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Research on the Application of Circuit Training in College Sports Major Tennis Specialized Courses

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Abstract: Circuit training refers to a training method where, based on specific training tasks, practice means are set up as several practice stations. Athletes complete the practice tasks at each station in sequence and along a predetermined route. This article starts with the circuit training method, exploring its role in specialized tennis courses and examining its impact on students' specialized technical skills and physical fitness, providing references and insights for the implementation of tennis courses in universities. Thru research, it was found that in the tennis specialized courses at Yunnan universities, there is a lack of physical fitness training in specialized technical practice, and students experience long periods of inactivity. Since physical fitness is the foundation for improving specialized techniques and plays a crucial role in training and competitions, this study aims to Therefore, this experiment applies the circuit training method to intervene in students' physical fitness and specialized techniques, setting up multiple training stations for physical fitness and specialized techniques, increasing training density, and testing the practical effects of the circuit training method in tennis specialized courses.

Keywords: Circuit Training Method; Tennis Specialization; Physical Education Teaching; Higher Education Institutions.

1. Introduction

The level of development of tennis is closely related to the degree of national economic development. As our country's economy continues to improve, the emphasis on school sports has also increased. To implement the spirit of the "Opinions on Comprehensively Strengthening and Improving School Sports Work in the New Era" issued by the General Office of the CPC Central Committee and the General Office of the State Council, and to carry out the "Implementation Opinions on Further Deepening the Reform of the Examination and Enrollment System for High School Students" (Yun Jiao Fa [2019 In recent years, the excellent performance of Chinese women's tennis on the international stage has significantly increased the sport's popularity in China. Tennis quickly entered the school education system in China and has been well-promoted in various universities. Many higher sports institutions have offered tennis courses. However, there are issues in the teaching process.

The tennis sport has been introduced to our country for over a century, but its initial development was relatively slow. After the founding of the People's Republic of China, with the advantage of the national system, China's competitive tennis has been well developed and achieved certain results, but the mass tennis team is extremely rare. When Li Na lifted the Grand Slam (French Open) women's champion trophy in 2011, the nation celebrated. Against the backdrop of nationwide fitness, more and more people are taking up tennis as a form of exercise.

In recent years, with the increase in universities offering tennis courses, tennis has become a very popular subject in many universities. It is evident that tennis courses have already integrated into the lives of college students, but many problems have arisen during the tennis teaching process. For example, the class sizes are too large, the teaching effectiveness is poor; there are too few scheduled classes; the teaching content is limited; and there is a lack of tennis court facilities, etc.[2]. The school bears the heavy responsibility of talent cultivation and is a sacred place for nurturing professionals in various fields. As an important component of university sports, tennis courses bear the sacred duty of developing tennis and spreading tennis culture. Thru research, it was found that many universities only offer general tennis courses, and very few have specialized tennis classes within their sports programs. Therefore, the development of specialized tennis courses in higher education institutions holds profound significance.

The tennis sport requires high physical fitness, fast ball speed, large court size, and difficult technical mastery, so a certain level of physical fitness is needed as a foundation.

In 2020, the School of Physical Education at Yunnan Agricultural University officially launched a specialized tennis course, which can provide an excellent research platform and conditions for this study.

2. Current Research Status of Circuit Training Method

2.1. Application Value Research of Circuit Training Method

Duan Wenyu discussed the value of circuit training, stating that the circuit training method can be tailored to each individual's situation, highlighting its practicality, applicability, and flexibility. It promotes the improvement of athletes' physical fitness and can make judgments based on specific situations at any time, promptly adjusting the training plan accordingly [3].

Wang Haiyuan analyzed the origins of circuit training, which comes from practice and is tested for its feasibility in sports practice. Due to its foundational role, this method occupies an extremely important position in teaching, training, and fitness, making it a suitable training method for different groups of people[4].

Garrickson proposed that each athlete has their own unique running style on the field. Based on the different running styles, he suggested combining techniques with running in

training. Regarding how to organize offensive and defensive drills, the author believes that circuit training can link these practice tasks together to form a complete training regimen[5]

Wilkinson Andrea F found during physical training that by combining athletes' strengths and weaknesses into a circuit training method, the time athletes spent learning techniques to overcome their weaknesses was shorter. This allowed them to experience the success of overcoming their weaknesses and no longer hold a fear of them[6].

A. Kokorev conducted physical training using the circuit training method on 140 college students. After 8 weeks of practice, the results showed a significant improvement in performance post-training, with a notable difference compared to pre-experiment results[7].

Takahata Y conducted a 100-day intervention study using circuit training on 41 college students, primarily examining their physical indicators. The results showed that circuit training can improve bone quality and muscle quality in the short term[8].

In summary, circuit training is often used in athletes' physical training and has achieved excellent results, but its application in tennis-specific training is relatively rare. Therefore, this study applies circuit training to tennis courses in university sports programs to explore its value.

2.2. Application Research of Circuit Training Method in Physical Education

Ji Chengzhi analyzed the training stations of the circuit training method in college students' breaststroke classes, mentioning that the circuit training method involves arranging training tasks in a suitable order during each training session, allowing practitioners to complete the training content at each station in sequence[9].

The practice content at each Ha Hanlong summarized the application effects of the circuit training method in badminton teaching for physical education majors in universities. The circuit training method has improved physical fitness, skills, footwork, and learning enthusiasm, with the only less noticeable improvement being in physical fitness, while achieving excellent results in other aspects[10].

Liu Dekun elaborated on the impact of the circuit training method on teaching effectiveness, indicating that in the process of physical education, applying the circuit training method, setting up scientifically effective training content, monitoring the training load and intensity, and providing students with scientific exercise methods can significantly enhance the teaching outcomes[11].

From the perspective of the changes in physical functions, Shiguang suggests that teaching content should be arranged according to the changes in students' physical functions during exercise. By using the circuit training method to set multiple learning contents, it can not only enhance students' enthusiasm for learning but also contribute to the improvement of their[12].

Guo Yulin's research on "The Application of the Circuit Training Method in College Badminton Teaching" indicates that this method is different from previous teaching methods and is more targeted in comparison. During the training period, it is more aligned with the actual level and needs of the students, better reflecting the teacher's leadership and the students' initiative[13].

Tan Fenghua, from the perspective of teaching quality, discussed the application of the circuit training method in junior high school basketball courses. The repeated practice of various training content not only improves students' basketball skills but also allows them to enjoy the fun that basketball brings[14].

Yu Yan and Feng Yonggang mentioned in "Research on the Application of Circuit Training in College Physical Education" that circuit training plays an important role in college physical education: first, it enhances students' overall abilities; second, it stimulates students' interest in learning; and third, it improves students' initiative in learning[15].

Lin Jingjing, in the article "Practical Research on Improving the Physical Fitness of Secondary Vocational Students thru the Application of Circuit Training Method," proposed applying the circuit training method to physical fitness training, allowing students to be exposed to scientific physical training methods and achieving the effect of applying what they have learned[16].

Yang Shangwen pointed out in the study "The Application Effect of Circuit Training Method in College Students' Public Physical Education Basketball Class" that the circuit training method improves teaching efficiency. Make full use of the time wasted in queuing, which will be beneficial for the development of technical movements and the formation of a cycle of quality exercises. Within the range of students' acceptance, more exercises can be completed in a unit of time, thereby improving exercise efficiency[17].

In summary, the circuit training method, commonly used in physical education, can be flexibly adapted to different groups and situations. It makes full use of time in training and teaching, enhances learners' interest in learning, encourages active participation in learning tasks, and improves teaching efficiency. This allows students to spend each physical However, no direct literature was found on its application in tennis specialized courses, so applying the circuit training method to tennis specialized courses in higher education sports programs has significant research value.

2.3. Application of the Circuit Training Method in Tennis Training

Xu Zhe, in his research on improving basic techniques, indicates that beginners frequently make errors during the formation of technical movements. By setting up training tasks at multiple stations, it is easy to identify the causes of these errors, which promotes skill improvement[18].

Wang Ruiyan concluded in his research on youth tennis training that the application of the circuit training method has a significant effect on improving physical fitness, enhancing the stability of basic techniques, effectively boosting athletes' competitive abilities, and making students' training more autonomous [19].

Wang Yuepeng and Wang Weifang, in their training design, primarily use six-person paired circuit training, emphasizing that practitioners can repeatedly practice the same action multiple times, accelerating the formation of action patterns. Those resting can observe their peers' training from different angles, discovering the connections between actions and reducing the frequency of errors[20].

In summary, the use of circuit training methods for technical improvement in tennis training is quite widespread, but it is only applied in training for minors. However, its application in college tennis courses is very limited, especially in specialized courses, where it is even rarer and requires further exploration. Applying the circuit training method to intervene in specialized techniques and physical fitness, and formulating appropriate training content for it.

3. Experimental Design

3.1. Experimental Subjects

The experiment selected 20 students from the 2019 Tennis Specialty Class of the College of Physical Education at Yunnan Agricultural University as subjects, all of whom are male. The sample size is 20, divided into an experimental group (10 people) and a control group (10 people). Due to the limited number of students enrolled in the tennis specialization course, the overall sample size for the experiment is relatively small.

The experimental group used the circuit training method for teaching, while the control group used the non-circuit training method. Before the experiment, the specialized skills, physical functions, and physical fitness of the two groups of students were tested to ensure that there were no significant differences in physical functions, physical fitness, and specialized Thru a 12-week teaching experiment, analyze the actual teaching effect of the circuit training method in college sports major tennis specialized courses.

Before the experiment, descriptive statistical analysis and independent sample T-tests were conducted on the experimental group and the control group for age, height, and weight. As shown in Table 3-2, the P-values for the three test indicators were 0.337, 0.386, and 0.482, all greater than 0.05, indicating that the means and degrees of dispersion for age, height, and weight were similar between the experimental group and the control group, with no inter-group The basic information of the experimental subjects is detailed in the table below.As shown in Table 1.

Table 1. comparison of basic information between experimental group and Control Group

Basic information	Experimental group (n=10) Mean ± Standard Deviation	Control group (n=10) Mean ± Standard Deviation	T	P
Height/cm	174.6±4.97	177±5.868	0.987	0.337
Weight/kg	68.6±5.296	70.7±5.272	0.889	0.386
Age	20.3±0.675	20.9±0.568	0.717	0.482

4. Research Results and Analysis

4.1. Analysis of Heart Rate Test Results Before and After the Experiment

According to the requirements of this experiment, a comparative analysis of heart rate test results under random grouping will be conducted both horizontally and vertically. As shown in Table 2 and Table 3.

Table 2. Horizontal Comparison Analysis of Heart Rate Test Scores

Grouping (n=10)	Heart rate (beats per minute)	Experimental group (n=10) Mean ± Standard Deviation	Control group (n=10) Mean ± Standard Deviation	T	P
Before the experiment	Resting heart rate	66.20±2.974	69.10±4.067	1.820	0.085
	Heart rate during exercise	126.10±5.109	126.80±5.432	0.297	0.770
	Post-exercise heart rate recovery rate	1.850±0.4089	1.920±0.3706	0.401	0.693
After the experiment	Resting heart rate	64.20±0.919	67.80±2.394	-4.439	0.001
	Heart rate during exercise	121.40±4.351	125.60±4.115	-2.218	0.040
	Post-exercise heart rate recovery rate	2.300±0.1886	2.070±0.2869	2.118	0.048

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference.

Table 3. Longitudinal Comparison Analysis of Heart Rate Test Scores

Grouping (n=10)	Heart rate (beats per minute)	Experimental group (n=10) Mean ± Standard Deviation	Control group (n=10) Mean ± Standard Deviation	T	P
Before the experiment	Resting heart rate	66.20±2.974	64.20±0.919	3.850	0.004
	Heart rate during exercise	126.10±5.109	121.40±4.351	4.967	0.001
	Post-exercise heart rate recovery rate	1.850±0.4089	2.300±0.1886	-3.148	0.012
After the experiment	Resting heart rate	69.10±4.067	67.80±2.394	1.816	0.103
	Heart rate during exercise	126.80±5.432	125.60±4.115	2.025	0.074
	Post-exercise heart rate recovery rate	1.920±0.3706	2.070±0.2869	-2.496	0.034

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference.

A paired sample t-test was applied to the recorded heart rates after 12 weeks of training sessions. Following the experiment, a longitudinal comparison of the two groups' post-test and pre-test heart rates was conducted to identify

patterns, developmental shifts, and trends throughout various time periods. The experimental group's resting heart rate, exercise heart rate, and post-exercise heart rate recovery rate were compared before and after the trial. There was a significant difference between the data collected before and after the experiment in the experimental group, as indicated by the three indicators showing P < 0.05.The control group's data before and after the experiment were compared and analyzed, and all of the P-values were greater than 0.05, indicating no significant changes before and after the experiment. But following exercise, the P-value for heart rate recovery was less than 0.05, indicating that the speed of recovery Following the experimental intervention, the experimental group and the control group's measured results differed significantly (P<0.05). Prior to the experiment, there was no discernible change in the measured outcomes between the experimental and control groups, suggesting that circuit training significantly affects students' hearts.

There was no significant difference in the average scores between the experimental group and the control group prior to the experiment (p>0.05), nor was there a significant difference in the scores between the experimental group and the control group following the experiment, according to the independent sample t-test of the sit-and-reach scores in Table 4.

Table 4. Horizontal Comparative Analysis of Seated Forward Bend Scores

	Grouping	n	Mean ± standard deviation	T	P
Before the experiment	Experimental group	10	83.40±8.208	0.451	0.658
	Control group	10	82.00±5.395		
After the experiment	Experimental group	10	84.00±8.042	0.596	0.560
	Control group	10	82.20±5.138		

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference.

Using a paired sample t-test on the sit-and-reach test results in Table 5, the control group's pre-test and post-test scores did not differ significantly (p>0.05), and the experimental group's pre-test and post-test results did not differ significantly either.

Table 5. Longitudinal Comparative Analysis of Seated Forward Bend Scores

	Grouping	n	Mean ± standard deviation	T	P
Experimental group	Before the experiment	10	83.40±8.208	-1.964	0.081
	After the experiment	10	84.00±8.042		
Control group	Before the experiment	10	82.00±5.395	-0.557	0.591
	After the experiment	10	82.20±5.138		

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference.

4.2. The Impact of Circuit Training on Students' Speed Quality

An independent samples t-test on the 50-meter run scores in Table 6 showed that, prior to the experiment, there was no significant difference in scores between the experimental group and the control group (p>0.05), and both groups were within the good range; however, following the experiment, there was a significant difference in scores between the experimental group and the control group (p<0.05).

Table 6. Horizontal Comparative Analysis of 50-Meter Dash Scores

	Grouping	n	Mean ± standard deviation	T	P
Before the experiment	Experimental group	10	83.00±6.128	1.260	0.224
	Control group	10	80.00±4.372		
After the experiment	Experimental group	10	87.90±6.027	3.204	0.005
	Control group	10	80.60±3.950		

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference.

According to the results of the paired sample t-test, the experimental group's pre-test and post-test scores differ significantly (p<0.05), while the control group's pre-test and post-test scores do not differ significantly (p>0.05). The experimental group demonstrated a notable improvement in speed quality when trained utilizing the circuit training method, according to a post-experiment comparison. On the other hand, there was no discernible improvement in the control group. The circuit training method's multi-site design improves students' speed quality in addition to increasing training density. As shown in Table 7.

Table 7. Longitudinal Comparative Analysis of 50-Meter Dash Scores

Grouping		n	Mean ± standard deviation	T	P
Experimental group	Before the experiment	10	83.00±6.128	-2.707	0.024
	After the experiment	10	87.90±6.027		
Control group	Before the experiment	10	80.00±4.372	-1.765	0.111
	After the experiment	10	80.60±3.950		

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference.

4.3. The Impact of Circuit Training on Students' Endurance Quality

via the t-test for independent samples. Prior to the experiment, there was no significant difference ($p>0.05$) in the two groups' test results; but, following the trial, there was a significant difference ($p<0.05$) between the experimental group and the control group, suggesting a significant improvement. As shown in Table 8.

Table 8. Comparative Analysis of 60-Second Jump Rope Test Results

	Grouping	n	Mean ± standard deviation	T	P
Before the experiment	Experimental group	10	150.80±3.967	-0.206	0.839
	Control group	10	151.10±2.331		
After the experiment	Experimental group	10	171.20±6.613	7.518	0.000
	Control group	10	153.70±3.234		

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference.

Following the experiment, the pre-test and post-test data from the experimental group and the control group were examined independently using the paired sample t-test. The findings of the post-test were superior to those of the pre-test in the experimental group, and there was a significant difference between the two tests ($p<0.05$). This suggests that the students' endurance quality was much enhanced by employing the circuit training method. As shown in Table 9.

Table 9. Longitudinal Comparative Analysis of 60-Second Jump Rope Test Results

Grouping		n	Mean ± standard deviation	T	P
Experimental group	Before the experiment	10	150.80±3.967	-7.589	0.000
	After the experiment	10	171.20±6.613		
Control group	Before the experiment	10	151.10±2.331	-2.177	0.057
	After the experiment	10	153.70±3.234		

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference.

The experimental physical fitness data was subjected to paired sample and independent sample t-tests using IBM SPSS Statistics 25, and the pre- and post-test outcomes of the three physical fitness tests were compared. Students' speed and endurance traits were successfully enhanced by the circuit training method, but their flexibility traits did not significantly alter. This suggests that the circuit training approach is not particularly helpful in enhancing students' flexibility.

4.4. Analysis of Tennis-Specific Technical Test Results Before and After the Experiment

4.4.1. The Impact of Circuit Training on Baseline Shot Depth

The test findings of the first two groups prior to the experiment did not differ significantly ($p>0.05$) according to the independent sample t-test comparative analysis of baseline stroke depth scores. Following the trial, the test results revealed a significant difference in forehand and overall scores ($p<0$), but no significant difference in backhand and stability scores ($p>0.05$). As shown in Table 10.

Table 10. Horizontal Comparative Analysis of Baseline Shot Depth Scores

	Grouping	n	Forehand score (M±SD)	Backhand score (M±SD)	Total score (M±SD)	Stability (M±SD)
Before the experiment	Experimental group	10	11.60±1.174	8.90±1.729	20.50±2.014	4.60±0.843
	Control group	10	11.50±1.841	9.40±1.265	20.90±1.729	4.80±0.919
T			0.145	-0.738	-0.477	-0.507
P			0.886	0.470	0.639	0.618
After the experiment	Experimental group	10	19.80±3.425	14.70±1.160	34.50±3.689	6.60±0.843
	Control group	10	14.60±2.836	13.50±2.369	28.10±4.254	6.00±0.943
T			3.698	1.439	3.594	1.500
P			0.002	0.167	0.002	0.151

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference.

Using paired sample t-tests on the shot depth baseline: Following the experiment, pre-test and post-test data from the experimental group and the control group were subjected to longitudinal comparative analysis. The experimental group's pre-test and post-test results differed significantly ($p<0.05$), with the pre-test being less than the post-test. Additionally, the control group's pre- and post-test findings.

The depth of forehand and backhand strokes significantly improved for both the experimental and control groups. There was a promoting effect regardless of whether the training approach was cyclic or non-cyclic. Nevertheless, the experimental group fared better overall than the control group, suggesting that cyclic training. As shown in Table 11.

Table 11. Vertical Comparative Analysis of Baseline Shot Depth Scores

Grouping		n	Forehand score (M±SD)	Backhand score (M±SD)	Total score (M±SD)	Stability (M±SD)
Experimental group	Before the experiment	10	11.60±1.174	8.90±1.729	20.50±2.014	4.60±0.843
	After the experiment	10	19.80±3.425	14.70±1.160	34.50±3.689	6.60±0.843
T			-6.009	-7.660	-9.487	-5.071
P			0.000	0.000	0.000	0.001
Control group	Before the experiment	10	11.50±1.841	9.40±1.265	20.90±1.729	4.80±0.919
	After the experiment	10	14.60±2.836	13.50±2.369	28.10±4.254	6.00±0.943
T			-2.697	-5.068	-4.450	-2.449
P			0.025	0.001	0.002	0.037

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference

4.4.2. The Impact of the Circuit Training Method on Baseline Shot Accuracy

There was no significant difference in test results between the two groups prior to the experiment (p>0.05), according to the independent sample t-test horizontal comparison analysis of baseline shot accuracy scores in Table 12. Following the trial, test results for the experimental group and the control group differed significantly (p<0.05).

Table 12. Horizontal Comparative Analysis of Baseline Shot Accuracy Scores

	Grouping	n	Forehand score (M±SD)	Backhand score (M±SD)	Total score (M±SD)	Stability (M±SD)
Before the experiment	Experimental group	10	9.50±0.850	9.20±1.317	18.70±1.418	5.00±1.333
	Control group	10	9.60±1.776	9.30±1.059	18.90±2.331	5.10±1.287
T			-0.161	-0.187	-0.232	-0.171
P			0.874	0.854	0.819	0.866
After the experiment	Experimental group	10	17.40±1.955	13.40±1.578	30.80±2.821	6.80±0.789
	Control group	10	14.10±2.025	12.10±1.101	26.20±2.821	5.80±0.632
T			3.708	2.137	3.647	3.128
P			0.002	0.047	0.002	0.006

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference

Using baseline shot accuracy's paired sample t-test: Following the experiment, pre-test and post-test data from the experimental group and the control group were compared longitudinally. There was a substantial difference (p<0.05) between the experimental group's pre-test and post-test results, with the post-test being superior. A comparison of the data collected before and after the trial reveals that the circuit training approach considerably increases hitting accuracy, despite a significant difference (p) after 12 weeks of training. As shown in Table 13.

Table 13. Longitudinal Comparative Analysis of Baseline Shot Accuracy Scores

Grouping		n	Forehand score (M±SD)	Backhand score (M±SD)	Total score (M±SD)	Stability (M±SD)
Experimental group	Before the experiment	10	9.50±0.850	9.20±1.317	18.70±1.418	5.00±1.333
	After the experiment	10	17.40±1.955	13.40±1.578	30.80±2.821	6.80±0.789
T			-12.016	-6.332	-12.458	-4.630
P			0.000	0.000	0.000	0.001
Control group	Before the experiment	10	9.60±1.776	9.30±1.059	18.90±2.331	5.10±1.287
	After the experiment	10	14.10±2.025	12.10±1.101	26.20±2.821	5.80±0.632
T			-5.084	-4.882	-5.508	-1.655
P			0.001	0.001	0.000	0.132

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference.

4.4.3. The Impact of Circuit Training on Serving

The serve is regarded as the most crucial method of scoring in tennis since it is the only strategy that is unaffected by the opposition. The high-level serve and the low-level serve are the two different kinds of serves. There are two serve possibilities for each point; if the first serve is unsuccessful, a second serve may be tried. This experiment is mostly concerned with advanced serves. Players can employ advanced serves to connect with their own tactics and control the entire court since they can create high-quality placement and speed. But serving is frequently a very challenging skill to acquire.

A player will have an extremely low first serve percentage if they do not have a firm knowledge of advanced serving strategies. It becomes challenging to restrain the opponent when the first serve percentage is low. Flat serves are one of the numerous varieties of advanced serves. Additionally, the second serve is typically topspin or sidespin, but its menace is frequently diminished to prevent a double fault. In order to become proficient in this method, one must not only have a fluid action but also good physical qualities.

Perform a cross-sectional comparison study of the test results for the experimental group and the control group prior to and following the experiment. Prior to the experiment, there was no discernible difference between the two groups' test results (p>0.05). Following the circuit training trial, the experimental group outperformed the control group.As shown in Table 14.

Table 14. Horizontal Comparison Analysis of Serve Points

	Grouping	n	Outside corner score (M±SD)	Inner corner score (M±SD)	Total score (M±SD)	Stability (M±SD)
Before the experiment	Experimental group	10	6.20±2.530	3.90±3.178	10.10±1.663	2.80±0.632
	Control group	10	5.30±2.214	4.70±2.751	10.00±2.261	2.70±0.675
T			0.847	-0.602	0.113	0.342
P			0.408	0.555	0.912	0.736
After the experiment	Experimental group	10	11.70±1.567	10.00±2.055	21.70±1.636	4.10±0.738
	Control group	10	9.30±2.163	8.10±1.853	17.60±3.169	3.80±0.422
T			2.842	2.172	3.635	1.116
P			0.011	0.044	0.003	0.279

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference.

Using paired sample t-tests for serve scores: The pre-test and post-test data for the experimental group and the control group were subjected to longitudinal comparison analysis following the experiment. The experimental group's pre-test and post-test results differed significantly (p<0.05). Even though the control group's pre-test and post-test results also revealed significant changes (p<0), this suggests that using the circuit training method in tennis-specific courses improves serving techniques. As shown in Table 15.

Table 15. Vertical Comparison Analysis of Serve Points

Grouping		n	Outside corner score (M±SD)	Inner corner score (M±SD)	Total score (M±SD)	Stability (M±SD)
Experimental group	Before the experiment	10	6.20±2.530	3.90±3.178	10.10±1.663	2.80±0.632
	After the experiment	10	11.70±1.567	10.00±2.055	21.70±1.636	4.10±0.738
T			-5.687	-6.972	-16.144	-4.118
P			0.000	0.000	0.000	0.003
Control group	Before the experiment	10	5.30±2.214	4.70±2.751	10.00±2.261	2.70±0.675
	After the experiment	10	9.30±2.163	8.10±1.853	17.60±3.169	3.80±0.422
T			-4.899	-4.083	-6.571	-3.973
P			0.001	0.003	0.000	0.003

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference

4.4.4. The Impact of Circuit Training on Specialized Fitness

Every racquet sport must have mobility as a fundamental component. It is an all-encompassing representation of traits like coordination, strength, speed, and agility. The level of mobility during a tennis match can affect how the game turns out. Athletes frequently run back and forth during games, and collegiate tennis players frequently move too slowly, have uncoordinated footwork, and lack lower body mobility training. Students' mobility can be successfully improved by the fan-shaped running movement training. Consequently, adding fan-shaped running training to the circuit training approach has improved college tennis training.

Prior to the experiment, the experimental group's scores did not differ significantly from the control group's (p>0.05). Following the trial, the experimental group's scores differed significantly from those of the control group (p<0.05). As shown in Table 16.

Table 16. Horizontal Comparison Analysis of Sector Running Scores

	Grouping	n	Mean ± standard deviation	T	P
Before the experiment	Experimental group	10	42.00±5.497	0.496	0.626
	Control group	10	40.70±6.201		
After the experiment	Experimental group	10	70.00±7.746	2.899	0.010
	Control group	10	60.70±6.550		

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference.

The results of a paired sample t-test on the sector run scores in Table 17 show that the experimental group's pre-test and post-test scores differ significantly (p<0.05), with the pre-test scores being lower than the post-test scores. This suggests that the students' sector run ability has significantly improved as a result of the training over the designated period. Nevertheless, there is no discernible variation between the pre-test.

Table 17. Vertical Comparative Analysis of Sector Running Scores

Grouping		n	Mean ± standard deviation	T	P
Experimental group	Before the experiment	10	42.00±5.497	-10.566	0.000
	After the experiment	10	70.00±7.746		
Control group	Before the experiment	10	40.70±6.201	-8.289	0.000
	After the experiment	10	60.70±6.550		

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference

Following 12 weeks of training, Table 15's horizontal comparison reveals that the experimental group's average score in the fan-shaped run was 42 points, compared to 40.7 points for the control group. There is no significant difference, as indicated by the P-value (0.626) > 0.05. Following the trial, the experimental group scored an average of 70 points in the fan-shaped run, compared to 60.7 points for the control group. There is a significant difference between the two groups, as indicated by the P-value (0.000) < 0.05. The average scores of the experimental group before and after the test, as well as the average scores of the control group before and after the test, have all significantly improved, as can be observed from the longitudinal comparison in Table 17.

4.5. The Impact of Post-Experiment Circuit Training on Competition Performance

Students' competitive skills were assessed in the experiment using real match techniques. A round-robin single-elimination format was used for the matches. There was only one big round of competition between the experimental and control groups of students. Nineteen rounds of matches (N-1) were played, and the total.Following the experiment, the test scores of the two groups were compared using the independent samples t-test in Table 18. The results showed that the experimental group had an average total score of 118.3 points, while the control group had an average total score of 102.9 points, with a significant difference in the scores obtained ($p<0.05$).

Table 18. Comparison and Analysis of Scores After the Experiment

	n	Mean ± standard deviation	T	P
Experimental group	10	118.30±2.452	7.889	0.000
Control group	10	102.90±5.666		

Note: P<0.05 indicates a significant difference; P>0.05 indicates no significant difference.

5. Conclusion

Twenty students participated in the tournament, and their performance was summarized after 12 weeks of instruction. Neither of the two student groups could take part in real matches prior to the experiment. Following the exercise, both groups were able to use the fundamental skills they had gained throughout training in straightforward matches. The experimental group using the circuit training method outperformed the control group using the non-circuit training method, according to the competition results, suggesting that the circuit training method improves students' tennis skills and physical fitness.

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