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Evaluation of Forehand and Backhand Technique: An Experimental Study of Training Effectiveness in Table Tennis

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Abstract: *Various techniques in the game of table tennis are studied in depth to improve the performance of athletes. The research focuses on the analysis of aspects of the game such as technical skills, biomechanics, and the level of effectiveness. This study was to look at the effectiveness of forehand and backhand skills in table tennis games. This research is included in the type of ex post facto research, where the measurement or testing of forehand and backhand hitting skills in table tennis games is carried out on students who have participated in table tennis lectures for 16 meetings, with a total of 24 participants. The learning process was conducted through structured sessions, ensuring that all participants received equal opportunities for practice using adequate facilities. Skill assessment was administered after the completion of the instructional program. Data analysis involved testing the normality of the data distribution, followed by the application of both parametric and non-parametric statistical approaches to compare forehand and backhand performance. The findings revealed that forehand performance tended to follow a normal distribution, while backhand performance showed slight deviations from normality. However, the results from both statistical approaches consistently indicated that there was no significant difference between forehand and backhand skills. Visual analysis further supported these findings, showing that forehand data aligned more closely with the expected distribution pattern, whereas backhand data demonstrated minor irregularities. In conclusion, beginner students exhibit relatively balanced development of forehand and backhand skills following structured learning. These findings suggest that the instructional approach applied in the learning process is effective in promoting proportional skill acquisition. The study emphasizes the importance of balanced technical training in early stages of learning and highlights the need for further research to explore additional factors that may influence skill development in table tennis.*

Keywords: *Table Tennis; Performance Sport; Training Method*

Introduction

The technique of playing table tennis has been studied extensively to improve the performance of the players. The research is focused on the analysis of various aspects of the game, including technical skills, biomechanics, and effectiveness. The main techniques identified included spin, block, chop, push, and drive, with spin being the most dominant (44.179%) in high-level play (Yulianto, 2015). Biomechanical studies have compared fast break and curving ball techniques, which reveal differences in racket speed during different phases of the stroke (Mao, 2012). Evaluation of the effectiveness of elite players' techniques has led to the development of formulas and criteria for assessing performance, with Chinese players generally excelling in most techniques compared to their international counterparts (Zhang et al., 2013). These studies provide valuable insights for players and coaches, highlighting the importance of mastering certain techniques and understanding their biomechanical aspects to achieve a high level of performance in table tennis.

Recent studies on table tennis playing techniques reveal significant differences between male and female players at a high level. Men tend to prefer forehand techniques and offensive shots, specifically flips, while women use defensive punches and backhand techniques more (Malagoli Lanzoni et al., 2024; Pradas de la Fuente et al., 2023). Women generally play more shots per rally and game compared to men (Malagoli Lanzoni et al., 2024). Top players show versatile technical skills, with attack after serve being an important technique for scoring points (Sung, 2019). The heart rate response during the match showed an average rate of 142.69 bpm and a peak rate of 167.26 bpm,

with forehand shots accounting for 57.88% of the total strokes (Picabea et al., 2022). Service placement usually targets areas close to the net, while subsequent shots are often directed to backhand corners (Malagoli Lanzoni et al., 2024). These findings highlight the importance of tailoring training sessions to address gender-specific playstyles and technical-tactical needs.

Recent studies on table tennis strokes have revealed important insights into technique, performance, and neural activity. Gender differences in punch kinematics were observed, with men using larger muscle groups and achieving higher hand acceleration compared to women (Bańkosz et al., 2020). The non-playing hand was found to move symmetrically with the playing hand during the topspin forehand, which could potentially support the punch (Winiarski et al., 2021). Neural efficiency in experts is demonstrated through lower cortical activation compared to beginners during forehand and backhand strokes, despite superior performance (Carius et al., 2023). To improve backhand accuracy in beginner players, external focus of attention (on the ball or table target) has been shown to be more effective than internal focus (on the hand), which supports the benefit of external cues in skill acquisition (Niźnikowski et al., 2022). These findings contribute to our understanding of stroke mechanics, skill-related differences, and effective training strategies in table tennis.

Table tennis is a popular sport among students that develops a wide range of skills, including coordination, speed, and accuracy (Zhukovskyi et al., 2020). For beginners, innovative teaching methods can enhance learning. Video analysis of forehand techniques helps students understand proper movements and correct mistakes (Chichenova, 2021). Reflective board devices have been shown to effectively improve forehand and backhand drive skills in beginner players (Hanim & Tomoliyus, 2019). Structured lessons typically include warm-ups, main exercises, and cool-downs, with coordination exercises placed at the beginning of the session (Zhukovskyi et al., 2020). The Confederation of Table Tennis Brazil and the University of Campinas have developed a comprehensive entry-level course that includes Olympic and Paralympic table tennis (Belli & Galatti, 2021). This approach can help beginners develop proper technique and improve their overall performance in table tennis. The main objective of this study is to see the effectiveness of table tennis learning on forehand and backhand shots.

Method

Design

This research is ex post facto research, where this research method examines the cause-effect relationship in events or events that have occurred (Darajat & Abduljabar, 2014). The measurement or test of forehand and backhand hitting skills in table tennis games was carried out on table tennis lecture students who had carried out lectures for 16 meetings with a total of 24 students, consisting of male and female students who were beginner students or had never played table tennis.

Instrument

The instrument used in this study is the backboard test in table tennis games. The backboard test has a validity value of 0.615 and a reliability value of 0.738; the purpose of this test is to measure beginner table tennis playing skills (Rumondor et al., 2022). The test backboard is a test where the testee makes a shot independently by reflecting the results of the shots to the wall of the table tennis table that is arranged vertically. The testee took the test for 30 seconds with a chance of 3 times, and the highest score was taken.

Procedure

The following is the research procedure carried out in this study, where the respondents carried out and participated in table tennis learning for many as 16 meetings. Table tennis learning is carried out for 2 x 50 minutes in each session with the number of tables used as many as 6 ping pong tables so that each student has the same opportunity to do treats. The skills test was conducted at the 17th meeting after the learning was completed.

Result

Here is a description of the test results of forehand and backhand skills in table tennis learning, as seen in table 1.

Table 1. *Description of Forehand and Backhand Skill Results Data*

	Types of Strokes	N	Mean	Hours of deviation	Std. Error Mean
Table tennis skills	Forehand	24	43.67	15.85	3.23
	Backhand		49.42	17.81	3.63

The results of the table tennis skills test in table 1 show the test score results of 24 respondents with an average forehand score of 43.67, a standard deviation of 15.85, and a standard error of 3.23. As for the backhand shot, it shows an average score of 49.42, with a standard deviation of 17.81 and a mean standard error of 3.63. Looking at the average score in Table 1 shows that the average score of the backhand shot has a higher success effectiveness than the forehand shot.

Furthermore, to see if there is a significant difference in the effectiveness of table tennis learning on forehand and backhand strokes, an independent samples test was conducted. Table 2 shows the results of the statistical test of independent samples by using SPSS.

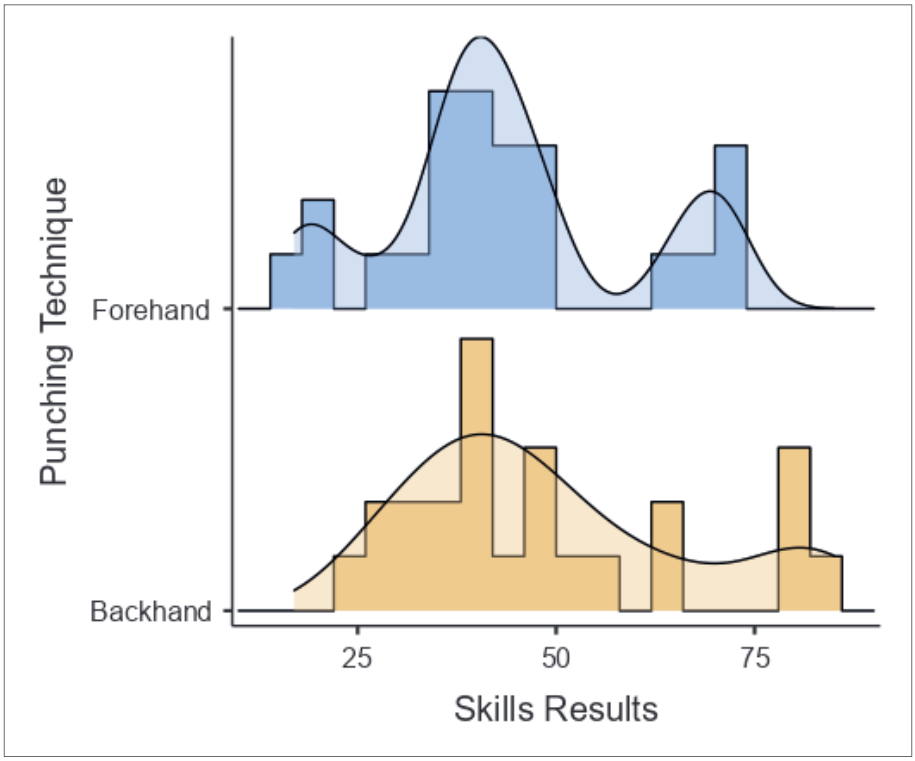

Figure 1. *Density and histogram of test result data*

Figure 1 show the distribution of skill results based on forehand and backhand stroke techniques exhibited distinct characteristics. For the forehand technique, data were spread over a fairly wide range, with a tendency toward a less symmetrical distribution and mild multimodality. The largest concentration of scores was in the mid-range (around 40–55), but there were also clusters of high scores, indicating variation in performance between subjects. Meanwhile, the backhand distribution tended to be more centralized and formed a unimodal pattern with a peak in the 35–50 range. Nevertheless, variation was still evident through the spread of scores into the high range, albeit with a lower frequency. Overall, both techniques had relatively similar score ranges, but forehand showed greater variation than backhand. This indicates that forehand ability is more heterogeneous among individuals, while backhand tends to be more consistent. Furthermore, both distributions did not fully follow a normal pattern, as indicated by skewness and uneven data distribution. These findings suggest the need for more specific training approaches for each technique to optimize overall skill mastery.

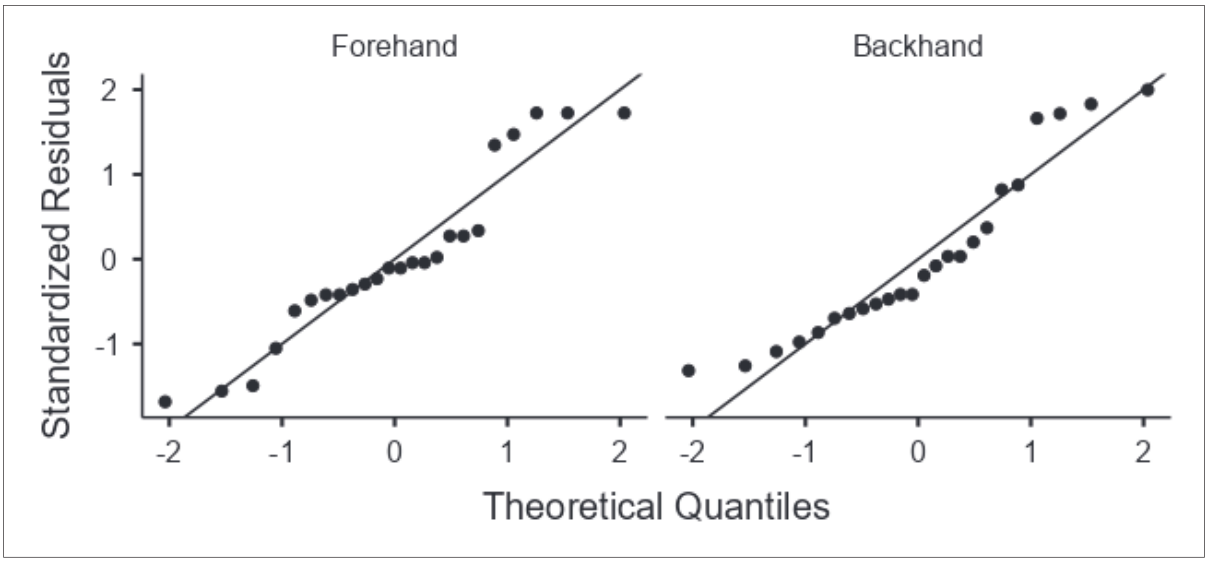

Figure 2. *Assumption of data normality*

The figure 2 shows the Q-Q plot (Quantile–Quantile Plot) of standardized residuals on the forehand and backhand variables used to evaluate the assumption of data normality. In the forehand plot, the data points tend to follow the diagonal line with slight deviations in the tails, indicating that the data distribution is close to normal, and therefore the assumption of normality is acceptable. In contrast, in the backhand plot, although some points are located around the diagonal line, there are more obvious deviations, especially in the lower tail and some points that are far from the reference line, indicating that the data distribution does not meet the assumption of normality. These visual findings are consistent with the results of the Shapiro–Wilk test, which obtained a W statistic value of 0.918 for the forehand and 0.905 for the backhand, with significance values (p-values) of 0.052 and 0.027, respectively. Based on the decision-making criteria ($\alpha = 0.05$), a p-value > 0.05 for the forehand indicates that the data are normally distributed, while a p-value < 0.05 for the backhand indicates that the data are not normally distributed. Thus, it can be concluded that the normality assumption is only met for the forehand variable, while the backhand variable requires a non-parametric analysis approach or data transformation before further analysis is carried out.

Table 2. *Non Parametrik Independent Samples Test Forehand And Backhand Skills*

		Statistic	df	p
Skills Results	Student's t	-1.18	46.0	0.243
	Mann-Whitney U	243		0.358

Note: $H_a\ \mu_{Forehand} \neq \mu_{Backhand}$

Based on Table 2, which displays the results of the test for differences between forehand and backhand skills, two analytical approaches were used, namely the parametric test (independent samples t-test) and the non-parametric test (Mann–Whitney U). The t-test results show a statistical value of -1.18 with a degree of freedom (df) of 46 and a significance value (p) of 0.243. Meanwhile, the Mann–Whitney U test produces a statistical value of 243 with a significance value (p) of 0.358. Referring to the decision-making criteria ($\alpha = 0.05$), both p-values are greater than 0.05, so there is no significant difference between forehand and backhand skills. Thus, the alternative hypothesis (H_a: μ forehand $\neq \mu$ backhand) is rejected, which means that statistically forehand and backhand skills are at a relatively similar level.

Discussion

The analysis results showed no significant difference between forehand and backhand skills, based on both parametric (independent samples t-test) and non-parametric (Mann–Whitney U) tests, with significance values of 0.243 and 0.358, respectively (p > 0.05). This finding indicates that statistically, the abilities of both types of strokes are at a relatively equal level. This condition may reflect that the training process given to the subjects has been able

to develop technical skills in a balanced manner between the forehand and backhand sides. In addition, the absence of significant differences may also be influenced by the homogeneous characteristics of the sample or a relatively uniform level of playing experience. From a methodological perspective, the results of the previous normality test showed that only forehand data were normally distributed, while backhand data were not, so the use of non-parametric tests is relevant to strengthen the analysis results. The consistency of the results between the two test methods strengthens the validity of the finding that there is no significant difference. The implication is that coaches or sports practitioners can maintain a balanced training approach but still need to conduct a more in-depth evaluation of certain technical aspects to improve specific performance, especially if there are individual variations that were not statistically detected in this study.

Recent studies have explored various approaches to improve the learning of forehand and backhand shots of table tennis. The scientific approach applied in the junior high school setting produced excellent learning outcomes for both strokes, with 68% of students achieving high proficiency (Mappaompo et al., 2023). Video-based learning media and apps significantly improve forehand and backhand skills among students (Fufu et al., 2020; Siregar et al., 2023). For elementary school students, the app-based learning model for forehand drive punches shows a modest skill improvement (Kurniadi et al., 2023). At the university level, a study on table tennis skills revealed that 46% of students showed excellent backhand shots, while 21% showed excellent forehand shots after a series of learning sessions (Azmi, 2024). These findings suggest that diverse teaching methods can effectively support the development of table tennis forehand and backhand skills across different age groups and education levels. The discovery learning style has shown a significant effect on improving basic techniques for students (Sari, 2020). Video-based self-recording during practice has been found to improve learning outcomes, with key skills including bouncing the ball, tapping the board, and forehand and backhand rallies (Sookhanaphibarn & Sookhanaphibarn, 2018). A survey of table tennis athletes revealed varying levels of proficiency in a variety of basic techniques, such as serving, attacking, defending, and certain types of strokes (Anwar et al., 2022). These findings suggest that a combination of innovative teaching methods, technology-assisted learning, and targeted skill development can contribute to improving basic table tennis skills for players at different levels.

In addition, various learning approaches are also very important to improve table tennis skills. Virtual reality (VR) training has shown promising results, with significant improvements in table tennis performance in the real world compared to the control group (Michalski et al., 2019; Oagaz et al., 2021). These studies show that the complex skills learned in VR can be transferred to the real world. Moreover, the *rich media platform for table tennis learning* (RMPTTL) has been found to improve advanced skills and participation motivation in young players (Zou et al., 2021). From a socio-ecological perspective, individual factors, such as intrinsic interests, have the most significant impact on adolescents' table tennis skills, followed by social support and physical environment (Gumilar, 2024; Gumilar et al., 2023; Xiao et al., 2020). To improve table tennis skills, it is recommended to cultivate intrinsic interests, encourage peer and parent support, provide adequate facilities, and incorporate innovative training methods such as VR and rich media platforms alongside traditional training techniques.

Another factor that favors table tennis performance and training is physical and physiological condition. Physical demands in tennis vary by court surface, performance level, and gender, with elite players exhibiting superior physical fitness and hitting performance compared to sub-elite players (Lambrich & Muehlbauer, 2022; Pluim et al., 2023). Sports training interventions have shown positive effects on physical fitness and stroke speed in young and adult tennis players, with varying effectiveness across different components (Lambrich & Muehlbauer, 2023). Specifically, large improvements were observed in agility, lower extremity muscle strength, upper extremity muscle strength, balance, and stroke speed. Age-specific differences in training adaptations were noted, with adult players showing greater potential for improvement in certain areas. In addition, research on transcranial direct current stimulation (tDCS) suggests that high-definition tDCS can offer superior behavioral and neurophysiological effects compared to conventional tDCS in visuomotor processing tasks (Sehatpour et al., 2021).

Conclusion

Based on the analysis results, it can be concluded that forehand and backhand skills do not show statistically significant differences, either through parametric tests (independent samples t-test) or non-parametric tests (Mann–Whitney U), with significance values greater than 0.05 for each. The normality test showed that the forehand data

were normally distributed, while the backhand was not, so a non-parametric analysis approach was used to ensure the reliability of the results. The consistency of the findings from both analysis methods indicates that forehand and backhand technical abilities are at a relatively balanced level. Thus, this study provides empirical evidence that there are no significant differences in ability between the two types of skills in the studied sample. The implications of these findings emphasize the importance of a proportional and integrated training approach in developing technical skills and open opportunities for further research to explore other factors that may influence performance variations in more depth.

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