Journal of Education and Educational Research
ISSN: 2957-9465 | Vol. 9, No. 2, 2024

The Impact of Scaffolding Teaching Method to Students' Learning Outcomes in Teaching Badminton

Huiwen Zhu [1, 2], Junji Chen [1, 2, *], Shutong Yang [1, 2]

[1] Graduate School, Adamson University, CO 1000, Manila, Philippines
[2] Guilin University, China

*** Corresponding author:** Junji Chen (Email: 77395715@qq.com)

Abstract: This study adopts the quasi-experimental method to analyze the differences of students' ability indexes before and after the experiment as well as students' responses to scaffolding teaching by intervening scaffolding teaching and traditional teaching in two badminton classes in Guilin University. The researcher selected 30 students from the two classes as the study subjects and divided them into experimental and control groups. The control group was taught by traditional teaching method and the experimental group was taught by scaffolding method after 8 weeks of experimental intervention. This study concluded that the gender ratio, grade distribution and number ratio of the control and experimental groups were comparable, which helped to reduce the influence of external factors on the results and improve the credibility of the study. Before the badminton program intervention, the control and experimental groups had similar scores. Before the badminton program intervention, there was no significant difference between the pre-test scores of the control group and the experimental group in terms of striking technique, footwork. The experimental group using the scaffolding method had a significant advantage in striking technique and footwork, which indicates the potential effectiveness of this teaching method in promoting students' skill development. The experimental group using the scaffolding method in the badminton course showed significant advantages in badminton skills. These results further demonstrate the positive role of scaffolding in physical education courses and provide a practical basis for further promotion and application of scaffolding.

Keywords: Scaffolding Teaching Method; Teaching Badminton; Students' Learning Outcomes.

1. Introduction

With the changes of the times, our country has put forward new requirements for the classroom teaching methods and talent training methods of school physical education. Improving the quality of school physical education teaching is also a top priority in accelerating the modernization of education and building a sports power. However, at present, physical education teaching in colleges and universities is still in the process of modernization transformation and development. School teaching methods should keep pace with the times, avoid traditional "indoctrination" teaching, determine students' zone of proximal development, and help students learn how to learn efficiently. Scaffolded teaching is where teachers combine students' situations to guide and help students complete some learning content that cannot be completed alone. It can help students construct the structure of technical movements and strengthen students' thinking abilities. This teaching method can effectively improve school physical education. The teaching effect and level are of great value to improving physical education.

At present, traditional teaching is the most common in physical education teaching in most schools, and the teaching effect is not obvious. It often involves teachers explaining technical movements and then organizing students to practice, correct and practice again. This teaching method makes students passive. The state of learning and the teaching effect are not ideal. Scaffolded teaching is a teaching method that takes students' learning initiative as the center point. It mainly aims at cultivating students' independent learning and active problem-solving abilities. This teaching method mainly takes students as the teaching subject and the teacher as the main subject. Leaders and instructors can more easily improve students' independent learning abilities.

Nowadays, more and more people like the sport of badminton. Badminton is highly interesting and easy to learn. It is gradually loved and sought after by men, women and children, and badminton courses are gradually being opened in various types of schools. Students I also like this sport quite a bit. However, in the learning process of badminton, the difficulty of learning basic techniques is not high. Students mastering some simple technical movements in a short period of time can enhance their physical fitness and self-confidence. However, the learning of basic badminton techniques is relatively boring. If you just use traditional If teaching methods are used, students' interest in badminton decreased. Therefore, during the teaching process, teachers must not only improve students' physical fitness, but also stimulate students' ability to learn independently and actively explore. This study aims to explore the positive impact and effect of scaffolded teaching on college students' badminton learning compared with traditional teaching methods.

2. Statement of the Problem

This study analyzes the impact of scaffolded teaching in college badminton teaching by comparing the effects of traditional physical education teaching methods and scaffolded teaching. This research focused on the following problems:

1. What is the pre-test score of the control and experiment group - respondents in Badminton before the intervention in terms of:

1.1 Strike

1.2 Shot footwork

2. Is there a significant difference in the pretest score of the control group and experimental respondent before the

intervention with regards to:

2.1 strike

2.2 shot footwork

3.What is the post test score of the control group (taught in traditional was) and the experimental group (utilizing scaffolding)

4.Is there significant difference in the post test result in the control group (using test) and experimental group after intervention?

5.Is there a significant difference in the Pre-test score (before intervention) and posttest (after intervention) of the control group?

6.Is there a significant difference in the pre-test score (before intervention) & post test score after the intervention of the experimental?

7.Based on the findings of the study, what enhanced badminton training program maybe proposed?

3. Hypotheses

Ho1: There is no significant difference in the pretest score of the control group and experimental respondent before the intervention.

Ho2: There is no significant difference in the post test of the control group and of the experimental group after the intervention.

Ho3: There is no significant difference in the post test results of the control group before and after the intervention.

Ho4: There is no significant difference in the post test result of the experimental group before and after the intervention.

4. Research Design

This study adapted the quantitative method particularly guasi-experimental. Through the intervention of scaffolding teaching and traditional teaching in two badminton classes at Guilin University, the study analyzes the differences in students' various ability indicators before and after the experiment and the students' response to the scaffolding.

The researcher selected 2 classes 30 students for class, they were divided into experimental group and control group. In order to ensure the authenticity of the experiment and reduce the experimental error, the teachers were taught by the same teacher, and the experiment was conducted in the Guangxi Zhuang Autonomous Region Guilin College.

5. RESULTS AND ANALYSIS

Table 1. Assessment of control and experiment group - respondents in badminton before the intervention in terms of forehand serve high ball

Indicators	Control group					Experiment group				
	Mean	SD	Description	Qualitative Interpretation	Rank	Mean	SD	Description	Qualitative Interpretation	Rank
1.Basic station: stand behind the baseline, feet apart, shoulder width.	2.17	.461	Slightly Acceptable	Slightly Effective	5	2.23	.626	Slightly Acceptable	Slightly Effective	5
2.Center of gravity: lean slightly toward your right foot	2.60	.675	TSE	TSE	1	2.60	.498	TSE	TSE	1
3.Clap: the forehand clap, clap head perpendicular to the ground	2.30	.596	Slightly Acceptable	Slightly Effective	3	2.30	.596	Slightly Acceptable	Slightly Effective	3.5
4.. Swing: the body to the other side of the field, maintain balance, arms straight, fast swing	2.37	.615	Slightly Acceptable	Slightly Effective	2	2.43	.626	Slightly Acceptable	Slightly Effective	2
5.Stop position: shift the weight to the left foot, clap head behind the left shoulder	2.27	.640	Slightly Acceptable	Slightly Effective	4	2.30	.596	Slightly Acceptable	Slightly Effective	3.5
Composite Mean	2.34	.284	Slightly Acceptable	Slightly Effective		2.37	.266	Slightly Acceptable	Slightly Effective	

N=60. Parameter limits: 4.20 - 5.00 Highly Acceptable (HA)/ Highly Effective (HE);3.40 - 4.19 Acceptable (A) / Effective €;2.60 - 3.39 To Some Extent (TSE);1.80 - 2.59 Slightly Acceptable (SA) / Slightly Effective;1.00 - 1.79 Not Acceptable (NA) / Not Effective (NE)

This section presents the presentation, analysis, and interpretation of data. The discussions are based on the sequence of the statement of the problem while analysis and interpretation are based on the treatment of data and guided by the literature and studies gathered in this study.

Ⅰ.The pre-test score of the control and experiment group - respondents in Badminton before the intervention

1.1 Strike

Table 1 shows the assessment of the control and experimental groups in badminton forecourt serve prior to the intervention.

The mean scores for the control group ranged from 2.17 to 2.60 with standard deviations between 0.461 and 0.675, while the mean scores for the experimental group ranged from 2.23 to 2.60 with standard deviations between 0.498 and 0.626. These scores indicate relatively stable performance on the different indicators, but with slight fluctuations in the experimental group. The scores of the groups on each indicator fall between "slightly acceptable" and "to some extent". This means that before the intervention, both the control and experimental groups performed at a slightly acceptable level in the badminton forecourt serve.

The highest mean indicator for both groups was "Center of gravity: lean slightly toward your right foot" with a mean score of 2.60, indicating that the students performed relatively well in leaning their center of gravity. The lowest mean score for both groups was "Basic station: stand behind the baseline, feet apart, shoulder width." The mean scores were 2.17 for the control group and 2.23 for the experimental group, which indicated that the students could improve their basic station skills. could be improved in the basic skills of standing.

Table 2. Assessment of control and experiment group - respondents in badminton before the intervention in terms of forehand hit high ball

Indicators	Control group					Experiment group				
	Mean	**SD**	**Description**	**Qualitative Interpretation**	**Rank**	**Mean**	**SD**	**Description**	**Qualitative Interpretation**	**Rank**
1.Basic position: left foot in front, right foot disaster, two feet open, shoulder width, hands flat on the side	2.40	.563	Slightly Acceptable	Slightly Effective	3.5	2.43	.626	Slightly Acceptable	Slightly Effective	3.5
2.Center of gravity: center of gravity on the right foot (back foot)	2.37	.669	Slightly Acceptable	Slightly Effective	5	2.43	.679	Slightly Acceptable	Slightly Effective	3.5
3.Clap: forehand clap, clap head up	2.40	.814	Slightly Acceptable	Slightly Effective	3.5	2.43	.774	Slightly Acceptable	Slightly Effective	3.5
4.Swing: the upper arm with the body to the left rotation, forearm rapid inward rotation, racket face forward, arm straight hit the ball carrier	2.50	.682	Slightly Acceptable	Slightly Effective	1	2.50	.630	Slightly Acceptable	Slightly Effective	2
5.Stop Position: the center of gravity from the right leg to the left foot, right hand swing to the outside of the left leg	2.47	.571	Slightly Acceptable	Slightly Effective	2	2.63	.669	TSE	TSE	1
Composite Mean	**2.43**	**.301**	Slightly Acceptable	Slightly Effective		**2.49**	**.309**	Slightly Acceptable	Slightly Effective	

N=60. Parameter limits: 4.20 - 5.00 Highly Acceptable (HA)/ Highly Effective (HE);3.40 - 4.19 Acceptable (A) / Effective €;2.60 - 3.39 To Some Extent (TSE);1.80 - 2.59 Slightly Acceptable (SA) / Slightly Effective;1.00 - 1.79 Not Acceptable (NA) / Not Effective (NE)

The overall mean scores were 2.34 for the control group and 2.37 for the experimental group which indicated that the overall performance of both groups in badminton forecourt serving skills was slightly at an acceptable level.

Tan (2022) showed that correct center of gravity is one of the key factors for successful serving in badminton. The experimental and control groups had the highest scores in terms of center of gravity, which is consistent with the results of Zhao's (2020) study. The correct position of the center of gravity improves stability and ball control and is therefore crucial in badminton serving skills. Ma and Yuan (2019) showed that a good basic stance is crucial for the overall performance of badminton players. However, Table 1 shows that the control and experimental groups had the lowest scores in basic stance, which suggests that the students have room for improvement in proper stance skills. This is in line with the findings of Che (2022), which emphasized that basic skills should be emphasized and strengthened during the training process. Although the performance of the experimental and control groups was similar in most of the indicators, there were differences in some of the indicators. This was caused by the fact that the experimental group received scaffolding teaching methods while the control group received traditional teaching methods. Therefore, future research could further explore how targeted training and teaching interventions can improve students' badminton skills, particularly in the areas of basic skills and stance.

Table 2 shows the assessment of the control and experimental groups in badminton forecourt strokes prior to the intervention.

The mean scores for the control group ranged from 2.37 to 2.50 with a standard deviation of 0.563 to 0.814, while the mean scores for the experimental group ranged from 2.43 to 2.63 with a standard deviation of 0.626 to 0.679. The groups' scores for each indicator fell between “slightly acceptable” and “to some extent”. This means that before the intervention, both the control and experimental groups performed at a slightly acceptable level in badminton front court hitting.

The highest mean indicator for the control group was “Swing: the upper arm with the body to the left rotation, forearm rapid inward rotation, racket face forward, arm straight hit the highest mean score was “Swing: the upper arm with the body to the left rotation, forearm rapid inward rotation, racket face forward, arm straight hit the ball carrier”, with a mean score of 2.50, which means that the performance in batting maneuvers was relatively good. The lowest mean score for the control group was “Center of gravity: center of gravity on the right foot (back foot)”, with a mean score of 2.37, indicating that there is room for improvement in maintaining the stability of the center of gravity.

Table 3. Assessment of control and experiment group - respondents in badminton before the intervention in terms of backhand serve front ball

Indicators	Control group					Experiment group				
	Mean	**SD**	**Description**	**Qualitative Interpretation**	**Rank**	**Mean**	**SD**	**Description**	**Qualitative Interpretation**	**Rank**
1.Basic station: stand behind the baseline, right foot in front, holding hands to the chest	2.43	.774	Slightly Acceptable	Slightly Effective	3	2.43	.728	Slightly Acceptable	Slightly Effective	2
2.Center of gravity: center of gravity on the front foot	2.57	.626	Slightly Acceptable	Slightly Effective	1	2.53	.681	Slightly Acceptable	Slightly Effective	1
3.Grip: a backhand grip with the head slightly below the wrist and elbow	2.53	.507	Slightly Acceptable	Slightly Effective	2	2.33	.661	Slightly Acceptable	Slightly Effective	4
4.Swing: Thumb to move the handle, hit the ball to the other side of the field	2.40	.675	Slightly Acceptable	Slightly Effective	4	2.40	.770	Slightly Acceptable	Slightly Effective	3
Composite Mean	**2.48**	**.293**	Slightly Acceptable	Slightly Effective		**2.43**	**.366**	Slightly Acceptable	Slightly Effective	

N=60. Parameter limits: 4.20 - 5.00 Highly Acceptable (HA) / Highly Effective (HE);3.40 - 4.19 Acceptable (A) / Effective Є;2.60 - 3.39 To Some Extent (TSE);1.80 - 2.59 Slightly Acceptable (SA) / Slightly Effective;1.00 - 1.79 Not Acceptable (NA) / Not Effective (NE)

The highest mean score for the experimental group was also “Stop Position: the center of gravity from the right leg to

the left foot, right hand swing to the outside of the left leg", with a mean score of 2.37, indicating improvement in maintaining the stability of the body's center of gravity. The highest mean score is "Stop Position: the center of gravity from the right leg to the left foot, right hand swing to the outside of the left leg", with an average score of 2.63, which shows that the experimental group has better control of the stopping position after mastering the batting maneuver. The lowest mean score of the experimental group is "Basic position: left foot in front, right foot disaster, two feet open, shoulder width, hands flat on the side" and "Center of gravity". The lowest mean scores were for "Basic position: left foot in front, right foot disaster, two feet open, shoulder width, hands flat on the side", "Center of gravity: center of gravity on the right foot (back foot)" and "Clap: forehand clap, clap head up". "With a mean score of 2.43, indicating room for improvement in basic stance, maintaining center of gravity stability, and correct execution of the clap.

The overall mean scores were 2.43 for the control group and 2.49 for the experimental group, which indicated that the overall performance of both groups in badminton forehand clapping skills was slightly at an acceptable level.

Liu (2021) found that good striking movements can increase the speed and accuracy of the ball, thus improving game performance. Therefore, the results of the assessment of striking movements in Table 3 reflect the potential ability and room for improvement in the skill level of the students. A stable center of gravity of the body can help players to better control the striking motion and improve accuracy and ball control (Meng, 2021). Therefore, the scores of the control and experimental groups on the center of gravity index reflect the importance of body stability for skill performance. Qin (2020) study has explored the effects of different teaching methods on improving badminton skills. Zhang (2023) study compared the effects of traditional and scaffolding teaching methods on students' badminton skills and found that scaffolding teaching methods could significantly improve students' skills.

Table 3 shows the assessments of the control and experimental groups on backhand serves prior to the intervention.

The mean scores for the control group ranged from 2.40 to 2.57 with standard deviations between 0.507 and 0.774, while the mean scores for the experimental group ranged from 2.33 to 2.53 with standard deviations between 0.366 and 0.770. These scores indicate relatively stable performance on the different indicators. The groups' scores for each indicator fell within the "marginally acceptable" range, indicating that both the control and experimental groups had achieved a certain level of performance on the backhand serve prior to the intervention.

The highest mean score for the control group was for "Center of gravity: center of gravity on the front foot", with a mean score of 2.57, indicating relatively good performance in mastering proper stance and control of the center of gravity. The lowest mean score for the control group was "Swing: Thumb to move the handle, hit the ball to the other side of the field", with a mean score of 2.40, indicating that the correctness of the swinging action and the transfer of power need to be improved. The average score was 2.40, indicating that the correctness of the swing and the power transfer could be improved.

The highest mean score for the experimental group is "Center of gravity: center of gravity on the front foot", with an average score of 2.53, indicating that students in the experimental group performed well in mastering the correct standing position and the control of the center of gravity of the body. The lowest mean score for the experimental group was "Grip: a backhand grip with the head slightly below the wrist and elbow", with an average score of 2.33, indicating that the experimental group performed similarly to the control group in terms of grip movement. This means that the students in the experimental group performed similarly to the control group in terms of their gripping movements, and that they need to improve their gripping posture to improve their skills.

The overall mean scores were 2.48 for the control group and 2.43 for the experimental group, indicating that the overall performance of both groups in the backhand serve skill was slightly at an acceptable level.

Standing position is crucial for the successful execution of badminton techniques. For example, Wang (2023) found that correct stance can help players balance their bodies better and improve the accuracy and power of their strokes. Miao (2021) showed that correct body weight control is one of the key factors in badminton technique. Leng (2020) found that placing the body weight on the correct foot can help players control their strokes better and improve the stability and accuracy of the technique. The results of the assessment regarding the center of gravity highlighted the importance of the students' body weight control in the execution of the technique. Abune (2019) study showed that the correct grip is essential for the successful execution of badminton technique. Incorrect racket grip leads to technical errors and reduced accuracy.

Table 4. Assessment of Strike of control and experiment group - respondents in badminton before the intervention

Indicators	Control group					Experiment group				
	Mean	**SD**	**Description**	**Qualitative Interpretation**	**Rank**	**Mean**	**SD**	**Description**	**Qualitative Interpretation**	**Rank**
forehand serve high ball	2.34	.284	Slightly Acceptable	Slightly Effective	3	2.37	.266	Slightly Acceptable	Slightly Effective	3
forehand hit high ball	2.43	.301	Slightly Acceptable	Slightly Effective	2	2.49	.309	Slightly Acceptable	Slightly Effective	1
bachandserve front ball	2.48	.293	Slightly Acceptable	Slightly Effective	1	2.43	.366	Slightly Acceptable	Slightly Effective	2
Composite Mean	**2.41**	**.239**	Slightly Acceptable	Slightly Effective		**2.43**	**.252**	Slightly Acceptable	Slightly Effective	

N=60. Parameter limits: 4.20 - 5.00 Highly Acceptable (HA) / Highly Effective (HE);3.40 - 4.19 Acceptable (A) / Effective €;2.60 - 3.39 To Some Extent (TSE);1.80 - 2.59 Slightly Acceptable (SA) / Slightly Effective;1.00 - 1.79 Not Acceptable (NA) / Not Effective (NE)

Table 4 shows the assessment of the control and experimental groups in terms of badminton hitting technique before the intervention. The table includes the mean scores, standard deviations, descriptive interpretations, qualitative interpretations, and combined means of the control and experimental groups on the three indicators.

The mean scores for the control group ranged from 2.34 to 2.48 with standard deviations between 0.239 and 0.293, while the mean scores for the experimental group ranged from 2.37 to 2.49 with standard deviations between 0.252 and 0.366. These scores indicate relatively stable performance on the different indicators, and the mean scores and standard deviations of the two groups are very close to each other. The scores of the groups on each indicator fall within the "marginally acceptable" range, indicating that the control and experimental groups had similar overall levels of badminton hitting skills prior to the intervention and had reached a certain level.

The highest mean score for the control group was "backhand serve front ball" with a mean score of 2.48, indicating a relatively good performance in the backhand serve. The lowest mean score for the control group is "forehand serve high ball" with a mean score of 2.34, which indicates a slightly lower level of skill in forehand serve.

The highest mean score for the experimental group is "forehand hit high ball" with a mean score of 2.49, indicating that the experimental group's technical performance in forehand hit is slightly better than the other indicators. The lowest mean value for the experimental group was "forehand serve high ball", with a mean score of 2.37, indicating that the experimental group's average performance in forehand serve high ball was slightly worse than other technical indicators.

The overall mean values were 2.41 for the control group and 2.43 for the experimental group, indicating that the overall level of badminton ball striking technique of both groups reached the "slightly acceptable" level.

Table 5. Assessment of control and experiment group - respondents in badminton before the intervention in terms of Combination of online pace

Indicators	Control group					Experiment group				
	Mean	SD	Description	Qualitative Interpretation	Rank	Mean	SD	Description	Qualitative Interpretation	Rank
1.Two-step stride: take one step in the direction of the ball with your left foot, and hit the ball with your right heel	2.43	.626	Slightly Acceptable	Slightly Effective	2	2.50	.682	Slightly Acceptable	Slightly Effective	2.5
2.Three-step Stride: take a step in the direction of the ball with your right foot, take a small step with your left foot, and finally, take a big step with your right foot and hit the ball	2.23	.626	Slightly Acceptable	Slightly Effective	3	2.30	.651	Slightly Acceptable	Slightly Effective	3
3.Cross step: step forward with the right foot to small cloth, followed by the right foot up, using the left foot staring step out of a big step	2.50	.572	Slightly Acceptable	Slightly Effective	1	2.50	.572	Slightly Acceptable	Slightly Effective	1
Composite Mean	2.39	.329	Slightly Acceptable	Slightly Effective		2.43	.292	Slightly Acceptable	Slightly Effective	

N=60. Parameter limits: 4.20 - 5.00 Highly Acceptable (HA)/ Highly Effective (HE);3.40 - 4.19 Acceptable (A) / Effective €;2.60 - 3.39 To Some Extent (TSE);1.80 - 2.59 Slightly Acceptable (SA) / Slightly Effective;1.00 - 1.79 Not Acceptable (NA) / Not Effective (NE)

Forehand serve technique is crucial for the performance of badminton players. Lu and Yang (2020) found that correct forehand serve technique can improve the accuracy and power of players' strokes, which can enhance the competitive ability. Rahmat et al. (2021) emphasized the importance of backhand serve technique for badminton players. A good backhand serve technique can increase players' variation and aggressiveness on the court and improve their athleticism. The importance of a comprehensive assessment of badminton technique was also emphasized. Xu (2021) found that coordination and balance between different technical indicators is one of the key factors affecting a player's overall performance.

1.2 Shot footwork

Table 6 shows the assessment of the control and experimental groups in terms of badminton footwork technique prior to the intervention.

The mean scores of the control group ranged from 2.23 to 2.50 with standard deviations between 0.572 and 0.626, while the mean scores of the experimental group ranged from 2.30 to 2.50 with standard deviations between 0.572 and 0.682. These scores indicate relatively stable performance on the different indicators, and the mean scores and standard deviations of the two groups are very close to each other.

The highest mean score for the control group was for the “Cross step” with a mean score of 2.50, indicating a relatively good technical performance in the cross step. The lowest mean indicator for the control group was “Three-step Stride” with a mean score of 2.23, indicating a slightly lower level of skill in the three-step stride.

The highest mean score for the experimental group is “Two-step stride”, with a mean score of 2.50, indicating that the experimental group is slightly better in two-step stride than the other indicators. The lowest mean value for the experimental group is “Three-step stride”, with a mean score of 2.30, indicating that the experimental group needs to improve its three-step technique.

The overall mean scores of 2.39 for the control group and 2.43 for the experimental group indicate that the overall level of badminton stride technique of both groups has reached the level of “slightly acceptable”.

Table 6. Assessment of control and experiment group - respondents in badminton before the intervention in terms of combination step of backward

Indicators	Control group					Experiment group				
	Mean	**SD**	**Description**	**Qualitative Interpretation**	**Rank**	**Mean**	**SD**	**Description**	**Qualitative Interpretation**	**Rank**
1.Cross step back: take a small step back with your right foot, cross your left foot behind your right foot, and take a big step back with your right foot	2.33	.606	Slightly Acceptable	Slightly Effective	3	2.33	.606	Slightly Acceptable	Slightly Effective	2
2.Step Back: after the turn, the left foot and the right foot at the same time, the right foot to take a big step back	2.43	.679	Slightly Acceptable	Slightly Effective	1	2.43	.679	Slightly Acceptable	Slightly Effective	1
3.Bounce Back: after the turn, the right foot slightly backward, bounce at the same time hit the ball	2.37	.490	Slightly Acceptable	Slightly Effective	2	2.30	.535	Slightly Acceptable	Slightly Effective	3
Composite Mean	**2.38**	**.243**	Slightly Acceptable	Slightly Effective		**2.36**	**.276**	Slightly Acceptable	Slightly Effective	

N=60. Parameter limits: 4.20 - 5.00 Highly Acceptable (HA) / Highly Effective (HE);3.40 - 4.19 Acceptable (A) / Effective €;2.60 - 3.39 To Some Extent (TSE);1.80 - 2.59 Slightly Acceptable (SA) / Slightly Effective;1.00 - 1.79 Not Acceptable (NA) / Not Effective (NE)

Fast reaction and accurate movement are essential for success in badminton. Two-step footwork is one of the most common movements on the badminton court, which enables players to adjust their position quickly and provides a stable base when preparing to hit the ball. Zhao (2023) showed that three-step footwork also plays an important role in badminton, especially when dealing with the opponent's change-ups. However, Guo (2020) found that the execution of three-step footwork requires more practice and technical improvement compared to other footwork.

Chang (2023) showed that the crossover step is a commonly used step on the badminton court that helps players to quickly adjust their position and adapt to their opponents' shots. Therefore, the relatively better performance of the control group and the experimental group in the crossover step reflects that they possessed strong movement flexibility and quick reaction ability.

Table 6 shows the assessment results of the control and experimental groups with respect to the badminton backward step combinations.

The mean values of both the control and experimental groups range from 2.30 to 2.43, and the standard deviation is relatively small, indicating that the range of variation of the assessment results is small and the data within the group is relatively stable.

The highest mean value for both the control group and the experimental group is “Step Back”, which is 2.43, indicating that the athletes in both groups are able to perform this movement with relative accuracy when performing the step back, which is slightly better than the other steps.

The lowest mean values for the control group were “Cross step back: take a small step back with your right foot, cross your left foot behind your right foot, and take a big step The lowest mean value was “Cross step back with your right foot: take a small step back with your right foot, cross your left foot behind your right foot, and take a big step back with your right foot”, with a mean value of 2.33. This indicates that the athletes in the control group performed a little lower than the other steps, and had some difficulties in executing the step, or had technical deficiencies in performing the step. The lowest mean value of the experimental group is “Bounce Back: after the turn, the right foot slightly backward, bounce at the same time hit the ball”, the mean value is 2.30. This suggests that when performing the Bounce Back footwork, the athletes in the experimental group performed slightly lower than the other footwork, with some challenges or deficiencies in the execution of the technique.

The overall mean values of 2.38 (control group) and 2.36 (experimental group) indicated that overall, the athletes in both groups performed slightly average in badminton backward step combinations.

In badminton, backward footwork has an important impact on athletes' technical performance and game results. Li (2022) found that good backward footwork can help athletes effectively respond to opponents' attacks, improve body balance and stability, and thus increase the winning rate of the game. In addition, Meng (2022) pointed out that the correct execution of the backpedal is closely related to the athletes' explosive power, agility, and body coordination, which are all factors that have a significant impact on performance in badminton matches. Comparative studies on different backpedaling techniques are also common. Yu (2021) compared the effects of cross backpedaling, jumping backpedaling, and normal backpedaling in the game, and found that the different techniques have different advantages and disadvantages in different scenarios, but overall, choosing the appropriate backpedaling technique for different types of racket movements can help athletes better control the game situation and adjust their positions. Zhu (2021) showed that athletes' backpedaling skill level is closely related to their training experience and personal characteristics. Athletes who have undergone systematic training are more consistent and accurate in the execution of the backpedal, while beginners or less skilled athletes need more time and guidance to improve their backpedal technique.

Table 7. Assessment of shot footwork of control and experiment group - respondents in badminton before the intervention

Indicators	Control group				Experiment group			
	Mean	SD	Description	Qualitative Interpretation	Mean	SD	Description	Qualitative Interpretation
Corbination of online pace	2.39	.329	Slightly Acceptable	Slightly Effective	2.43	.292	Slightly Acceptable	Slightly Effective
corbinaton step ofbackward	2.38	.243	Slightly Acceptable	Slightly Effective	2.36	2.76	Slightly Acceptable	Slightly Effective
Composite Mean	2.38	.206	Slightly Acceptable	Slightly Effective	2.39	.172	Slightly Acceptable	Slightly Effective

N=60. Parameter limits: 4.20 - 5.00 Highly Acceptable (HA)/ Highly Effective (HE);3.40 - 4.19 Acceptable (A) / Effective €;2.60 - 3.39 To Some Extent (TSE);1.80 - 2.59 Slightly Acceptable (SA) / Slightly Effective;1.00 - 1.79 Not Acceptable (NA) / Not Effective (NE)

Table 7 shows the results of the pre-intervention badminton footwork assessment for the control and experimental groups.

The mean values for the control group ranged from 2.38 to 2.39. The highest mean value for the control group was “Corbination of online pace” at 2.39, which indicates that the control group performed relatively well in the combination of online steps. The lowest mean for the control group is “Corbinaton step of backward” at 2.38, which means that the control group performed slightly less well in the combination of backward steps.

The mean for the experimental group ranges from 2.36 to 2.43. The highest mean for the experimental group is “Corbination of online pace” at 2.43, which indicates that the experimental group performs relatively well in combinations of online steps. The lowest mean for the experimental group is “corbinaton step of backward” at 2.36, which indicates that the experimental group performed slightly less well in the combination of backward steps.

The overall mean value of 2.38 for the control group and 2.39 for the experimental group indicates that overall the

control and experimental groups are similarly rated in terms of badminton footwork and both are at a slightly acceptable and slightly effective level.

Good footwork can increase a player's speed and stability, thus enhancing his competitiveness in the game. Li (2021) showed that badminton footwork training can be improved through systematic and progressive training methods. For example, adopting a phased training program to gradually guide players to master the skills and applications of various footwork can help improve their technical level. In addition, designing training courses and practice programs according to the characteristics and requirements of different footwork is also one of the effective methods. Qiu et al. (2020) pointed out that the training of badminton footwork should pay attention to individual differences. Players at different levels and with different skill bases require different degrees of training intensity and frequency. Therefore, individualized training programs are very important to improve players' footwork technique and application ability. Psychological factors also have an impact on the training and application of badminton footwork. Wu (2019) showed that players' psychological qualities such as self-confidence, concentration and resilience are closely related to the accuracy and stability of their footwork. Therefore, psychological training should also be emphasized in badminton footwork training.

II. Difference in the pretest score of the control group and experimental respondent before the intervention

2.1 strike

Table 8. Differences in in the pretest score of strike the control group and experimental respondent before the intervention

Indicators	group	Mean	SD	Computed t-value	Sig	Decision on Ho	Interpretation
forehand serve high ball	control	2.34	.284	-.469	.641	Accepted	Not Significant
	Experiment	2.37	.266				
forehand hit high ball	control	2.43	.301	-.762	.449	Accepted	Not Significant
	Experiment	2.49	.309				
bachandserve front ball	control	2.48	.293	.681	.449	Accepted	Not Significant
	Experiment	2.43	.366				
Over-all	control	2.41	.239	-.263	.794	Accepted	Not Significant
	Experiment	2.43	.252				

Legend: significance level of 0.05

Table 8 shows the difference between the pre-test scores of the control and experimental groups in terms of pre-intervention batting.

For the “forehand serve high ball” indicator, the mean score of the control group was 2.34 and that of the experimental group was 2.37. The calculated t-value was -0.469 and the P-value was 0.641. Based on the result that the P-value was greater than 0.05, we accepted the null hypothesis that the difference between the two groups was not significant. The difference between the two groups is not significant. For “forehand hit high ball” and “backhand serve front ball”, the t-value is -0.762 and 0.681 respectively and the P-value is greater than 0.05. Therefore, we also accept the null hypothesis that the difference between the two groups is not significant. Therefore, we also accept the null hypothesis that the difference between the two groups is not significant. Overall, there was no significant difference between the pretest scores of the control and experimental groups in terms of striking.

In badminton, the assessment of striking skills is one of the most important indicators for assessing the skill level of athletes and the effectiveness of training. Wang and Xi (2018) showed that badminton players do not show significant improvement in their striking skills immediately after undergoing the same or similar training programs. This is because the improvement of striking skills requires long-term, systematic training and practice. In addition, factors such as individual differences, skill level, and training experience can affect badminton players' stroke performance (Zhang, 2022). Therefore, even under the same intervention conditions, the starting point and rate of improvement in striking skills can vary between individuals.

2.2 shot footwork

Table 9. Differences in in the pretest score of shot footwork the control group and experimental respondent before the intervention

Indicators	group	Mean	SD	Computed t-value	Sig	Decision on Ho	Interpretation
Corbination of online pace	control	2.39	.329	-.554	.582	Accepted	Not Significant
	Experiment	2.43	.292				
corbinaton step of backward	control	2.38	.243	.331	.742	Accepted	Not Significant
	Experiment	2.36	.276				
Over-all	control	2.38	.206	-.227	.821	Accepted	Not Significant
	Experiment	2.39	.172				

Legend: significance level of 0.05

Table 9 shows the difference between the pretest scores of the control and experimental groups in terms of batting stride before the intervention. Comparing the pretest scores of the two groups, the results showed that there was no significant difference between the two groups. Specifically, the t-values for each indicator did not reach the significant level, implying that there was no statistically significant difference between the pretest scores of the two groups of students in terms of batting stride. Such results suggest that prior to the start of the intervention, students in both the control and experimental

groups had relatively similar skill levels in terms of batting footwork.

Prior to conducting an experiment or intervention, it is critical to ensure that baseline levels are similar between the control and experimental groups. Doing so reduces misinterpretation of the effects of the intervention and enhances the reliability of the experimental results. Liu (2020) showed that it is a common practice in research design to ensure that the control and experimental groups are at similar levels prior to the intervention. Doing so ensures that the effect of the intervention is assessed rather than the difference in baseline levels. Bian et al. (2022) studied that the choice and design of the control group is critical to the interpretation of experimental results. The control group should be as similar as possible to the experimental group in all respects to minimize the influence of external factors on the results. The importance of comparing the baseline levels of the control and experimental groups prior to intervention. By making this comparison, researchers can ensure that the assessment of the intervention effect is more accurate and reliable. Zhu (2019) showed that statistical analysis of the differences between the control and experimental groups is standard practice in assessing the effect of an intervention.

III. The post test score of the control group (taught in traditional was) and the experimental group (utilizing scaffolding**)**

3.1 Strike

Table 10. Assessment of control and experiment group - respondents in badminton post-intervention in terms of forehand serve high ball

Indicators	Control group				Experiment group			
	Mean	**SD**	**Description**	**Qualitative Interpretation**	**Mean**	**SD**	**Description**	**Qualitative Interpretation**
1.Basic station: stand behind the baseline, feet apart, shoulder width.	2.80	.664	TSE	TSE	3.77	.935	Acceptable	Effective
2.Center of gravity: lean slightly toward your right foot	2.93	.583	TSE	TSE	3.73	.868	Acceptable	Effective
3.Clap: the forehand clap, clap head perpendicular to the ground	3.20	.664	TSE	TSE	4.03	.850	Acceptable	Effective
4.. Swing: the body to the other side of the field, maintain balance, arms straight, fast swing	3.33	.785	TSE	TSE	3.63	.809	Acceptable	Effective
5.Stop position: shift the weight to the left foot, clap head behind the left shoulder	2.97	.718	TSE	TSE	3.50	.900	Acceptable	Effective
Composite Mean	**3.05**	**.374**	TSE	TSE	**3.73**	**.428**	Acceptable	Effective

N=60. Parameter limits: 4.20 - 5.00 Highly Acceptable (HA) / Highly Effective (HE);3.40 - 4.19 Acceptable (A) / Effective €;2.60 - 3.39 To Some Extent (TSE);1.80 - 2.59 Slightly Acceptable (SA) / Slightly Effective;1.00 - 1.79 Not Acceptable (NA) / Not Effective (NE)

Table 10 shows the results of the post-intervention assessment of the control group (traditional teaching method) and the experimental group (teaching method utilizing scaffolding) in terms of badminton serve.

The mean range of the control group was between 2.80 and 3.33 with standard deviation ranging from 0.583 to 0.785, while the mean range of the experimental group was between 3.50 and 4.03 with standard deviation ranging from 0.809 to 0.935. The range of the mean of the experimental group was higher than that of the control group as a whole, which suggests that after the use of scaffolding pedagogy the experimental group of students achieved a better performance.

The highest mean score for the control group is “Swing” with a mean score of 3.33, which indicates that students in the control group performed relatively well in swinging quickly and maintaining balance. The lowest mean score for the control group was “Basic station” with a mean score of 2.80, which implies that the students in the control group did not perform well in basic station.

The highest mean score for the experimental group was “Clap” with a mean score of 4.03, which suggests that the experimental group made significant progress in mastering the stroke after using the scaffolding method. The lowest mean for the experimental group was “Stop position” with a mean score of 3.50, which means that there is still room for improvement in controlling the body posture and stance of the students in the experimental group.

The overall mean of the control group is 3.05, while the overall mean of the experimental group is 3.73. The overall mean of the experimental group is significantly higher than that of the control group, which indicates that the use of scaffolding teaching method has a significant impact on improving students' serving skills.

In badminton teaching, scaffolding teaching method can help students to improve their skills by introducing basic technical movements step by step, providing demonstrations, providing feedback and adjusting teaching strategies. Liu (2021) showed that the use of Scaffolding teaching method can improve students' skill level and academic performance. For example, Chang (2023) found that students who received

Scaffolding instruction showed higher skill levels and faster learning speeds in badminton serving skills. This is consistent with the results of the experimental group in Table 13, suggesting that the Scaffolding instruction method is effective in improving serving skills. Meng (2021) study stated that correct posture and stance are crucial for the performance of badminton serving skills. Students were able to serve the ball more effectively with correct stance and posture, improving the accuracy and power of the ball. This is supported by the results presented in Table 13, especially in the control group where lower scores were associated with less accurate basic stance.

Rahmat etg al. (2021) showed that fluidity and consistency of movement are essential for the performance of sports skills. The indicators “Swing” and “Clap” in Table 13, which relate to the fluidity of swing and batting movements, were better performed by the experimental group, which is in line with the results of past studies. Using innovative teaching methods compared to traditional teaching, Wang (2023) has demonstrated that the use of scaffolding in physical education improves students' skill levels and academic performance. For example, Yu (2021) found that students who used scaffolding teaching methods made significant improvements in both technical performance and performance in competition. Similarly, Li (2022) showed that the application of scaffolding teaching methods in sports such as basketball and volleyball could promote students' skill development and competitive performance.

Table 11. Assessment of control and experiment group - respondents in badminton post-intervention in terms of forehand hit high ball

Indicators	Control group				Experiment group			
	Mean	SD	Description	Qualitative Interpretation	Mean	SD	Description	Qualitative Interpretation
1.Basic position: left foot in front, right foot disaster, two feet open, shoulder width, hands flat on the side	3.27	.583	TSE	TSE	3.90	.759	Acceptable	Effective
2.Center of gravity: center of gravity on the right foot (back foot)	3.37	.928	TSE	TSE	3.67	.884	Acceptable	Effective
3.Clap: forehand clap, clap head up	3.37	.850	TSE	TSE	3.67	.802	Acceptable	Effective
4.Swing: the upper arm with the body to the left rotation, forearm rapid inward rotation, racket face forward, arm straight hit the ball carrier	3.33	.758	TSE	TSE	3.97	.765	Acceptable	Effective
5.Stop Position: the center of gravity from the right leg to the left foot, right hand swing to the outside of the left leg	3.23	.626	TSE	TSE	3.73	.691	Acceptable	Effective
Composite Mean	3.31	.291	TSE	TSE	3.79	.413	Acceptable	Effective

N=60. Parameter limits: 4.20 - 5.00 Highly Acceptable (HA) / Highly Effective (HE);3.40 - 4.19 Acceptable (A) / Effective €; 2.60 - 3.39 To Some Extent (TSE);1.80 - 2.59 Slightly Acceptable (SA) / Slightly Effective;1.00 - 1.79 Not Acceptable (NA) / Not Effective (NE)

Table 11 shows the results of control and experimental groups assessed on badminton serve high technique.

The mean values of the control group ranged from 3.23 to 3.37 while the mean values of the experimental group ranged from 3.67 to 3.97. This indicates that the mean values of the experimental group were slightly higher than the control group on all the assessed indicators, showing that the students in the experimental group performed better overall on the serve-high technique.

The highest mean values for the control group were for “Center of gravity: center of gravity on the right foot (back foot)” and “Clap: forehand clap, clap, head up”. The mean score for “Center of gravity: center of gravity on the right foot (back foot)” and “Clap: forehand clap, clap head up” was 3.37, which means that the control group students performed better in keeping the center of gravity stable and swinging the racket correctly. The lowest mean score for the control group was “Stop Position: the center of gravity from the right leg to the left foot, right hand swing to the outside of the left leg”. This means that the students in the control group need to improve their posture and balance after finishing the stroke.

The highest mean score for the experimental group was “Swing” with a mean score of 3.97, which indicates that the experimental group students performed well in terms of the smoothness and accuracy of the swing. The lowest mean scores were for “Center of gravity: center of gravity on the right foot (back foot)” and “Clap: forehand clap, clap, head up”. The mean score for “head up” is 3.67, which indicates

that the students in the experimental group are slightly deficient in some specific details of the movements and need to pay more attention to and improve them.

The overall mean was 3.79 (experimental group) and 3.31 (control group). This indicates that the overall level of serving skills of the students in the experimental group was slightly higher than that of the control group.

Comparisons of training and teaching methods for motor skills have been extensively explored. Among them, studies using the scaffolding teaching method have shown that this teaching method can help students master motor skills more effectively. Zhu (2019) showed that the use of the scaffolding teaching method can provide more individualized instruction to help students progressively master complex motor skills. This approach emphasizes providing just the right amount of support and guidance to students as they progress through the learning process in order to facilitate their learning and skill development. Zhang (2023) research has shown that the use of scaffolding instructional methods can improve students' skill levels. By gradually guiding students to master different aspects of the skill, this approach can increase their self-confidence and improve their performance. Su (2021) showed that the scaffolding teaching method helps students to better understand and execute complex movements. This individualized instruction helps students establish proper movement patterns and improves their movement fluency and accuracy. Using the scaffolding method of instruction stimulates students' interest and increases their engagement. This method provides a positive learning environment for students and encourages them to engage more deeply in the learning process, thus promoting their skill development.

6. Conclusion

Based on the presented findings of the study, the researcher came up with the following conclusions:

1. In the basic information of the study subjects, the gender ratio, grade distribution and the proportion of the number of people in the control and experimental groups were comparable, which helped to reduce the influence of external factors on the results and enhanced the credibility of the study.

2. Before the badminton program intervention, the control and experimental groups showed different differences in the predictive scores of striking techniques. The control group had relatively low scores in striking technique while the experimental group had higher scores in some areas, but overall, the control and experimental groups had similar scores.

3. There was no significant difference between the pretest scores of the control and experimental groups in terms of striking technique, footwork and cooperative learning awareness before the intervention in the badminton program. This suggests that prior to the intervention, the two groups of students had similar base levels in these areas, providing a basis for subsequent comparisons of the effects of the intervention.

4. The experimental group using the scaffolding approach demonstrated a significant advantage in the areas of striking technique and footwork, indicating the potential effectiveness of this teaching method in promoting students' skill development.

5. The experimental group that adopted the scaffolding teaching method in badminton course showed a significant advantage in badminton skills and cooperative learning awareness. This strongly supports the effectiveness of using scaffolding-based teaching methods to improve students' skill levels and promote cooperative learning. These results further demonstrate the positive effects of the scaffolding teaching method in physical education courses and provide a practical basis for further promotion and application of the teaching method.

7. Recommendations

Based on the conclusions derived in this study, the following are the recommendations:

1. Teachers should make extensive use of scaffolded teaching methods in the badminton curriculum in order to improve students' skill levels. This includes providing students with appropriate support and guidance during the teaching process to help them gradually master complex technical movements.

2. In teaching practice, emphasis should be placed on developing students' sense of cooperative learning. By promoting cooperation and communication among students, their interest in learning can be better stimulated, their teamwork skills improved and their understanding of badminton deepened.

3. Schools and educational institutions can carry out relevant teacher training and professional development activities to enhance teachers' understanding of and ability to apply scaffolded teaching methods. This helped promote innovation and improvement in teaching methods and enhance teaching quality.

4. For the design and implementation of badminton courses, due consideration should be given to students' individual differences and learning needs, and teaching strategies should be flexibly adjusted to ensure that every student can receive effective learning support and guidance.

5. Further research conducted in the future to explore the applicability and effectiveness of scaffolding teaching methods in other physical education courses and subject areas, so as to provide more theoretical and practical support for teaching reform and innovation.

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