A Study on the Teaching Efficiency of Automatic Tennis Serve-machine for Players' Volley Technique

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[**Abstract**] In this study, forty athletes aged 14-16 from Kunming "Wangdong Wangshi" Tennis Club were selected as research participants. Several methods were used in this study, such as literature review, teaching experiment and statistical method, combined with the author's tennis teaching and training experience to conclude whether the tennis serve-machine can or cannot improve the teaching quality of the athletes' volley technique. After reviewing the relevant literature and three months of teaching experiments, a conclusion was drawn that the tennis serve-machine can improve the teaching quality of the athletes' volley technique. However, the tennis serve-machine is not sophisticated enough and has several limitations as discussed in the paper.

[**Key words**] automatic tennis serve-machine; tennis volley technique; teaching effect

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1 Introduction

Since Li Na won the French Open women's singles championship in 2011 and won the Australian Open women's singles championship in 2014, Chinese tennis has developed. In the following years, many world-class players have also emerged, such as Wang Qiang, Zhang Shuai, Peng Shuai, Zheng Saisai, etc., and tennis continues to develop in China. Tennis belongs to the skill-led antagonistic event group, which means that skill is the most important factor in tennis. An athlete can only be regarded as "excellent" if he has the correct technical movements. Therefore, finding suitable and fast teaching methods to improve the tennis skills of athletes is the direction that many coaches have been working hard on. Currently, much auxiliary practice equipment for tennis has appeared on the market, such as tennis serve-machines, assist tennis trainers, tennis training rebound nets, etc. These products have played an important role in the popularisation and development of tennis in China. So what is the difference between teaching with these auxiliary practice equipment and traditional teaching methods? Is auxiliary practice equipment more efficient than traditional methods?

This article takes the tennis serve-machine as an example to study the teaching efficiency of the volley technique. It means to provide new teaching methods and has important practical significance for promoting Chinese tennis and sports industry.

2 Research objects and methods

2.1 Research objects

In this study, 40 students from Kunming "Wangdong Wangshi" Tennis Club were selected as samples. They all received the same volley training, corresponding technical data were recorded and analyzed, and the conclusion was drawn.

2.2 Research methods

2.2.1 Literature method

In this research, the relevant domestic literature on CNKI was searched. Tennis World Magazine, Tennis Sports System Training, Tennis Sports Course and Sports Training, and other books were consulted to learn more about the development of tennis. The author's own experience in daily teaching and training was taken into consideration. Based on these, this research was developed.

2.2.2 Expert interview method

To provide more theoretical basis and practical experience for this research, the author interviewed four experts on tennis (a professor and three associate professors) from Yunnan University of Finance and Economics and six senior coaches from a few tennis clubs in Kunming. The interview focuses on the topic of automatic serve-machine, about whether the tennis serve-machine can improve the efficiency of volley teaching or not.

2.2.3 Teaching experiment method

In this study, the teaching experiment was carried out with the support of previous theoretical knowledge. The experimental group and the control group were set up. The experimental group used a tennis serve-machine for volley training, and coaches served by their hands for the control group's volley training. The two groups were trained for volley technique for a month, and then the same standard volley technique test was performed on the athletes of two groups. The experimental results were analyzed to verify the influence of automatic serve-machine on the teaching effect of athletes' volley technique.

(1) Model and parameters of automatic serve-machine

In this research, SIBOASI tennis automatic serve-machine T1600 is used as a subject; the volley training model can be set, and the serving angle and speed can be adjusted; the loading capacity is 150 balls; the serving frequency is 1.8-9 seconds per ball.

(2) Personnel settings

In this study, forty students from Kunming "Wangdong Wangshi" Tennis Club were divided into two groups, with twenty students for each group. Group one is the experimental group and group two is the control group. All the students are between ages of 14 to 16.

(3) Training settings

The experimental group was trained by an automatic serve-machine, and the control group was trained by coaches. The training period is one month (twelve classes), and the training time per class is 2 hours. After this period, two groups of students will be tested separately.

(4) Technical assessment methods

The full mark of the assessment is 100 points, of which 50 points are accounted for the movement assessment and the controlled assessment respectively.

The movement assessment was judged by 3 coaches with more than 5 years of teaching experience and a tennis level of 4.0 or higher. The experts would score them according to the scoring standards based on the students' strokes.

Table 1. Movement assessment scoring standard

Movement	Score
Grip the racket properly, well-prepared to hit, the center of gravity is steady, the backswing of the racket is suitable, the shoulder, elbow and wrist joints are stable, the footsteps of the hit are correct, the hitting force is sufficient.	41 - 50 points
Grip the racket properly, well-prepared to hit, the center of gravity is steady, the backswing of the racket is overmuch, the shoulder, elbow and wrist joints are stable, the footsteps of the hit are correct, the hitting force is slightly poor.	31 - 40 points
Grip the racket properly, preparations are not sufficient, the center of gravity and joints are not stable enough, the backswing of the racket is overmuch, the footsteps of the hit are correct, the hitting force is slightly poor.	21 - 30 points
Grip the racket properly, lack preparation, the center of gravity and joints are very unstable, the backswing of the racket is overmuch, the footsteps of the hit are correct, the hitting force is insufficient.	11 - 20 points
Incorrect grip, inadequate preparation, instability of the center of gravity and joints, excessive backswing of the racket, incorrect footsteps, insufficient hitting force, and can barely hit the ball into the court.	0 - 10 points

Assessment of the control: The coach serves for the control group, and the automatic serve-machine serves for the experimental group. Each student hits 20 times, using one forehand, and one backhand, with 2.5 points for each hit. The points are scored only if they fall within the effective area. Students are required to return to the stand by position after completing each hit before making the next hit. The trainer's position, the student's position and the effective scoring area are shown in Figure 1:

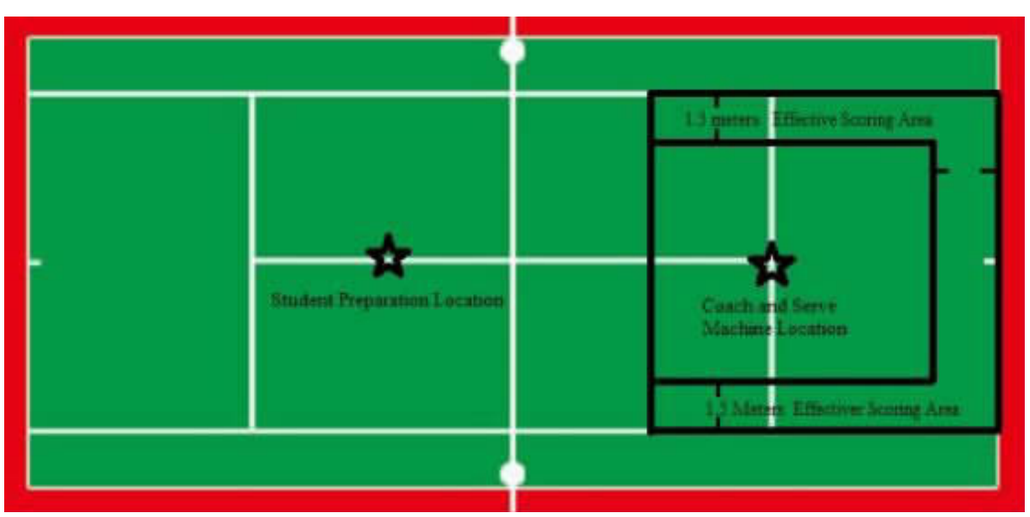

Figure 1. The trainer's position, the student's position and the effective scoring area

This research uses EXCEL and SPSS19.0 software to perform statistics and analysis of experimental data. The results are expressed in the form of mean ± standard deviation ($\bar{X} \pm SD$), and an independent sample T-test is performed on the data between groups. $P > 0.05$ is defined as the level of no significant difference; $P < 0.05$ is defined as the level of significant difference; $P < 0.01$ is defined as the level of highly significant difference.

3 Results and analysis

3.1 Test results and analysis of the experimental group and the control group before the training

In this study, after randomly grouping forty students, before starting group teaching, a comprehensive assessment of 40 students' volley technique was carried out. According to the assessment and data analysis, the conclusion of whether the experimental group and the control group have significant volley technique differences can be drawn. If there is a significant difference, it means that these two groups of students are not suitable for this research and the experiment cannot be carried out. If there is no significant difference, it means that the experiment can be carried out. The test results are shown in Table 2:

Table 2. Test results of the experimental group and the control group before the training

Group	Sample	$\overline{X}$ ±SD	P
Experimental Group	20	51.625±3.626	P=0.691>0.05
Control Group	20	51.700±3.706	

After analyzing the above data, we can see that the experimental group and the control group have no significant difference in the data of mean and standard deviation, and $P=0.691>0.05$, which means that the experimental group and the control group are in the 95% confidence interval. There is no significant difference and the experiment can be carried out.

3.2 Analysis of the test results of the experimental group and the control group after the training

One month later, students from the experimental group and the control group have improved their volley technique under different training methods. We performed the same assessment on two groups according to the assessment method, and the data analysis obtained is shown in Table 3:

Table 3. Test results of the experimental group and the control group after the training

Group	Sample	$\overline{X}$ ±SD	P
Experimental Group	20	89.900±3.366	P=0.00<0.01
Control Group	20	68.225±4.357	

From the above data, we can see that after the training with different methods, the average final data of the experimental group is higher than that of the control group, and leads the control group with a score of 84.9. From the perspective of standard deviation, the experimental group is 3.366, lower than the control group's 4.357, which shows that the experimental group's athletes are more stable in volley technique performance than the control group's athletes, and the level gap between the same group's athletes is smaller. $P=0.00<0.01$ indicates that there is a highly significant difference between the volley technique of the experimental group and the control group after training with different methods.

3.3 Statistics of volley technical level of the experimental group before and after training

One month later, the volley technique of the experimental group athletes has been greatly improved. We analyzed the experimental group's pre-training and post-training data to obtain the results as shown in Table 4:

Table 4. Data analysis of volley technique of experimental group athletes before and after training

Group	Sample	$\overline{X}$ ±SD	P
Experimental Group (before)	20	51.625±3.626	P=0.00<0.01
Experimental Group (after)	20	84.900±3.366	

From the above data, we can see that the average score of experimental group athletes' volley technique has been greatly improved before and after training, from 51.625 to 84.900, which proves that the volley technique of the athletes trained by the tennis serve-machine has a very good result. As P value=0.00<0.01, the data also shows that there is a highly significant difference in the volley technique of the experimental group athletes before and after training.

4 Conclusions and suggestions

4.1 Conclusions

At the end of the one-month training, we obtained the evaluation results of the experimental group and the control group and conducted data analysis on the evaluation results. With the analysis results, we can see that the use of tennis serve-machine to train teenagers' volley techniques is better than coaches serving alongside the court. We analyzed the entire training process for a month and found that when the same coach is teaching, using a tennis serve-machine has the following advantages:

(1) Tennis serve-machine is a piece of new training equipment for teenagers. It can make athletes excited, improve their training enthusiasm, and improve the quality of coaches' courses.

(2) When tennis serve-machine is serving the ball in the court, the coach can shorten the teaching distance with the students, and improve the learning effect of the players on an explanation and demonstration scale.

(3) The coach can correct the athlete's technical movements hand by hand in time, and save a lot of time for more demonstrations so that the athletes can better imitate the coach and correct their movements.

(4) Compared with coach-serving, the tennis serve-machine has a stable serving track, strength and spin, which is conducive for beginners to correct their movements.

(5) With the tennis serve-machine, coaches can try different teaching methods, increase the diversity of training, and improve the training attitude of students.

Disadvantages of the tennis serve-machine in teaching are:

(1) Most tennis serve-machines on the market need to be connected to the power supply to work. However, for most tennis courts, especially outdoor tennis courts, there is no power supply for tennis serve-machines. This situation greatly restricts the popularity of serve-machine in teaching and training.

(2) Since most tennis serve-machines are not well-designed, they will get stuck and need to be adjusted for a long time, which will waste certain training time.

(3) At present, the application of artificial intelligence in the tennis serve-machine is still impractical. Although the serve-machine can set the ball speed, rotation and duration, it cannot set the combined serving method. Tennis is a sport that requires tactics. This restricts the tennis serve-machine from carrying out some

tactical training for high-level athletes. It can only carry out some simple technical action for details training, or for beginners to shape their movements.

4.2 Suggestions

Racket sports such as tennis, table tennis and badminton all require a lot of multi-ball training to gradually improve the athlete's competitive level. Both amateur and professional players need multi-ball training. Artificial intelligence machines can help us achieve this goal. Therefore, we should make more use of advanced artificial intelligence machines for teaching, and explore new teaching methods that use machines as assistants. But in such a process, we should not rely too much on the machine. After all, the machine is relatively rigid, while tennis is a very flexible sport. It requires athletes to constantly think and make changes. We should realize the advantages and disadvantages of tennis serve-machine, and organize new ways of training. At the same time, we improve the teaching methods according to the feature of the tennis serve-machine based on their disadvantages. At present, the technology of artificial intelligence is developing rapidly. We must try to use advanced artificial intelligence technology in the research and development of tennis serve-machines, and carry out vigorous promotion in the sports market so that artificial intelligence can help us play tennis better and scientifically, thus promoting the tennis market in China.

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