordination which had a mean of 44.88486. This indicates that the variable "class" has a significant influence on hand-eye coordination ability.

A Chi-Square test with a value of 23.392 indicates a significant difference between the actual data and the expected data. With degrees of freedom (df) 3 and Asymp. Sig. 0.000, the null hypothesis (H0) stating "There is no interaction between the training programme model and hand-eye coordination" is rejected. The conclusion is "There is a significant interaction between the training programme model and hand-eye coordination."

Significant interactions occurred in the following combinations:

1) Linear training with high hand-eye coordination vs. nonlinear training with low eye-hand coordination. Mean difference: 13.126643, significance: 0.000 (significant), interpretation: Linear training with high coordination is more effective than nonlinear training with low coordination.

2) Linear training with high hand-eye coordination vs. nonlinear training with high hand-eye coordination. Mean difference: 8.906500, significance: 0.000 (significant), interpretation: linear training with high coordination is more effective than nonlinear training with high coordination.

3) Nonlinear training with high hand-eye coordination vs. linear training with high hand-eye coordination. Mean difference: -8.906500, Significance: 0.000 (significant), Interpretation: Nonlinear training with high coordination is less effective than linear training with high coordination.

4) Nonlinear training with low hand-eye coordination vs. linear training with high hand-eye coordination. Mean difference: -13.126643, Significance: 0.000 (significant), Interpretation: Nonlinear training with low coordination is less effective than linear training with high coordination.

CONCLUSION

The results of the analysis and discussion concluded, there is a significant difference between the effectiveness of linear and nonlinear training programmes on the skills of children's badminton players. There is a very significant difference between groups with high and low hand-eye coordination in the skills of children's badminton players. There is a significant interaction between the training programme model and hand-eye coordination on the skills of children's badminton players. The highest interaction test result is the mean difference between "Linear training with high hand-eye coordination" vs. "Nonlinear training with low hand-eye coordination," which is 13.126643. This difference is significant with a significance value of 0.000, indicating that linear training with high hand-eye coordination is much more effective than nonlinear training with low hand-eye coordination.

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