



**THE APPLICATION OF COMBINATION TRAINING METHOD ON  
THE SPEED ENDURANCE LEVEL IN PHYSICAL EDUCATION  
FOR FRESHMEN STUDENTS IN CHINA**

**BY  
LEYAO ZHANG**

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT  
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Thesis entitled

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Leyao Zhang  
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### Abstract

This study aimed to compare speed endurance before and after using the Combination Training Method in Physical Education for Freshmen in China, and investigate student satisfaction with this method. A mixed-method approach was used, and the computer software calculated means and standard deviations. The research combined literature review, questionnaires, and statistical analysis, focusing on 30 male Freshmen physical education major from H College in Hunan Province. The students underwent a four-week Combination Training program designed to improve speed endurance.

The physiological and biochemical indices of the students before and after the experiment, along with their track and field performance, were analyzed. The results showed that: 1) Lactate clearance increased from 11.17% to 17.23%, compared to the pre-test rate of 1.44%; 2) Maximal heart rate decreased from 172 to 166 beats per minute, and heart rate recovery improved from 18% to 26.51% after 3 minutes; 3) Maximal anaerobic power of the lower extremities rose from 11.01 w/kg to 12.22 w/kg, with average power also improving from 8.46 w/kg to 8.85 w/kg; and 4) Track and field performance improved significantly in 100m, 800m, 1500m, triple jump, javelin, and shot put.

The conclusions were: 1) The Combination Training Method effectively improved lactate clearance, reducing fatigue and injury risk; 2) It accelerated heart rate recovery, aiding faster energy recovery after intense training; 3) It enhanced anaerobic capacity in athletes; and 4) This method was a fast, scientific, and effective way to boost speed endurance.

(Total 143 pages)

Keywords: Combination Training Method, Speed Endurance Level, Physical Education

Student's Signature ..... Thesis Advisor's Signature .....

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# CHAPTER 1

## INTRODUCTION

This chapter explained the background and rationale of the research, research objectives, research questions, research hypothesis, the scope of the research, the conceptual framework of the research, operational definitions, expected outcomes of the research, and the limitations of the research.

### 1.1 Background and Rationale of the Research

Athletics was fundamentally a sport centered around speed and fitness, with speed endurance being the predominant aspect. This sport was characterized by the necessity for prolonged and intense muscular explosiveness, with the most notable feature being the special speed endurance qualities required to maintain a high speed over a sustained period. Reflecting on the history of track and field, it becomes evident that the evolution and refinement of training methods had been the essential driving forces behind advancements in athletes' speed and endurance. Physical education students who specialized in track and field typically possess a relatively good ability to sustain fast running, maintain speed endurance, and demonstrate strong muscular strength (Rocha, 2021). Their performance was generally stable, but when they reached a certain plateau or bottleneck, improvement tend to be slow and there were no significant advancements in a short period. The daily training regimen of track and field students usually relies on traditional single training methods, which was the primary reason for the slow progress in their performance.

Fiorenza (2019) and other scholars, while researching the effects of combining various individual training methods on the special strength training of athletes engaged in jumping sports within track and field, concluded that even

when these athletes' physical abilities reach a plateau, performance could be improved by combining multiple training methods and techniques. This approach helped enhance the precision of movements, leading to improved sports performance. Thus, exploring and researching more optimal training methods remains a valuable endeavor (Morin & Samozino, 2016). The findings suggest that integrating diverse training strategies could break through performance bottlenecks and promote further development in athletes' abilities. Consequently, the continuous pursuit of better training methodologies was crucial for driving advancements in track and field performance.

As athletes face performance plateaus, it became imperative to innovate and incorporate varied training approaches. The research underscored the importance of combining different training techniques to address the limitations of traditional single-method training. By doing so, athletes could achieve incremental improvements and ultimately enhance their overall performance. This holistic approach to training not only addresses the immediate need for improvement but also contributes to the long-term development of speed endurance and muscular strength in track and field athletes. The ongoing exploration of optimal training methods was essential for pushing the boundaries of athletic performance and achieving new heights in the sport.

The overall trend in speed endurance quality training had experienced two distinct phases, transitioning gradually from an initial focus on aerobic metabolic capacity training to a more integrated approach that combines aerobic and anaerobic metabolism and the corresponding functional capacity conversion training (Cheng, 2018). In modern competitive sports, excellent middle and long-distance runners possess not only robust aerobic endurance but also exceptional speed ability and superior speed endurance quality. With the continuous advancement of contemporary science and technology, those involved in physical education increasingly recognize that speed endurance quality was a crucial factor affecting the competitive performance of middle-distance runners. Although these athletes already exhibit excellent endurance, having an absolute speed advantage was the fundamental guarantee of superior speed endurance and enhanced competition performance (Kim, 2021).

This research aimed to scientifically integrate various single training methods and apply them to the daily training routines of athletes. By tailoring each training method to the athletes' individual physical conditions, physiological situations, and the characteristics of their specific specialties, the goal was to develop a scientifically sound training program. Employing a Combination of different single training methods was expected to yield more significant results with less effort. The training program would be systematically applied to training sessions, allowing for the timely detection of issues during training experiments. This enabled the modification and adjustment of the training program to continually improve its effectiveness. Ultimately, the research seek to develop an optimal training program tailored to enhance the speed and endurance quality of track and field students (Miller & Johnson, 2019).

By continually refining and adapting the training methods based on real-time feedback and performance assessments, this approach ensures that athletes receive the most effective and efficient training possible. The integration of diverse training techniques not only addresses the specific needs of each athlete but also maximizes the potential benefits of each session. This comprehensive and dynamic training strategy aims to produce middle and long-distance runners who excel in both endurance and speed, thus significantly improving their overall competitive performance. Through scientific innovation and practical application, this research endeavors to set a new standard in the training of speed endurance quality for track and field athletes.

At the present stage, the challenge faced by physical education major track and field students was not a lack of physical fitness or scientific training methods, but rather the absence of atargeted and rational Combination of these methods to develop a more effective training program aimed at improving speed and endurance (Navarro & Martín, 2020). Consequently, this research intends to utilize principles from sports training, physiology, and related fields to create a Combination training program. This program would be evaluated by measuring physiological indicators before and after training to reflect changes in the students' speed and endurance, alongside track and

field specific performance test indicators. The goal was to verify the impact of the Combination Training Methods on speed endurance levels, and to explore new theories and modes of training that could lead to breakthroughs in this area. Ultimately, the findings would be synthesized into theories with practical significance.

The purpose of this research was to thoroughly investigate and summarize a Combination Training Method that effectively enhanced speed and endurance through scientific analysis and practical testing. By doing so, it aimed to optimize the specific implementation of the Combination Training Method according to the unique demands of athletics. This tailored approach was expected to improve the speed and endurance quality of students selected for athletics, using a systematic application of various scientific training Combinations in the field of sports education and training (Reilly, 2016). The research seek to provide a comprehensive evaluation and verification of the Combination Training Method's effectiveness, thereby offering new insights and strategies for improving athletic training programs.

In essence, this research strived to bridge the gap between existing physical fitness and training methods by developing a scientifically integrated training program that was both targeted and reasonable. By leveraging physiological principles and sports training techniques, the study aims to create a new paradigm for enhancing speed endurance in track and field students. The results of this research would contribute to the advancement of training theories and provide practical solutions for sports educators and trainers, ensuring that the Combination Training Methods were not only scientifically sound but also practically applicable in real-world athletic settings.

Considering the theoretical significance of the Combination Training Method for track and field athletes to improve the level of speed endurance, the innovative training mode allowed athletes not to had a single or multiple isolated specialized physical qualities, but to apply the diversity of specialized qualities of the body reasonably and efficiently in athletic competitions (Wang & Chen, 2018). The integrated use of multiple training methods, i.e. the Combination Training Method,

not only combines different items and types of training methods for each specialty together, but also provided new ideas, new thoughts and means for the training of speed endurance.

The Combination Training Method hold substantial theoretical importance for track and field athletes seeking to enhance their speed endurance capabilities. This methodological innovation facilitates athletes in utilizing a spectrum of specialized physical attributes efficiently, rather than fixating solely on isolated elements (Wang & Chen, 2018). By integrating various training methods, including the Combination training approach, athletes were able to amalgamate diverse training items and methodologies tailored to their respective disciplines. This integration not only consolidates different training types and components but also introduces fresh insights, innovative concepts, and effective strategies aimed at refining speed endurance during competitive sports engagements.

Considered practically, it was essential to integrate the specific circumstances of students and the inherent characteristics of the project with regular daily training to enhance the scientific rigor of training. The Combination Training Method adapts flexibly to individual physical attributes and external environmental conditions, emphasizing systematic integration of key training factors throughout the training process. Tailoring training according to students' varying phases of readiness and competitive levels, while adhering to scientific training principles, optimizes training effectiveness and enhances specialized performance improvements (Xu & Li, 2015).

In practice, it was crucial to align the training regimen with students' unique needs and the specific requirements of the project. By incorporating daily training routines, the Combination training approach could adjust seamlessly to individual physical attributes and external environmental factors. This method underscores the methodical integration of critical training elements throughout each stage of training. Moreover, by tailoring training protocols to accommodate students' diverse levels of readiness and competitive aspirations, and by adhering strictly to established

scientific principles of sports training, optimal training outcomes could be achieved, ultimately bolstering specialized performance gains (Xu & Li, 2015).

The practical application of these principles ensured that training was not only comprehensive but also targeted towards maximizing individual potential within the constraints of the project's objectives. By incorporating a nuanced understanding of students' physical capabilities and external influences, trainers could optimize the effectiveness of each training session. This approach fostered a holistic development approach that considers the athlete's phase of development, competitive aspirations, and the evolving demands of the sport. Through systematic adaptation of training protocols, athletes could navigate different training phases with precision, ensuring that each session contributes meaningfully to overall performance enhancement. Thus, the Combination Training Method stand as a cornerstone of modern athletic preparation, offering a dynamic framework for achieving peak performance through strategic integration and scientific rigor (Xu & Li, 2015).

Teaching Combination training in a class setting involved a careful blend of resistance and cardiovascular exercises to maximize the benefits of both. To start, a well-structured warm-up was essential. A 5-10-minute warm-up could include dynamic stretches and light cardiovascular activities such as jogging or jumping jacks. These activities were designed to increase heart rate, warm up the muscles, and prepare the body for the more intense work ahead. Dynamic stretches like leg swings, arm circles, and lunges help to improve range of motion and reduce the risk of injury. The goal was to ensure participants were physically ready for the demands of the workout. The main portion of the class should be a balanced integration of resistance and aerobic exercises. One effective method was circuit training, where participants move through a series of exercise stations that alternate between strength and cardio. For example, a circuit could include squats, push-ups, and dumbbell presses interspersed with jumping rope, high knees, or sprinting in place. This approach not only keeps the class dynamic and engaging but also ensures a comprehensive workout. It's important to adjust the intensity based on the fitness levels of the participants, providing modifications for beginners and more challenging options

for advanced participants. Encouraging proper form and offering guidance during exercises helps prevent injuries and maximizes the effectiveness of the workout. To conclude the session, a cool-down phase of 5-10 minutes should be incorporated. This could include static stretching to help improve flexibility and promote muscle recovery. Stretches should target the major muscle groups worked during the session, such as the hamstrings, quadriceps, chest, and shoulders. This phase allows the heart rate to gradually return to resting levels and helps prevent muscle stiffness and soreness. By structuring the class to include a thorough warm-up, a balanced mix of strength and cardio exercises, and a proper cool-down, instructors could provide a safe and effective Combination training experience that benefits participants' overall fitness and health.

Combination training offered a multitude of benefits, especially in a class setting where participants could motivate and challenge each other. One significant benefit was improved overall fitness. By integrating both cardiovascular and resistance training, participants enhance their heart health, muscular strength, and endurance simultaneously. This holistic approach could lead to better performance in various physical activities and sports, as well as improved daily functioning. Additionally, Combination training could help in weight management and body composition. The aerobic component helped burn calories and reduce body fat, while resistance training builds lean muscle mass, which in turn boosts metabolism even at rest. This dual approach was particularly effective for those looking to lose weight and tone their bodies. Another advantage of Combination training was its time efficiency. For many individuals, finding time for separate strength and cardio sessions could be challenging. Combining these workouts into a single class allows participants to achieve their fitness goals without spending extra time at the gym. This efficiency was particularly appealing to busy professionals and parents who need to maximize their workout time. Moreover, the variety within Combination training keep the sessions interesting and engaging, reducing the risk of boredom and increasing adherence to a regular exercise routine. The social aspect of a class setting also enhances motivation and accountability, as participants encourage each other and build a sense of community. Despite its numerous benefits, Combination training also came

with certain limitations. One major challenge was the potential for the interference effect, where the benefits of strength training and cardiovascular training may counteract each other to some extent. This could be particularly problematic for advanced athletes who need to maximize gains in a specific area. Additionally, the increased intensity and volume of Combination training could lead to a higher risk of overtraining and injury if not properly managed. Instructors need to carefully design the program to ensure balanced workloads and adequate recovery periods. Proper guidance and monitoring were crucial to prevent participants from pushing themselves too hard and experiencing burnout or injuries. By being aware of these limitations and planning accordingly, instructors could create effective and safe Combination training classes that maximize benefits while minimizing risks.

This was very conducive to enriching the overall training method theory system of athletics, and providing scientific theoretical references for coaches to guide the training of students who were specially selected for athletics in the future. In this research, for the need to improve the quality of speed and endurance, the development of a targeted Combination of training methods of quality training; for track and field events, the Combination of training method contained a quantitative research of training single, explored practical, effective, targeted Combination of training methods, and effectively improve the level of speed and endurance of track and field students selected (Yoon, 2020).

## **1.2 Research Objectives**

1.2.1 To compare speed endurance level before and after using Combination Training Method in Physical Education for Freshmen students in China.

1.2.2 To investigate freshmen students' satisfaction towards using the Combination Training Method in Physical Education for Freshmen students in China.

### **1.3 Research Questions**

1.3.1 Was there an improvement in speed endurance level training in Freshmen after the implementation of the Combination Training Method?

1.3.2 Would the Freshman students be satisfied with the Combination Training Method in Physical Education?

### **1.4 Research Hypotheses**

After using the implementation of the Combination Training Method in Freshmen students, their speed endurance training level would improve.

### **1.5 Scope of the Research**

The research was carried out in accordance with the parameters outlined above. As a result, it was important to proceed cautiously when extrapolating the findings, particularly when considering varying educational backgrounds and research equipment.

In this research, the effect of Combination Training Method on the speed and endurance level of track and field students majoring in physical education was studied. Thirty male students in freshman from the physical education majoring in H college were selected as the experimental samples. In addition, data were collected from the freshman students at that particular school through questionnaire and test scores.

#### **1.5.1 Location of the Research**

H college, established in 1904 in Hengyang, Hunan Province, China, was a comprehensive institution renowned for its teacher education programs. The college offers diverse undergraduate and graduate programs across various

disciplines, including humanities, social sciences, natural sciences, engineering, and management. The beautiful campus features modern facilities such as well-equipped classrooms, laboratories, and a comprehensive library, creating a conducive environment for learning and research. With a strong emphasis on academic excellence and innovation, H college was dedicated to cultivating skilled and ethical professionals who contribute positively to society.



Figure 1.1 Location of the Research School

Source: Baidubaike, 2022

### 1.5.2 Research Population

Population: Physical education and sports training were the two best majors in the H college of physical education and sports science, both of which were "first-class" undergraduate major construction sites in Hunan Province. The target population of the research included 613 students from freshman to senior year, there were 121 freshmen students.

Sample: The researcher applied clustered random sampling to select 30 male freshman students, age from 18-21 years.

### 1.5.3 Time Frame

The goal of the 4-week training plan was a significant increase in the speed endurance level of the sample group of 30 students, which was carried out in 3 phases.

Table 1.1 The goal of the 4-week training

Categories	Time	Arm setting	Training content	Scientific basis of training
Phase 1	week	Improve general endurance	1 Timed runs 1 Quantitative Running 1 Cross-country running 1 Ball activities	According to the theoretical basis of speed endurance, the pre-training phase requires the development of general endurance and aerobic training. The students' psychological factors and willpower are the factors affecting the implementation of speed endurance training. The Combination Training Method adjusts the content and intensity of the training so that the students' psychological state is good and they slowly adapt to the beginning of the training, while the stage-by-stage goals subconsciously develop their willpower.

Table 1.1 The goal of the 4-week training (Cont.)

Categories	Time	Arm setting	Training content	Scientific basis of training
Phase 2	week	Increased speed and endurance	1 Aerobic training as a supplement 1 Strength Training 1 Strength Training: 1 Maximum Strength 1 Strength Endurance 1 Coordination	The aim is to train the lower limb explosive force and absolute speed, the development of speed endurance needs to pay attention to absolute speed and upper and lower limb coordination. Running, jumping and throwing power for cycle Combination action organic Combination, at the same time in line with the student's psychology and the same amount of training when the sense of purpose one by one rapid implementation of the training was more state of the art good vitality. Cycle training method, through the exercise, the potential could be stimulated. Maximum strength training applies to all phases of the training period.

Table 1.1 The goal of the 4-week training (Cont.)

Categories	Time	Arm setting	Training content	Scientific basis of training
	week		<p>1 Strength training as a supplement</p> <p>1 Speed endurance was the main focus</p> <p>1 Speed Endurance:</p> <p>1 Slow Interval Training</p> <p>1 Fast Interval Training</p> <p>1 Long repetitions</p>	<p>The movements are organically combined and the training methods are organically combined.</p> <p>The long repetition method focuses on the development of the athlete's lactate energy metabolic system and the aerobic metabolic system mixed energy supply capacity. The main function of the short distance interval method is to develop the athlete's speed and speed endurance. Medium-distance intervals focus on the development of the athlete's mixed-oxygen metabolism. Circuit training, through which the potential of the athlete was stimulated and the quality of will be developed. Maximum strength training is used in all phases of training.</p>

Table 1.1 The goal of the 4-week training (Cont.)

Categories	Time	Arm setting	Training content	Scientific basis of training
				Repetitions are used in the recovery phase and intervals in the pre-competition phase.
Phase 3	week	Holding the level	1 General Endurance 1 Speed Endurance	Cross-country running could be structured as a fun aerobic workout, with mid-distance intervals to develop mixed- metabolic capacity

Table 1.2 Timeline of this research

Activity	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Literature Review								
Research Proposal								
Research Proposal Defense								
Data Collection								
Data Analysis								
Report Writing and Thesis Defense								

### 1.5.4 Research Plan

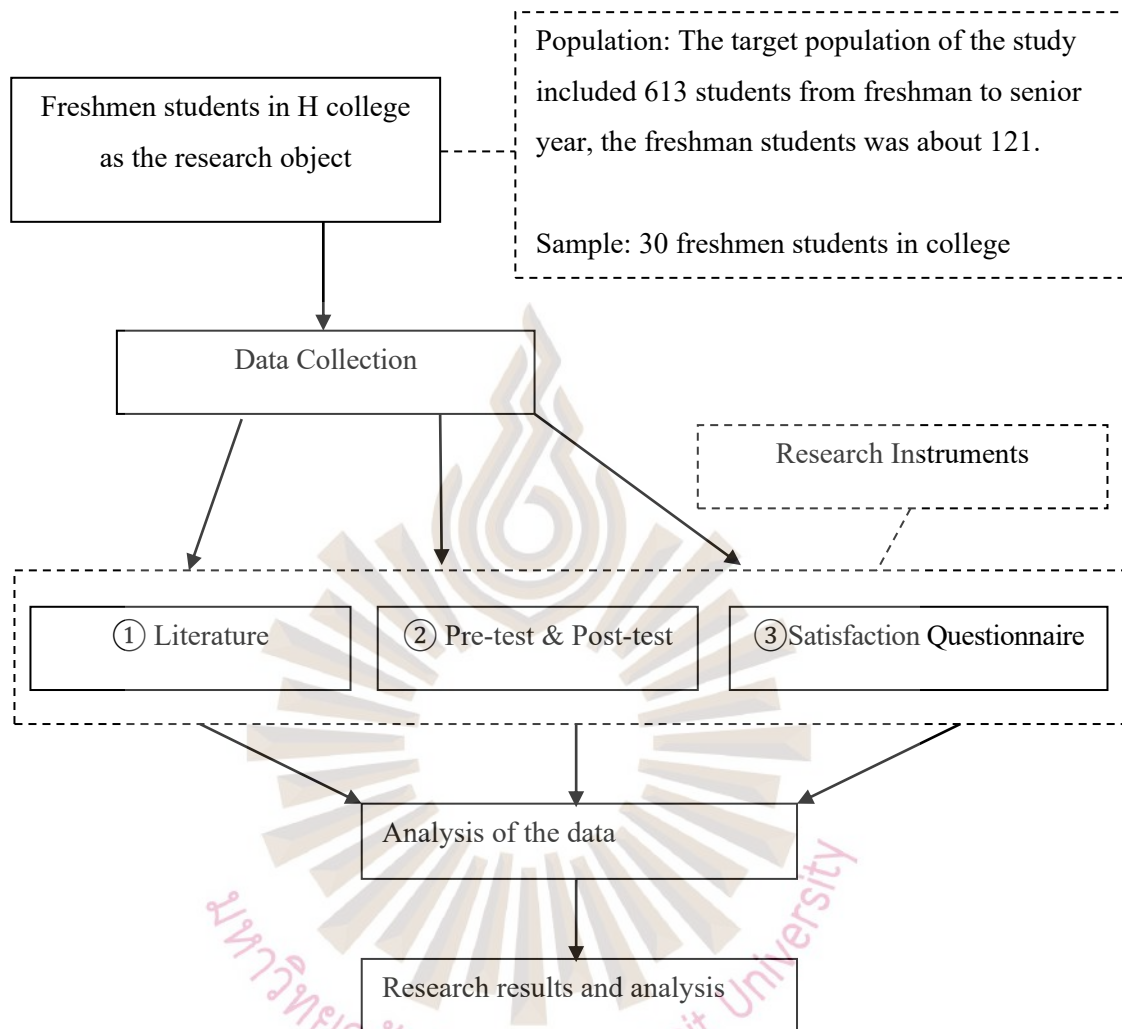


Figure 1.2 Research Plan

Source: Compiled by Researcher

### 1.6 Conceptual Framework of this Research

This research was composed of independent variable and dependent variables. The independent variable was the Combination Training Method in Physical Education. The speed endurance level and student satisfaction were the dependent variables, as shown in Figure 1.3.

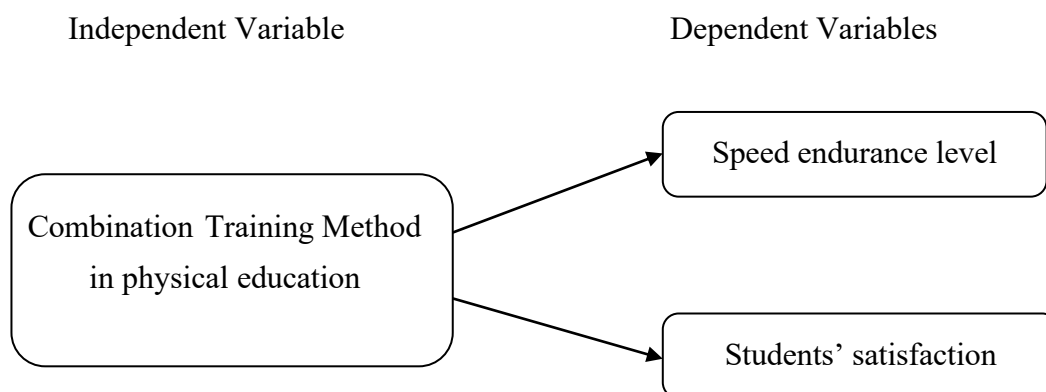


Figure 1.3 Conceptual Framework of the research

## 1.7 Definitions of Terms

**Combination Training Method** It was an approach that integrates multiple types of exercise routines and training techniques to achieve comprehensive fitness and performance goals. This method was designed to address various aspects of physical fitness, such as triple jump, javelin, shot put, 100 meters, 800 meters, 1500 meter.

Benefits and Advantages: 1) Holistic Fitness Development, by incorporating various training methods, individuals develop multiple facets of physical fitness, leading to better overall health and performance. 2) Prevention of Boredom, variety in training routines helps keep workouts interesting and engaging, reducing the likelihood of monotony and increasing adherence to the exercise program. 3) Injury Prevention, by addressing different components of fitness, Combination training could help prevent overuse injuries associated with repetitive training and ensure a more balanced physical development. 4) Improved Performance, athletes and individuals looking to enhance their performance could benefit from the diverse training stimuli, which prepare the body for a wide range of physical challenges.

**Speed Endurance Level** It referred to the ability to maintain a high level of speed or power output over a prolonged period. It combines elements of both speed and endurance, allowing an individual to perform high-intensity activities without a significant decline in performance, through the 500m, 800m and 1500m measure the level.

Speed endurance was further divided into phosphagen-supplied anaerobic endurance and glycolysis-supplied anaerobic endurance. The development of speed endurance was mainly to improve glycolysis ability, lactate was the end product of glycolysis, test blood lactate concentration could basically reflect the anaerobic glycolysis energy supply system in exercise. In actual training, it was difficult to test blood lactate frequently, and heart rate could be used to infer the situation of anaerobic metabolism. Post-exercise blood lactate clearance can reflect the effect of stage-specific aerobic endurance training. Anaerobic power sourced anaerobic metabolic capacity and could evaluate the effectiveness of anaerobic training methods. Anaerobic training centrifugal rated reserve intensity was in the range of 80%-90% and maximal heart rate intensity was in the range of 87%-93%.

**Student Satisfaction on Using Combination Training Method in Class** This referred to how content and pleased students were with their experience of using the Combination Training Method in fitness classes. It encompasses their overall happiness with the program, the perceived benefits, enjoyment, and whether their fitness goals and expectations were met, relevant questionnaires were distributed through WENJUANXING website and the questionnaires were analyzed by SPSS and conclusions were drawn.

**Physical Education Freshmen Students** These were students who were pursuing their undergraduate degrees in the field of physical education. They were typically enrolled in programs that cover various aspects of physical activity, sports science, and related subjects, with the goal of becoming educators, coaches, trainers, or sports professionals.

## **1.8 Limitations of the Research**

1.8.1 This research selected only 30 freshmen students from one college in China. They were not a representative of the entire physical education curriculum.

1.8.2 Since the lesson plans and data collecting for this research were finished in a month, it was possible that the research period was insufficient to produce results that maybe questioned.

## 1.9 Significance of The Study

The following was a list of anticipated research outcomes:

1.9.1 The Combination Training Method improved the speed endurance level of physical education freshmen students in Hunan province.

1.9.2 This research provided a reference for the application of the Combination Training Method in physical education freshmen students in Hunan province.

1.9.3 The results of this search shed light on an alternative method of teaching physical education in China and other stakeholders.



## **CHAPTER 2**

### **LITERATURE REVIEW**

This chapter provided an overview of the research, the literature, and the history of relevant teaching and learning theories. To provide a greater understanding of the areas under investigation, a summary of related research and studies was provided at the end of the chapter.

#### **2.1 Background on Education System of China**

In recent years, many colleges and universities had established sports training majors in the process of scale development. Among the sports colleges and universities, the sports training major, as a key major, carries many important responsibilities for the education and training of athletes. We should not only improve the basic theoretical knowledge of the athletes, but also guide the athletes to pay more attention to the theoretical study in the professional training, so that the athletes could become the high-level complex sports talents who could represent the school, the region, and the country in the professional and vocational teams, and win the honor for the region and the country, and made the due contribution. Theoretically speaking, the number of sports professional complex talents in China would be greatly improved, but from the actual situation, it seemed that the athletic training professionals cultivated by various universities in China had appeared the phenomenon of alienation of training objectives, which had a great deal to do with the cultivation method and the cultivation environment.

Among them, the lag in the basic cultural course and theoretical learning of athletes had increased this influence to a certain extent. Therefore, with the development of the times, the importance of cultural education in the cultivation process of athletic

training students was further highlighted. Therefore, as an important part of the all- round talent cultivation system of China's colleges and universities, the athletic training major played an important role in the development and continuous improvement of the process of continuously improving the cultural education of athletes and strengthening the cultivation of reserve talents.

However, due to the fact that athletes occupied a lot of time and energy in high-intensity sports training for along time, the cultural learning time and environment were weakened, resulting in their weak cultural foundation. After entering colleges and universities, they face the challenges of theoretical learning and talent cultivation goals. Among them, learning outlook, as the most direct influence factor of learning effect, determines to a certain extent the quantity and efficiency of athletes' acquisition of cultural knowledge. Whether it was from the long-term development of China's sports industry, or sports students themselves, guiding them to establish a correct view of learning had a crucial role. Especially under the premise that the education reform of colleges and universities had begun to expand the scale of enrollment and the autonomy of running schools had been continuously improved, strengthening the cultural education of athletes and guiding them to set up the correct learning concepts provide broader opportunities and prospects for the development and training of athletes in colleges and universities in China.

## **2.2 Physical Education in China**

This research implemented a program of research focusing on the specific training of speed endurance qualities for physical education students specializing in track and field, and the many concepts associated with them were the theoretical guidance for the starting point and direction of exploration of speed endurance qualities research; therefore, accessed to and study of the concepts associated with them here was a key step in the development of the research into the training of speed endurance qualities.

### **2.2.1 Physical Quality (In Athletics)**

Physical fitness was one of the many qualities of a human being, a manifestation of the basic athletic ability of human beings, and an expression of the bodily functions of the organs of the human body and the systems in which they were located in muscular activity (Ma, 2014). The 1984 edition of the Dictionary of Physical Education defines it clearly: "Physical fitness was the ability of human beings to be able to move freely, and refers to the body's expression of the physical elements of the human body in its daily activities and life. elements, such as: speed, endurance, explosive power, and strength." Physical quality was also divided into two kinds, health quality was indispensable to our normal daily activities, the quality of this quality directly affects the level of personal health and vital signs, such as: muscle endurance activity, body flexibility and sensitivity, etc.; quality of movement refers to the integrity of the human body in the process of completing a movement, the ability to consistency, which was the athlete's body depends on the long-term necessary qualities, the individual differences would be directly affected by the quality of movement (Zhu, 2015). Individual differences in the quality of movement would directly affect the degree of completion of the athlete's movement, thus affecting the performance of the game.

### **2.2.2 Speed Quality (In Athletics)**

Speed quality was the ability to move fast or slow in an individual's bodily functions, it could be categorized in competitive sport as instinctive reaction speed, speed of completion and speed of movement. The basis of instinctive reaction speed was reaction time, which was a kinesiological concept and could be called reaction latency. The so-called reaction latency refers to the time when an athlete receives a stimulus signal as a start, and makes a muscle reaction response process. Reaction latency was mainly determined by the following factors: the degree of sensitivity of the receptor organ receiving the stimulus, the degree of development of the afferent and efferent nerve endings, the degree of excitability of the effector,

external factors including the degree of fatigue and the degree of proficiency of the movement, and so on (Wang & Cao, 2019).

Men's middle distance running reaction latency was reflected in the reaction time of the start, athletes hear the sound of the gun this external stimulus to make a muscle response to respond to the fast start, the shorter the reaction time of the start, the more conducive to improve the performance of middle and long-distance running competition. Completion of action speed and speed of movement in common was dependent on the motor nervous system and muscle system, could in the shortest possible time to complete the action or displacement of a form of rapid movement. In most of the known sports, especially in some of the early human competitive sports, such as: middle and long- distance running in track and field speed sports. Speed of completion and speed of movement were important factors affecting the performance of middle- and long-distance running.

In the book "Modern Speed and Endurance Training Methods", Summarized and concluded that the main factors affecting the level of speed of completed movement were as follows (Zhang, 2022):

Table 2.1 The main factors affecting the level of speed

1.	from the perspective of motor nerve cell transmission, it was the transmission of excitement between nerve fibers;
2.	from the perspective of muscular organ effect, the excitement was transmitted by the nerve fibers to the end effector muscular organ, and it was the form of the movement issued by it together with the elasticity degree of muscular organ;
3.	from the biochemical point of view, the excitement was transmitted to the end effector muscular organ through the nerve fibers.;
4.	from the degree of concentration of the individual organism, the ability of the individual to focus his attention and to coordinate it with the speed system of the organism, and also to pay attention to the presence or absence of impediments to speed

Source: Zhang, 2022

Completion of movement speed was a very important part of the speed quality, completion of movement speed was the number of consecutive repetitions of a certain action within a unit of time, in the running program for the upper limb swinging frequency, foot stomping frequency. At the sametime, a special summary outlines the following key factors affecting the level of movement speed:

Table 2.2 The key factors affecting the level of movement speed

1.	whether to do preheating before exercise, activating the state of the body's various organs and systems;
2.	the degree of excitation of the nervous system and the nervous inhibition of the process of conversion of the flexibility of the nervous system, and measured in terms of its sensitivity;
3.	each individual of various muscle types accounted for the proportion of the ratio of the percentage of the proportion of the white muscle was positively correlated with the ratio of the proportion of the white muscle;
4.	the muscles of the interconversion of relaxation and elasticity properties;
5.	muscle organ flexibility;
6.	individual motorskill proficiency.

Source: Chen, 2023

The speed of movement refers to the speed of displacement in one direction or repeated reversal, measured by the absolute distance moved by the center of gravity of the body per unit of time, e.g., the time taken to complete a 400-metre run (including a change of direction) was 50.02 seconds, and if you want to increase the speed, you had to increase the frequency of completing the movement in this distance as well as the stride distance (Chen, 2023).

### 2.2.3 Endurance Quality (In Athletics)

Endurance qualities were defined as the ability of an individual's body to maintain a certain intensity, load, and quality of completed movements over a period of time. Endurance could be divided into muscular endurance and circulatory

(cardiovascular) endurance according to the body's physiological circulatory system. If subdivided, muscular organ endurance could also be called strength endurance, and cardiovascular endurance could also be divided into aerobic endurance and anaerobic endurance. Aerobic endurance refers to the ability of an exerciser to continue exercising for an extended period of time with an adequate supply of oxygen (Shi, 2017).

On the contrary, as the name suggests, anaerobic endurance refers to the ability of the athlete to keep on exercising by using anaerobic metabolism as a means of energy supply for a short period of time under the conditions of short-time and high-intensity exercise and insufficient supply of oxygen (Ma, 2021). Middle and long-distance running was a comprehensive test of endurance that combines anaerobic endurance with aerobic endurance in terms of the time it takes to complete the race and the amount of explosive power required. Human endurance refers to the ability to resist nerve fatigue and muscle fatigue under the intensity of non-normal activities, and the quality of endurance could be divided into general endurance and special endurance from special characteristics, the concept of special endurance had been put forward for a long time, but the connotation and extension of the concept of endurance had never reached a consensus.

One of the special endurances was each sport special indispensable difference from other sports ability, analysis of previous research found that special endurance was "endurance" and "special" combined with the unity of the concept, when the athlete carries out a certain competition, through a full understanding of the characteristics of the sport, gradually achieve a kind of adaptability to the game, the level of this ability directly affects the competition results. When the athlete carries out a certain competition, through a full understanding of the characteristics of the sport, gradually achieve a kind of ability to adapt to the game, the level of this kind of ability directly affects the performance of the competition, therefore, we need to focus on improving the athlete's endurance qualities of the specialized athletic ability (Zhang, 2020). A stage of the middle-distance running competition was mainly aerobic energy supply, but the midway and sprinting need to test the explosive power of the athlete's anaerobic endurance. According to the characteristics of the middle distance running competitive

events, from the whole competition, each race from the start to finish basically in two minutes up and down to four minutes up and down, so the competition needs athletes in the early aerobic function was the main, need to had aerobic endurance qualities, and at the same time from the middle of the competitive intensity and the late sprint, athletes had to face more than the anaerobic energy supply critical time of the full force of the run, statistics show that the majority of the athlete Statistics show that most of the athletes start from the energy supply mainly with CP energy and lactate energy supply, which especially puts high requirements on the lower limb acid tolerance ability of middle distance runners. If athletes want to achieve good results, they must maintain the intensity and quality of movement throughout the whole course of the program, which was based on good aerobic and anaerobic endurance qualities (Zhao, 2021).

#### **2.2.4 Speed and Endurance Quality (In Athletics)**

Tian (2022) in the "sports training science" that speed endurance quality was the organism to adhere to the ability of prolonged exercise. In track and field specialized middle and long-distance running event sports, speed endurance quality, in addition to the requirement of very good absolute speed, but also need to endurance reserves, the period of time there were most of the time was to the organism anaerobic metabolism as the main mode of energy supply, and could adhere to a certain time level of ability. Xie (2019) points out that the concept of speed endurance is: "The ability of a sprinter to stop this speed from dropping faster or slower and in amplitude after reaching the peak of speed was achieved midway through the sprinter's journey to run to maintain the absolute fastest speed." And most phases of middle-distance running were similar to sprinting in its entirety, a combination of speed endurance qualities.

## 2.3 Current Status of Research on The Relationship Between Speed Endurance and Athletics in China

Table 2.3 Current status in China 1

Luo, 2019	The energy supply of speed endurance was based on the function of glycolysis system in the body, through different training methods and approaches, targeting the glycolysis energy supply system of the athlete's body to enhance and develop the ability to resist the accumulation of lactic acid, buffer the fatigue of lactic acid accumulation in the muscle, and really fundamentally improve the quality of speed endurance of the athlete.
Chen, 2020	The competition phase of the athlete's 400-meter run requires the absolute sprint speed of the 100-meter run, which should be categorized as a sprint event in the physical category, and in today's arena, the good 400-meter runner would consistently maintain high speeds from the start of the pre-competition phase right up to the sprint at the end of the race and across the finish line, which requires the absolute speed ability of the athlete in route to the finish line. Absolute speed ability was the backbone of the specialized abilities required in the 400m race.
Feng, 2017	Absolute speed improvement would be an essential part of 400 performance improvement. Speed endurance was based on speed, the core was endurance, if you want to improve the quality of speed endurance in the 400 meters, it was essential to give priority to the development of absolute speed ability in the 400 meters.
Yu, 2018	The 400-metre run requires athletes to have a strong aerobic and anaerobic capacity, and both aerobic and anaerobic training were essential. The training program mentioned clearly states that speed endurance training three times a week, each time there was a need to have a combination of long and short distance round trip running, and at the same time to strengthen the waist and abdominal region as

Table 2.3 Current status in China 1 (Cont.)

	<p>well as the hip and hip parts of the strength training, the purpose of doing so was that the 400 meters backstage need to be enough power to maintain a certain rate of swinging the leg. The strengthening of aerobic training was to allow the athlete to better control the contradiction with lactic acid accumulation, had a good reserve capacity of muscle glycogen, and prevent a rapid decline in speed in the later stages.</p>
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In summary, the common point elaborated by each of the four scholars in their articles was that in some track and field specialties', the quality of speed and endurance was the basic guarantee for athletes to achieve results, in which speed was the foundation and endurance was the core, and it was necessary to develop both the athletes' aerobic and anaerobic abilities at the sametime.

Table 2.4 Current status in China 2

Xu, 2022	<p>By physical fitness as the leading speed endurance quality special training, cannot blindly copy the inherent training methods, the specific requirements of different situations need to be treated differently, the training process, the training time and the intensity of training to control, effectively enhance the body's ability to resist the accumulation of lactic acid, and effectively enhance the performance.</p>
He, 2023	<p>Developing athletes' speed endurance most effectively uses as many methods as possible for combination training, so that the athlete's body receives different forms and modes of stimulation, effectively improving the ability to run fast medium and long distances. Speed endurance quality training had a complementary relationship with speed training and endurance training, speed was the foundation of speed endurance, without the foundation, it would not effectively develop excellent speed endurance quality."</p>

Table 2.4 Current status in China 2 (Cont.)

Li, 2016	400 meters running was a competitive event that athletes still need to overcome in the case of high intensity sports that produce a large amount of lactic acid, the need to allow the body's various special qualities to improve comprehensively, so that the athletes' ability to resist the accumulation of lactic acid muscle fatigue had been enhanced, and to improve the athletes' comprehensive ability of the 400-metre run through the large number of trainings in the special speed endurance.
Chen, 2020	Although 400 meters running was mainly a short distance running anaerobic metabolic characteristics of the main athletic events, but the athlete's aerobic metabolic capacity in the 400 meters running special ability training also occupies a very important position, for each athlete's training intensity and training means should be based on the level of their blood lactate indexes, so as to enhance the athlete's aerobic metabolism capacity in a targeted manner.

In summary, when several scholars talk about the specialized training of speed endurance in athletics, there were proposed training methods for one or more ability enhancement, including the Combination Training Method, as well as the method of single large amount of training for one ability, or a combination of the two, in which exploring a suitable training method for the specialized students of athletics in this study was the key work to be done.

## 2.4 Current Status of Research on The Relationship Between Speed Endurance and Athletics Abroad

Upon review, experimental studies by scholars at home and abroad using the Combination Training Method had also found its important role in sports training.

Table 2.5 Current Status Abroad

Adams, 2016	Numerous experimental studies had found that the combination of weighted squat training and muscular strength training was more effective than weighted squat training or speed strength training in improving the body.
Brown, 2016	Combination Training Method was the best way to improve the explosive power of track and field athletes, such as "maximum load training method plus maximum speed training method" such a combination of training methods, compared with a single training method, such a combination was conducive to the effective development of explosive power, therefore, the ability to choose the best combination of training methods to train the athlete's body of various muscle types Therefore, the best combination of training methods could be chosen to train the various muscle types of the athlete's body.
Daniels, 2017	According to the traditional single training method to train the strength of the players, its effect was not ideal, the results show that the students of the single quality, physical function and movement skills to improve the less obvious, on the contrary, it would give the students of the endurance quality of the body to bring a serious impact, on the other hand, a single training of this model was not able to think from the perspective of the students, it would give the students of the enthusiasm continues to decline.
Gentil, Lima, & Souza, 2017	The Combination Training Method was characterised by the ability to stimulate the nervous system of the organism in the widest range of ways, with a special emphasis on proprioception, which allows the processes of excitation and inhibition to take place in time, so that the movements were more fluid and the organism was not overtaxed.

Table 2.5 Current Status Abroad (Cont.)

<p>Navarro &amp; Martín, 2020</p>	<p>Mono training method in the training process had been the nervous system always stimulate, no change, easy to make the nervous system into fatigue, sometimes deepen, so the nervous system was not easy to quickly recover, in the strength qualities of the training would be more so. Former scholars in the exercise of the lower limbs to do research on the exercise, the beginning of the first strength training, and then do off the ground training (jumping training), and finally do the maximum speed training, do these were to strengthen the lower limbs of the important qualities, but the form of the action in these training and the form of the work was completely different</p>
<p>Skovgaard &amp; Silva, 2022</p>	<p>A large number of studies had concluded that it could improve the athletes' sports performance, and the Combination Training Method for the athletes of the year-round scientific training rhythm to get help, greatly reducing the possibility of athletes' injuries, in line with the basic principle of pedagogy of teaching according to the talent, each athlete's game characteristics were different, the special enhancement of the content of their weaknesses was therefore different, according to the rhythm of each athlete's training and competition to develop a suitable for their According to the rhythm of each athlete's training and competition to develop a combination of training program intensity and rest interval, more effective development of the level of the athlete's physiological functions, the combination of the athlete's different abilities together to achieve the effect of comprehensively improve the quality of the body.</p>

In the process of literature search, it was found that most of the studies, including the full-text data search library of China Journal Network (CNKI), the full-text database of China's excellent master's degree theses, the database of China's doctoral degree theses, as well as the important conferences and core journals in related fields, were all aimed at studying the characteristics of the energy supply system of middle and long-distance running, and then formulating the training methods of this project. Means. There was also through the study of the absolute speed and speed endurance constraints dependence, that the 400 m running base absolute speed, the core of the key link was the speed endurance quality, and then formulate the relevant training programs, used to improve the athletes' special performance. However, during the winter training period of a year, for athletes speed endurance training means due to weather, environment and physiological reasons would become relatively less, a lot of literature was also for the non-winter training period of the special training method of training research, winter training period of the training method of research in the country was relatively little relevant results were also rare, for this paper's comprehensive study of the combination of training method of the athletes' speed endurance absolute enhancement. For this paper, the comprehensive study of the Combination Training Method on the absolute improvement of athletes' speed and endurance would bring certain difficulties, but it would also become a major innovation point of this paper.

## **2.5 Studies Related to The Combination Training Method**

### **2.5.1 Basic information on The Combination Training Method**

The mono-training method does not mean that the athlete only uses a single item of practice in training, it was the development of only one indicator of physical fitness in a single training session or over a period of time, and the different training methods used for this physical fitness were not fully understood to be for the sole purpose of developing a single indicator, but rather for the purpose of the athlete's continuous training and development of this quality (Kormos & Csizer, 2014). Among the traditional methods of mono-training method, such as continuous

training method, repetitive training method and interval training method were mono-training methods. The advantage was that it had a more pronounced effect on the improvement of a specific physical quality, but the disadvantage was that the overall level of the athlete needs to be improved through a number of different training programs, with a longer period of time.

Compared with the singularity of the single training method, the proposed Combination Training Method was based on the different training stages of athletes, athletes were not the same training level, training stage and individual innate sports qualities, etc., and the use of scientific theories, such as: the principles of athletic training, physiological principles and other related theories, one or more training elements scientifically and reasonably arranged in different proportions, in order to obtain the best combination of results.

This training method was characterized by the scientific and reasonable arrangement of several relevant and effective single training methods together, complementary advantages, the proportion of training intensity size distribution should be appropriate, as well as a reasonable arrangement of rest time, so as to allow athletes to comprehensively and reasonably achieve the desired results. Different from the traditional repeated training method, a single training method and interval training method, but not all the training method simply do the addition of random combinations, but according to the characteristics of a project sports when the proportion of scientific rationalization of the proportion of the configuration, the combination of cross-training. For example, in the process of arranging the energy metabolism function training program, aerobic metabolic capacity training and anaerobic metabolic capacity training respectively should be arranged according to the speed endurance characteristics of the 800 meters project, the training process was not a single one, but it should be in the process of aerobic training project to join anaerobic training elements, anaerobic training project to join aerobic training elements, according to the appropriate for the middle and long-distance running project to allocate the appropriate percentage.

Combined training was an organic combination of various training methods, based on reasonable and effective training methods, the interval between two groups of training to provide metabolic recovery was the basis of the training program, the training means to be selected depending on the situation, in order to achieve the overall effect of the training effect of the scientific training methods. Carte (2007) and other two scholars in the study of short and medium-distance events in the theory of the strength training of the outstanding athletes found that another feature of the combined training methods In the use of the Combination Training Method, one of the single training intensity was not large, the intensity was based on the overall planning of a reasonable distribution, was arranged according to a reasonable proportion of the combination of the overall intensity of the medium intensity and higher intensity, in line with the intensity of the competition demand. The consistency of the two was conducive to the function of the athlete's body system to play the maximum capacity, effectively combining the intensity of all individual training loads, it would be conducive to obtaining the overall effect, and the muscles were difficult to fall into fatigue, but any training method had its own shortcomings, the use of combination training if the arrangement of the intensity of the proportion of the training program within the training program was not appropriate, but instead of making the athlete's body part of a particular part of the body was prone to produce long-term fatigue, resulting in injury, affecting the progress of the overall training program, and may even be unable to participate in normal competition.

### **2.5.2 A Study Related to The Combination Training Method in Sports Training**

Zhou (2021) explicitly mentioned that the structural model of the competitive level of modern sports was constantly changing, improving and optimizing, and constantly adapting to the requirements of competitive matches. The previous study of the "barre effect", the current theory of the "block model" and the subsequent "twin model" were all aimed at improving the physical quality of athletes and their special abilities at different stages, marking the gradual improvement of the Combination Training Method.

Liu (2017) research shows that after fifteen weeks of training using the Combination Training Method, not only does the level of the player's physical activity indexes improve significantly, but it was also obvious that the number of injuries and illnesses of the players was reduced compared with the usual number of injuries and illnesses, so it proves that most of the experimental arrangements for the use of the Combination Training Method were reasonable, which demonstrates that the application of this training method was effective for the enhancement of the physical quality of athletes in track and field and a number of other athletic sports.

Huo (2019) experiment concluded that in the use of Combination Training Method on the pilot's physical fitness quality of special training, through a period of practice, the pilot's joint flexibility, movement agility, body coordination and balance and other indicators had been more obvious to improve, the most important thing was that the pilot's physical fitness quality had been developed to varying degrees, which confirms that the Combination Training Method could play a very good role in the process of athletes' physical fitness quality training. It confirms that the Combination Training Method could play a good role in the training process of athletes' physical fitness.

### **2.5.3 A Study Related to The Combination Training Method in Track and Field Training**

Gu (2018) clearly pointed out that: "the higher the level of athletes on the playing field, their daily requirements for training also rose, from the intensity of training, interval, participate in the number of competitions were a little bit more, in this case if you insist on using only a single training method would make the athlete become physically fatigued, this time we had to use other training methods to intervene in a single training, not only to reach the Reverse the disadvantage, but also could play the respective advantages of different training methods, complementary advantages and disadvantages, learning from each other, twice the result with half the effort."

The discovery of different characteristics in athletes, the constant identification and improvement of deficiencies, and the expansion of training tools according to the characteristics of middle and long-distance events were relevant to the main themes of today's competitive arena. At the same time, this was a variety of different factors co-determined by the sport, was bound to be the athlete a variety of qualities of the integrated impact of the specific performance, although the main thing was still dependent on the physical quality of the physical quality of the training was also the most important, the optimization of the traditional single training method to make a combination of the training effect to achieve the "1+1>2" the comprehensive level, to further improve the consolidation of athletes' comprehensive ability to compete.

Cheng (2018) first proposed this training method standard model, but also pointed out the use of the method of specific training methods, clearly pointed out that the combination of training method was more effective training methods for athletes training efficiency and training science, the theory of the proposed not only expand the choice of training methods for athletes, but also for the further development of track and field projects to bring positive results, very scientific and reasonable to enhance the athletes' physical qualities. Eventually, after continuous experimental research to make it a mature functional training, so that the targeted combination of training on the athletes of a physical quality in the competitive games could be tested, but also could make the speed endurance training methods more and more rich.

#### **2.5.4 Research Instruments Related to The Combination Training Method**

Table 2.6 Research Instruments Related to The Combination Training Method

Equipment	Description	Reference/Source
<b>Physiological Evaluation Index Test Equipment</b>		
Alcohol	Used for sterilizing the skin before taking blood samples or applying electrodes.	Used in clinical and sports medicine settings for disinfection before physiological tests.
Cotton Balls	Absorbent cotton used for cleaning or applying alcohol for disinfection.	Commonly used in medical settings for hygiene purposes during tests.
Containers	Small sterile containers for storing blood or other biological samples.	Essential for storing physiological samples such as blood or urine.
Portable Blood Lactate Analyzer	Device for measuring blood lactate levels to assess anaerobic thresholds in athletes.	Essential for performance assessment in endurance sports (e.g., model: Lactate Scout 4).
Reagent Strips for Lactate Analyzer	Chemical strips used in conjunction with the analyzer to detect lactate levels in blood.	Compatible with specific analyzers and essential for accurate lactate measurement.
Heart Rate Belt	A wearable belt that monitors and transmits heart rate data during physical activity or tests.	Often used in sports and exercise science to monitor cardiovascular responses during training.
<b>Test Equipment for Training Evaluation Indicators</b>		
Starter	A device or signal used to mark the beginning of performance tests, such as sprinting or drills.	Used in sports timing systems to ensure accurate start times.
Stopwatch (PC2810)	A precise stopwatch model used to measure the duration of specific exercises or drills.	Model PC2810 is known for its precision and is often used in athletic testing and research.

Table 2.6 Research Instruments Related to The Combination Training Method (Cont.)

Equipment	Description	Reference/Source
Tape Measure	A tool used to measure distances, commonly for performance metrics such as sprint distances.	Used to accurately measure performance-related distances, e.g., during sprints or jumping drills.
<b>Training Equipment</b>		
Barbells	Long bars used with adjustable weight plates for strength training exercises.	Barbells are widely used in resistance training to improve muscle strength and endurance.
Barbell Plates	Weighted plates that can be attached to barbells for adjusting the total weight used in exercises.	Standard in strength and conditioning, allowing for progressive overload in training.
Elastic Balls	Inflatable exercise balls used for stability, balance, and core strengthening exercises.	Often used in functional training to enhance stability and flexibility.
Solid Balls	Also known as medicine balls, they are used for power and strength exercises, typically weighted.	Medicine balls are effective for plyometric and power training.
Mats	Cushioned mats used for floor exercises, providing comfort and protection during training.	Commonly used in gyms for exercises involving bodyweight or flexibility training.
Weighted Vests	Vests with adjustable weights used to add resistance during bodyweight exercises or conditioning.	Often used in sports training to increase resistance for exercises like running, jumping, or calisthenics.

Source: Reasearcher

These tables provide a more comprehensive view of the research instruments, along with references to their common use in physiological testing and training scenarios.

## 2.6 Benefits of The Combination Training Method

Combination training, often referred to as concurrent training, involves the integration of both strength and endurance exercises within the same training regimen. This method offers a variety of benefits, making it a popular choice for athletes and fitness enthusiasts alike. Here were some key benefits of combination training:

**Improved Overall Fitness.** Combination training enhances both aerobic and anaerobic capacities. By incorporating both endurance and strength elements, individuals could achieve a well-rounded fitness profile, improving cardiovascular health, muscle strength, and endurance simultaneously.

**Enhanced Muscle Strength and Cardiovascular Health.** Regular strength training increases muscle mass and strength, while endurance exercises improve heart and lung capacity. When combined, these benefits lead to improved heart health, better circulation, and stronger muscles, providing a comprehensive approach to fitness.

**Efficient Use of Time.** For individuals with limited time for exercise, combination training allows them to maximize their workouts by addressing multiple fitness goals in a single session. This efficiency could lead to better adherence to fitness routines and more consistent progress.

**Increased Caloric Burn and Weight Management.** Engaging in both types of exercise could increase the total number of calories burned during a workout. Strength training boosts the metabolic rate by increasing muscle mass, while endurance exercises burn a significant number of calories, contributing to effective weight management and fat loss.

**Reduced Risk of Injury.** Balancing different types of exercise could reduce the risk of overuse injuries associated with repetitive motion. Strength training could fortify muscles and connective tissues, making them more resilient to the stresses of endurance exercises.

**Improved Metabolic Health.** Combination training had been shown to improve various markers of metabolic health, including insulin sensitivity and lipid profiles. This could reduce the risk of developing chronic diseases such as type 2 diabetes and cardiovascular disease.

**Enhanced Athletic Performance.** For athletes, integrating both strength and endurance training could lead to improved performance in their specific sports. Strength training could enhance power and speed, while endurance training could improve stamina and recovery.

**Greater Flexibility in Training.** Combination training allows for a more varied and enjoyable exercise routine. This variety could keep workouts interesting and engaging, reducing the likelihood of boredom and burnout.

**Balanced Body Composition.** Combining strength and endurance exercises helps in achieving a balanced body composition. While strength training promotes muscle growth, endurance training helps in reducing excess body fat, leading to a leaner physique.

**Cognitive Benefits.** Regular exercise, particularly when combining different types, had been linked to improved cognitive function and mental health. The varied demands of combination training could stimulate brain function and help reduce symptoms of anxiety and depression.

## **2.7 Related Theories**

The Combination Training Method (CTM) integrates various training approaches to enhance physical performance, particularly in athletes. The method blends strength, endurance, speed, agility, and flexibility exercises. Several theories underpin the effectiveness of CTM, drawing from exercise physiology, sports science, and biomechanics. Here were some related theories:

### **2.7.1 Concurrent Training Theory**

Concurrent training refers to the simultaneous training of both endurance and strength within a single workout regimen. The theory suggests that combining these training modes could lead to improvements in both aerobic capacity and muscular strength. While there was some debate about the potential for interference (where one type of training may hinder the progress of the other), strategic planning of exercise modalities and recovery could mitigate these effects.

### **2.7.2 Specificity and Transfer of Training Theory**

This theory posits that training adaptations were specific to the type of exercise performed. However, certain physical qualities could transfer across different types of activities. For instance, improvements in strength could enhance power and speed, which could then positively affect endurance performance. CTM leverages this by including a variety of exercises that develop a range of physical attributes.

### **2.7.3 Periodization Theory**

Periodization involves systematically varying training intensity, volume, and type over specific cycles (macro, meso, and microcycles) to optimize performance and prevent overtraining. CTM could incorporate periodization principles by cycling through different training focuses (e.g., strength, endurance, speed) within a training program, thereby maximizing overall athletic development and recovery.

### **2.7.4 Neuromuscular Adaptation Theory**

This theory focuses on the nervous system's role in improving muscle function and coordination. Different types of training (e.g., strength, speed, agility) enhance neuromuscular efficiency in distinct ways. CTM integrates these different training

forms to optimize overall neuromuscular adaptation, leading to better performance in various physical activities.

## 2.8 Related Research and Studies

Hickson (2018) research on concurrent training, which combines endurance and resistance training, was central to understanding CTM. Studies like those by Hickson (1980) demonstrated that concurrent training could lead to improvements in both strength and endurance, although the extent of these improvements could be influenced by factors like training intensity, frequency, and the sequence of exercises.

Rhea, Ball, Phillips, and Burkett (2022) research periodization was a key component of CTM, and various studies had shown its effectiveness in optimizing performance and preventing overtraining. A study by Rhea et al. (2002) demonstrated that periodized training programs were more effective for strength gains compared to non-periodized programs.

Zatsiorsky and Kraemer (2016) research on supercompensation and recovery had highlighted the importance of rest and recovery phases in training. A study by Zatsiorsky and Kraemer (2016) emphasizes that adequate recovery was crucial for achieving supercompensation and maximizing training adaptations.

Häkkinen et al. (2016) studies on neuromuscular adaptations provide insights into how different types of training affect muscle function and coordination. Research by Häkkinen et al. (2013) showed that combined strength and endurance training could lead to significant improvements in neuromuscular performance.

Tanaka and Swensen (2018) research on cross-training and energy system development indicates that varied training could improve overall fitness. A study by Tanaka and Swensen (2018) reviewed the benefits of cross-training for endurance athletes, highlighting improvements in cardiovascular and muscular endurance.

Schmidt and Lee (2021) studies on motor learning and skill acquisition show that varied practice could enhance skill development. Research by Schmidt and Lee (2021) found that practicing different types of movements could improve motor skills and adaptability in athletes.

Selye (2016) Selye's General Adaptation Syndrome (GAS) theory was foundational in understanding the body's response to training stress. Research on adaptation energy, such as Selye's original work, underscores the need for balanced training loads to avoid overtraining and optimize performance.

Liu (2018) examined the effects of concurrent strength and endurance training on the performance of middle-distance runners. The study found that a well-structured CTM program improved both VO<sub>2</sub> max and muscular strength without significant interference effects.

Zhang and Wang (2020) explored the application of periodized training in elite Chinese swimmers, incorporating phases of strength, speed, and endurance training. The study concluded that periodization within CTM led to significant improvements in overall performance and reduced the risk of overtraining.

Chen (2017) studied the effects of a combination training program on the physical fitness and motor skills of adolescent basketball players. The research demonstrated that CTM significantly enhanced their agility, strength, and aerobic capacity, contributing to better overall performance on the court.

Li and Zhao (2019) conducted research on the biomechanical changes in sprinters following a combined plyometric and strength training regimen. The study highlighted improvements in stride length and frequency, leading to faster sprint times.

Zhou and Liu (2016) analyzed the impact of CTM on athletes recovering from ACL injuries. Their study showed that incorporating strength, flexibility, and proprioception training within the rehabilitation program led to faster recovery times and reduced the likelihood of re-injury.

Gao (2015) studied the effects of cross-training on endurance and strength athletes, finding that incorporating swimming and cycling into the training routines of runners led to overall improvements in aerobic capacity and muscular endurance.

To summarize, the development of CTM was very rapid in China and even globally, and it has been deeply penetrated into various subject areas. It has attracted a lot of people to study it, which was where the charm of the CTM lies, and the Combination Teaching Method was in line with the current education situation in China, and also in line with the direction of the country's education reform. Many scholars have already conducted corresponding research on the teaching strategies of the Combination Teaching Method. Moreover, the CTM has been gradually being combined with specific sports programs, which in turn lead to experimental research on sports teaching.



## CHAPTER 3

### RESEARCH METHODOLOGY

The purposes of this research were to compare the level of speed endurance before and after the use of the Combination Training Method in physical education and to examine the students' satisfaction with the use of the Combination Training Method. In this chapter, the researcher would introduce the methodology of this research. It included the research design, the sample group, the research instrument used to collect data, the validity and reliability of the research instrument, and the data analysis.

#### 3.1 Research Design

The experimental training period total 4 weeks, with 3 sessions of 90min each per week. Speed endurance training was divided into 3 phases, with the first phase developing general endurance, the second phase being the improvement of speed endurance, and the third phase being maintenance.

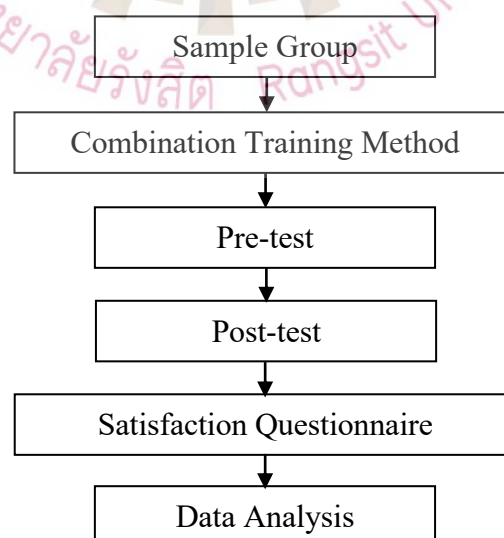


Figure 3.1 Research design of the research

## 3.2 Population and Sample

### 3.2.1 Population

The two best majors at the H College of Physical Education and Sports Science were Physical Education and Sports Training. Both majors were "first-class" undergraduate construction sites in Hunan Province. The research's target population comprised 613 students ranging in year from freshman to senior, with roughly 121 of them being freshmen.

### 3.2.2 Sample group

By using a clustered random sampling technique, the sample group consisted of a group of 30 students were all male Freshmen students, their basic information: age, height, weight, years of exercise were as followed:

Table 3.1 Basic Information

Name	Age	Heigh(cm)	Weight(kg)	Years of exercise
NO.1	19	176	68	5
NO.2	20	176	70	4
NO.3	20	172	60	5
NO.4	20	183	75	4
NO.5	20	178	71	5
NO.6	18	173	70	3
NO.7	20	177	68	5
NO.8	20	182	80	5
NO.9	20	175	67	5
NO.10	21	180	78	5

Table 3.1 Basic Information (Cont.)

Name	Age	Heigh(cm)	Weight(kg)	Years of exercise
NO.11	19	187	73	4
NO.12	20	183	72	5
NO.13	19	174	67	4
NO.14	21	178	70	5
NO.15	21	178	67	5
NO.16	19	176	71	4
NO.17	19	187	78	4
NO.18	20	183	70	5
NO.19	19	174	67	4
NO.20	20	179	70	3
NO.21	20	187	71	5
NO.22	18	178	70	4
NO.23	20	173	68	5
NO.24	20	183	80	4
NO.25	20	174	67	5
NO.26	21	178	78	5
NO.27	19	178	73	4
NO.28	20	176	71	4
NO.29	18	173	70	3
NO.30	20	177	68	3
X	19.75±0.79	178.55±4.39	70.6±2.62	4.45±0.69

### 3.3 Research Instruments

Collecting data instruments were the equipment used in research. In order to collect information for the research topics in this research, lesson plans, achievement tests, and a satisfaction questionnaire were utilized. The sample group consisted of 30 students during the duration of the research. The next section discusses the research instruments that were utilized in this research to accomplish the goals.

#### 3.3.1 Training Plans

Table 3.2 Basic Part of The Training Plan

Categories	Time	Arm setting	Training content	Scientific basis of training
Phase 1	Week 1	Improve general endurance	1 Timed runs 1 Quantitative Running 1 Cross-country running 1 Ball activities	According to the theoretical basis of speed endurance, the pre-training phase requires the development of general endurance and aerobic training. The students' psychological factors and willpower are the factors affecting the implementation of speed endurance training. The combination training method adjusts the content and intensity of the training so that the students' psychological state is good and they slowly adapt to the beginning of the training, while the stage-by-stage goals subconsciously develop their willpower.

Table 3.2 Basic Part of The Training Plan (Cont.)

Categories	Time	Arm setting	Training content	Scientific basis of training
Phase 2	Week 2	Increased speed and endurance	1 Aerobic training as a supplement 1 Strength Training	The aim is to train the lower limb explosive force and absolute speed, the development of speed endurance needs to pay attention to absolute speed and upper and lower limb coordination. Running,
			1 Strength Training: 1 Maximum Strength 1 Strength Endurance 1 Coordination	jumping and throwing power for cycle combination action organic combination, at the same time in line with the student's psychology and the same amount of training when the sense of purpose one by one rapid implementation of the training is more state of the art good vitality. Cycle training method, through the exercise, the potential could be stimulated. Maximum strength training applies to all phases of the training period.

Table 3.2 Basic Part of The Training Plan (Cont.)

Categories	Time	Arm setting	Training content	Scientific basis of training
	Week 3		<p>1 Strength training as a supplement</p> <p>1 Speed endurance was the main focus</p> <p>1 Speed Endurance:</p> <p>1 Slow Interval Training</p> <p>1 Fast Interval Training</p> <p>1 Long repetitions</p>	<p>The movements are organically combined and the training methods are organically combined. The long repetition method focuses on the development of the athlete's lactate energy metabolic system and the aerobic metabolic system mixed energy supply capacity. The main function of the short distance interval method is to develop the athlete's speed and speed endurance. Medium-distance intervals focus on the development of the athlete's mixed-oxygen metabolism. Circuit training, through which the potential of the athlete was stimulated and the quality of will be developed. Maximum strength training is used in all phases of training. Repetitions are used in the recovery phase and intervals in the pre-competition phase.</p>

Table 3.2 Basic Part of The Training Plan (Cont.)

Categories	Time	Arm setting	Training content	Scientific basis of training
Phase 3	Week 4	Holdin g the level	l General Endurance l Speed Endurance	Cross-country running could be structured as a fun aerobic workout, with mid- distance intervals to develop mixed-metabolic capacity.

#### Details of Research Instruments:

1) Physiological evaluation index test equipment: alcohol, cotton balls, containers, portable blood lactate analyzer with reagent strips, heart rate belt, etc. Alcohol swabs are commonly used in medical and laboratory settings to maintain sterility before taking blood samples or placing monitoring devices (Journal of Sports Science, 2021).

2) Test equipment for training evaluation indicators: starter, stopwatch (model: PC2810), tape measure, etc. In timed physical tests, a starter or electronic trigger system is used to minimize reaction time variability (International Journal of Sports Medicine, 2018).

3) Training equipment: barbells, barbell plates, elastic balls, solid balls, mats, vests, etc. Training equipment is often used in physical assessments to gauge distance-based outcomes, such as sprinting distance or flexibility (National Strength and Conditioning Association, 2020).

### 3.3.2 Questionnaire

The researcher designed the Likert Schle questionnaire with the scale including

5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree, respectively.

Table 3.3 Satisfaction Questionnaire

Statistical of Students' Learning Interest						
1.	I liked the learning process of the combination training method.					
2.	I was interested in the results of the combination training method.					
3.	The combination training method improved my physical fitness.					
4.	I took the initiative to ask questions during the learning process of the combination training method.					
5.	I consulted information and research problems in the process of learning the combination training method.					
Statistical of Students' Ability to Discover, Analyze, And Solve Problems						
6.	I asked my teacher for guidance in solving problems in the process of learning the combination training method.					
7.	I would take the initiative to research after class to solve the unsolved problems in class.					
8.	I could use what I had learned to solve problems in the process of learning the combination training method.					
9.	I could find my own mistakes and try to solve them in the process of learning the combination training method.					
10.	I could take the initiative to make plans in the process of learning the combination training method.					

Table 3.3 Satisfaction Questionnaire (Cont.)

11.	I could reflect on the learning process in the combination training method learning process, and summarize the learning experience.					
Statistical of Students' Sense of Cooperation and Communication						
12.	I was very willing to share the joy of harvesting with my classmates in the learning process of the combination training method.					
13.	In the group discussion, I was serious and actively participate in the discussion to increase the spirit of cooperation among classmates.					
14.	In group discussions, I normally actively communicated with my classmates.					
15.	I liked to communicate with my classmates in the research of combination training method.					
16.	I normally shared my views on the combination training method with my teachers and classmates.					
17.	I would do my best to win in the group competition of the combination training method.					
18.	The combination training method helped me to develop my own training level.					
Statistical of Students' Ability of Specialized Knowledge and Apply It						
19.	After the training of the combination training method, my physical fitness was improved.					
20.	My physical fitness was improved through the combination training method.					
21.	My training endurance was improved through the combination training method.					
22.	My running speed was improved through the combination training method.					

Table 3.3 Satisfaction Questionnaire (Cont.)

23.	My heart rate level was increased as a result of the combination training method.					
24.	My ability to study endurance was improved as a result of the combination training method.					
25.	My ability to study speed was improved through a combination of training methods.					
26.	After training with the Combined Training Method, my study of endurance was improved.					
27.	My ability to study speed was improved as a result of the combination training method.					
An Open-ended Question Please give additional comments and suggestions						

### 3.4 Measurement Methods

By reviewing the information related to speed endurance and expert interviews, there were many indicators reflecting speed endurance, and in view of our actual situation, after the interviews, it was recommended that the following three physiological and biochemical indicators be selected in the current situation: blood lactate, heart rate, and anaerobic power. A secondary reference indicator was selected: track and field specialized test scores. Because the improvement of athletic performance may be the improvement of speed endurance or because of the improvement of speed, so as a reference.

The correlation between blood lactate, heart rate, anaerobic power and speed endurance was illustrated. Speed endurance, also known as "anaerobic endurance", refers to the ability of the body to sustain work for longer periods of time with anaerobic metabolism as the primary form of energy supply. Speed endurance was further divided into phosphagen-supplied anaerobic endurance and glycolysis-supplied anaerobic endurance. The development of speed endurance was mainly to improve glycolysis ability, lactate was the end product of glycolysis, test blood lactate

concentration could basically reflect the anaerobic glycolysis energy supply system in exercise. In actual training, it was difficult to test blood lactate frequently, and heart rate could be used to infer the anaerobic metabolism. Post-exercise blood lactate clearance could reflect the effect of stage-specific aerobic endurance training. Anaerobic power sources anaerobic metabolic capacity and could evaluate the effectiveness of anaerobic training methods. Anaerobic training has a heart rate reserve intensity of 80%-90% and a maximum heart rate intensity of 87%-93%.

### **3.4.1 Selection of Blood Lactate Indicators and Test Methods**

Glycolysis was the process by which the sugar components in the organism were broken down under anaerobic conditions to produce lactic acid, while releasing energy for energy supply. When the trainee exercises at maximum intensity, in the first phase (6-8s), the energy was supplied by the phosphagen supply system, which was dominated by ATP-CP (adenosine triphosphate-phosphocreatine) substances. During this phase, the glycolytic energy supply process was activated, and myo-glycogen was rapidly broken down to produce lactic acid, which was involved in the energy supply of the body during exercise. In the second phase (2-3min), the glycolytic energy supply system would replace the phosphagen energy supply system as the main energy supply system. The rate of glycolytic energy supply reaches a maximum when the trainee was exercising at maximal intensity for 30-60s, and then decreases and was maintained for 2-3s. Therefore, for speed events that require exercise at maximal speed for along period of time (more than 10s), the body's muscle energy requirements were mainly obtained through glycolytic energy supply. A large amount of lactic acid would be generated during glycolytic energy supply, and the development of a glycolytic energy supply system requires an increase in the body's ability to generate lactic acid tolerance.

The Lacate-Scout Portable Lactate Meter was an instrument that used electronic biochemical technology for rapid determination of blood lactate concentration. The principle was to test the changing lactate content in the blood, which could well reflect the optimal training level and fatigue state of individual

students, to develop a more scientific and reasonable training intensity, and to detect and avoid ineffective training in time.

The blood lactate-related indicators were selected by reviewing speed endurance- related information, combining the opinions of coaches and experts, and taking into account the actual situation, and finally picking out the values of blood lactate concentration in the immediate post-exercise period, blood lactate concentration in the 15-minute post-exercise period.

Measurements were taken immediately after the students completed the explosive strength test and 15 minutes after the test was completed. To start the measurement, the first step was to sterilize the fingertip, the second step was to stick a needle in the fingertip, the third step was to remove the first drop of blood and then squeeze the second drop and use a test strip mounted and adjusted on the blood lactate analyzer to collect the blood. Only one drop (0.5 $\mu$ l) of whole blood was required as a test sample, which took about 15 seconds to complete, and the fingertip blood collection was monitored immediately and 15 min after exercise. The fourth step was to give the student a cotton ball to gently press the fingertip to stop the bleeding, the fifth step was to record the results and finally to organize the equipment.

#### **3.4.2 Selection of Heart Rate Indicators and Test Methods**

Heart rate refers to the frequency of the heart's periodic mechanical movement, that is, the number of times it beats per minute, expressed in beats per minute (b/min). Heart rate was a basic indicator that reflects the size of the load borne by the heart when the muscles did work, and within a certain range of variation, it would rise rapidly as the intensity of physical exercise increases, i.e., the heart rate was positively correlated with the intensity of exercise. In the process of sports training, heart rate and its recovery speed and degree could be used to measure the level of adaptation of the athlete to the intensity of training as well as before and after the exercise of physical function. If an athlete's heart rate recovers faster under the same training load, it indicates that he was able to withstand a higher intensity training volume.

Heart rate could be used to infer anaerobic metabolism during training. This experimental research was to focus on the heart rate situation before and after the experiment, to explore and analyses the athlete's recovery, and to observe the level of heart rate recovery after exercise.

The heart rate related indexes were selected by reviewing the speed endurance related information, combining the opinions of coaches and experts, and combining with the actual situation, and finally selecting the values of maximum heart rate and 3-minute post-exercise heart rate.

Test method: Students performed explosive exercise, as well as maximum heart rate and 3-minute post-exercise heart rate measurements. Measurement of the first step, take out the heart rate belt and accessories, transmitter buckle, wear the heart rate belt, adjust the length of the heart rate belt in the chest line below the skin, the second step of the debugging normal use after the beginning of the observation and recording of the maximum heart rate, the third step of the recording of the heart rate of 3 minutes after the exercise, and then of the results, and finally to organize the equipment.

### **3.4.3 Oxygen-Free Power Index and Test Methods**

Most studies had shown that the level of anaerobic power index was a reflection of an athlete's ability to did work in a short period of time, and that the maximal intensity continuous exercise test with a period of 30s and 60s could show an athlete's level of explosive power, speed quality and speed endurance. The anaerobic power test was a classic test that could be used to evaluate the energy supply level of an athlete during anaerobic energy supply. The anaerobic power index (w/kg) measured during the experiment represents the level of phosphagen supply of the trainee, and the average power represents the level of glycolytic supply in the subject's body under anaerobic conditions.

The anaerobic power related indexes were selected by reviewing the information related to speed endurance and combining the opinions of the coaches and experts, and finally picking out the values of maximal power of the upper limbs, average power of the upper limbs, maximal power of the lower limbs, and average power of the lower limbs.

Test method: Using the upper limb anaerobic power bike to test, students prepared for the activity, start to carry out the upper limb anaerobic power bike test, firstly, press the "TEST" key on the keyboard to start the anaerobic power test procedure. Firstly, press the "TEST" key on the keyboard to start the anaerobic power test program. Secondly, input the basic parameters such as age, weight, gender, etc., and the equipment would automatically calculate the load and confirm. Third, press the "START" key on the keyboard to start the countdown, and let the speed reach the fastest when the countdown comes to an end. Fourth, continue to insist on the test for 30 seconds at maximum capacity, and finally record the results. Process Note: First, the standing test should be completely removed from the seat, the tester should stand on the flat plate above the equipment, did not stand on the ground directly test. Secondly, the crank length should be adjusted and fully fastened before the test. Third, the height of the resistance head should be adjusted according to the height of the tester and the characteristics of the project before the test.

To perform the test using the Lower Body Anaerobic Power Bike, students prepared for and began the Lower Body Anaerobic Power Bike test by, firstly, opening the software and selecting the "Wingate" test program. Firstly, opened the software and selected the "Wingate" test program. Secondly, found or created a new group and tester's name, and checked or entered accurate personal information. Third, place the appropriated weights in the resistance basket and lift the weight disc. Fourthly, start warming up and then entered into the test state, did your best to make the speed reach the maximum of your ability when you put down the weight disc, and insist on riding as hard as you could for 30 seconds, the test would be finished, and the result would be recorded at the end. Note: First, before each test, the seat and handrails of the equipment should be checked to ensure that there was no loosening

of the safety. Secondly, the height of the seat should be recorded before the test and try to ensure that there was not much difference in the time schedule of multiple tests.

### 3.4.4 Selection of Indicators and Testing Methods for Athletics Specialized Tests

Indicators related to track and field special performance tests were selected by reviewing information related to speed endurance, combining the opinions of coaches and experts, and taking into account the actual situation, and finally selecting 100 meters, 800 meters, 1500 meters, triple jump, javelin, and shot put.

Table 3.4 Testing Methods for Athletics Specialized Tests

NO.	Program	Test methods
1	triple jump	<ol style="list-style-type: none"> <li>1. Trainees warm up, and staff members such as the chief judge, starting point judge, landing point judge, score measurer and recorder take their respective positions.</li> <li>2. Try 1-2 jumps in order.</li> <li>3. Take turns in the order as instructed by the staff. Start the test, run, the first jump (single-footed jump), the second jump (straddle jump), the third jump (jump), the final landing in the moment of contact to softly bend the knees cushioning, hips and body over the landing point, forward out of the bunker, record the effective results.</li> <li>4. Test 3 times, take the best valid score, record the result.</li> </ol>
2	javelin	<ol style="list-style-type: none"> <li>1. The trainee warms up and the head referee, infield referee, drop referee, outfield referee, recorder and other staff were each in position.</li> <li>2. Try the throws in order.</li> <li>3. Take turns in sequence as instructed by staff. Start the test by holding the snatch, holding the gun, assisting in the run, exerting the final effort, maintaining the body balance and recording the valid score.</li> </ol>

Table 3.4 Testing Methods for Athletics Specialized Tests (Cont.)

NO.	Program	Test methods
		4. Test 3 times, take the best valid score and record the result.
3	shot put	<p>1. Trainees warm up and staff members such as the head referee, infield referee, drop referee, outfield referee and recorder were each in position.</p> <p>2. Try the throws in order.</p> <p>3. Take turns in sequence as directed by staff. Start the test by using the lateral slide technique. Grip the ball, hold the ball, ready position, lateral slide, final force build-up, final force acceleration, and record the valid score.</p> <p>4. Test 3 times, take the best valid score and record the result.</p>
4	100 meters	1. Prepare to start.
5	800 meters	2. Starting in accordance with the command "all in position", "ready" and "run", the starter would raise the flag at the sametime, and the timekeeper would start the stopwatch.
6	1500 meters	3. Pay attention to keep the upper body tilted forward near the finish line, and the time would be counted when the torso reaches the finish line.

### 3.5 Validity, Reliability, Approval & Ethical Consideration

#### 3.5.1 Validity

Validity was the extent to which the instrument accurately measures the properties of a concept (LoBiondo & Haber, 2015). Consequently, the content validity would be used in this research. A successful data collection survey was more than just a set of well-designed questions that were recorded and applied to a sample population. A good survey generates key information and provides an important window into the heart of the topic of interest, and validity and reliability were fundamental measures of the quality of the survey (Fink & Litwin, 1995).

Thus, the content validity would be performed by inviting 3 experts. IOC (Item Objective Congruence) would be used to assess the correspondence of projects to objectives based on scores +1, 0, and -1.

+1: The item meets the objectives or ensures that the following measures meet the stated objectives.

0: It was not certain or obvious whether the measure meets the objective.

-1: The items did not meet the objectives or ensure that the measures did not meet the designated objectives.

The following formula would be used to calculate the IOC for this research.

1) If the IOC rating range was 0.67-1.00, it means that the test item was congruent and could be retained.

2) If the IOC rating range was less than 0.66, it means that the test item was not incongruent and needs to be removed or adjusted.

In this research, all instruments were validated with the scores which were higher than 0.67. This proved that all of these instruments were valid for the further use.

### 3.5.2 Reliability

After the validity of the content was confirmed by experts, the interview questions were sent out for pilot testing to ensure reliability. Pilot test to ensure reliability. The sample for the pilot test was taken from the H college 30 participants were pilot tested.

The collected responses and Cronbach's alpha ( $\alpha$ ) were used to test its reliability. The reliability coefficients of the interview questions were tested.

Table 3.5 below shows the Cronbach's alpha scores based on the pilot test to confirm the reliability of the interview questions.

Table 3.5 Rating Scale

Alpha Coefficient Range	Internal Consistency
$\geq 0.90$	Excellent
$\geq 0.80$	Good
$\geq 0.70$	Acceptable
$\geq 0.60$	Questionable
$\geq 0.50$	Poor
$< 0.50$	Unacceptable

Source: George & Mallery, 2003

As a result, all items of the questionnaires were reliable with the scores of 0.70 and higher.

### 3.5.3 Approval and Ethical Consideration

To conduct the research in the school, the researcher obtained an approval letter from the H college of administrative department. Because the participants in this research were between the ages of 18 and 21, the researcher also seek approval from the school's responsible department as well.

Participants were also informed of the research objectives before the strategy was implemented. Additionally, research participants signed consent documents to protect their legal and moral rights.

## 3.6 Data Analysis

The researcher applied two different methods to analyze the data, each aligned with the two research objectives. The researcher utilized quantitative data derived from pre- test and post-test scores, as well as the results of the questionnaire to assess student performance in the area of speed endurance before and after training using the combination training method. SPSS was utilized to analyze the data and assess the improvement in the students' physical performance.

Essentially, the researcher used the quantitative data obtained from the survey to measure student satisfaction with the use of the Combined Training Method in physical education students.

### 3.6.1 Quantitative Data Analysis

Quantitative data were collected through the scores on achievement tests (pre-test and post-test). Mean and standard deviation were used to analyze the results. The response from the questionnaire were analyzed using mean and standard deviation.

These methods were used in this research to investigate the performance of sports students in 6 areas such as 100m, 800m, and etc. after training using the combination training method and to assess their satisfaction in it. The results of the questionnaire (means) would be interpreted according to the following ranges.

Table 3.6 The Range of Mean Score Interpretation

Mean Score Range	Perceptions Level
4.21-5.00	Highest
3.41-4.20	High
2.61-3.40	Moderate
1.81-2.60	Low
1.00-1.80	Lowest

Source: Moidunny, 2009

## CHAPTER 4

### RESULTS AND DATA ANALYSIS

This thesis design was applied to investigate the combination training method of the speed endurance level in physical education for freshmen students in China and to explore the satisfaction of students with combination training method in physical education. The results were obtained from pre-test, post-test and questionnaire. The following was the sequence in which the data findings were given in this chapter.

4.1 Pre-Test and Post-Test Data Analysis

4.2 Test Scores Analysis

4.3 Questionnaire Analysis

#### 4.1 Pre-Test and Post-Test Data Analysis

Table 4.1 Blood Lactate Test Data

Name	Pre-test blood lactate	Post-test blood lactate	Different
NO.1	16.79	14.78	2.01
NO.2	13.93	12.26	1.67
NO.3	14.84	13.06	1.78
NO.4	13.41	11.80	1.61
NO.5	13.3	11.70	1.6
NO.6	15.35	13.51	1.84
NO.7	16.6	14.61	1.99
NO.8	13.33	11.73	1.60
NO.9	11.66	10.26	1.40
NO.10	12.8	11.26	1.54
NO.11	13.97	12.29	1.68

Table 4.1 Blood Lactate Test Data (Cont.)

Name	Pre-test blood lactate	Post-test blood lactate	Different
NO.12	14.79	13.02	1.77
NO.13	13.48	11.86	1.62
NO.14	15.27	13.44	1.83
NO.15	14.88	13.09	1.79
NO.16	13.12	11.55	1.57
NO.17	11.47	10.09	1.38
NO.18	12.27	10.80	1.47
NO.19	13.97	12.29	1.68
NO.20	13.57	11.94	1.63
NO.21	12.61	11.10	1.51
NO.22	13.12	11.55	1.57
NO.23	13.99	12.31	1.68
NO.24	13.87	12.21	1.66
NO.25	11.28	9.93	1.35
NO.26	10.87	9.57	1.30
NO.27	11.48	10.10	1.38
NO.28	9.57	8.42	1.15
NO.29	13.57	11.94	1.63
NO.30	14.28	12.57	1.71
$\bar{x}$	13.45	11.83	1.61

Table 4.2 Heart Rate Indicator Test Data

Name	Pre-test heart rate	Post-test heart rate	Different
NO.1	179	158	21
NO.2	160	141	19
NO.3	175	154	21
NO.4	168	148	20
NO.5	184	162	22
NO.6	169	149	20

Table 4.2 Heart Rate Indicator Test Data (Cont.)

Name	Pre-test heart rate	Post-test heart rate	Different
NO.7	156	137	19
NO.8	180	158	22
NO.9	180	158	22
NO.10	171	150	21
NO.11	176	155	21
NO.12	179	158	21
NO.13	169	149	20
NO.14	168	148	20
NO.15	168	148	20
NO.16	166	146	20
NO.17	163	143	20
NO.18	167	147	20
NO.19	175	154	21
NO.20	162	143	19
NO.21	156	137	19
NO.22	160	141	19
NO.23	168	148	20
NO.24	180	158	22
NO.25	169	149	20
NO.26	165	145	20
NO.27	168	148	20
NO.28	167	147	20
NO.29	166	146	20
NO.30	158	139	19
$\bar{x}$	169	149	20

Table 4.3 Lower Extremity Anaerobic Power Index Test Data

Name	Pre-test lower extremity anaerobic power index	Post-test lower extremity anaerobic power index	Different
NO.1	9.69	8.53	1.16
NO.2	10.9	9.59	1.31
NO.3	11.91	10.48	1.43
NO.4	10.44	9.19	1.25
NO.5	13.94	12.27	1.67
NO.6	9.42	8.29	1.13
NO.7	12.88	11.33	1.55
NO.8	9.87	8.69	1.18
NO.9	9.96	8.76	1.20
NO.10	13.12	11.55	1.57
NO.11	12.24	10.77	1.47
NO.12	11.37	10.01	1.36
NO.13	12.19	10.73	1.46
NO.14	10.72	9.43	1.29
NO.15	11.77	10.36	1.41
NO.16	12.28	10.81	1.47
NO.17	12.57	11.06	1.51
NO.18	10.3	9.06	1.24
NO.19	11.49	10.11	1.38
NO.20	11.18	9.84	1.34
NO.21	11.48	10.10	1.38
NO.22	11.93	10.50	1.43
NO.23	10.17	8.95	1.22
NO.24	9.64	8.48	1.16
NO.25	8.36	7.36	1.00
NO.26	9.6	8.45	1.15
NO.27	9.28	8.17	1.11
NO.28	9.59	8.44	1.15

Table 4.3 Lower Extremity Anaerobic Power Index Test Data (Cont.)

Name	Pre-test lower extremity anaerobic power index	Post-test lower extremity anaerobic power index	Different
NO.29	10.17	8.95	1.22
NO.30	10.11	8.90	2.21
$\bar{x}$	10.95	9.65	1.36

Table 4.4 Upper Extremity Anaerobic Power Index Test Data

Name	Pre-test upper extremity anaerobic power index	Post-test upper extremity anaerobic power index	Different
NO.1	650	572	78
NO.2	472	415	57
NO.3	472	415	57
NO.4	605	532	73
NO.5	497	437	60
NO.6	428	377	51
NO.7	575	506	69
NO.8	422	371	51
NO.9	561	494	67
NO.10	577	508	69
NO.11	490	431	59
NO.12	654	576	78
NO.13	678	597	81
NO.14	508	447	61
NO.15	594	523	71
NO.16	432	380	52
NO.17	487	429	58
NO.18	432	380	52
NO.19	534	470	64
NO.20	585	515	70
NO.21	469	413	56

Table 4.4 Upper Extremity Anaerobic Power Index Test Data (Cont.)

Name	Pre-test upper extremity anaerobic power index	Post-test upper extremity anaerobic power index	Different
NO.22	487	429	58
NO.23	472	415	57
NO.24	605	532	73
NO.25	497	437	60
NO.26	428	377	51
NO.27	575	506	69
NO.28	422	371	51
NO.29	561	494	67
NO.30	469	413	56
$\bar{x}$	521	459	63

Table 4.5 Pre-Test Athletics Specialized Test Data

Name	100m	800m	1500m	Triple jump	Javelin	Shot-put
NO.1	12.26	2.19	4.43	12.25	35	10.15
NO.2	12.35	2.18	4.35	12.03	30	9.53
NO.3	12.09	2.19	4.38	12.21	33	9.32
NO.4	12.42	2.23	4.35	11.95	28	9.13
NO.5	12.26	2.21	4.41	12.33	26	10.15
NO.6	12.26	2.16	4.37	12.25	31	10.18
NO.7	12.45	2.16	4.38	12.08	31	9.57
NO.8	12.31	2.23	4.29	12.18	27	10.35
NO.9	12.03	2.16	4.35	12.03	28	11.05
NO.10	12.09	2.19	4.38	12.21	33	9.32
NO.11	12.42	2.23	4.35	11.95	28	9.13
NO.12	12.43	2.19	4.39	12.26	31	10.15
NO.13	12.26	2.22	4.38	12.26	31	9.58
NO.14	12.42	2.23	4.35	11.95	28	9.13
NO.15	12.26	2.22	4.28	11.88	30	10.15

Table 4.5 Pre-Test Athletics Specialized Test Data (Cont.)

Name	100m	800m	1500m	Triple jump	Javelin	Shot-put
NO.16	12.31	2.17	4.46	12.18	27	9.32
NO.17	12.27	2.18	4.42	12.25	26	10.15
NO.18	12.35	2.19	4.35	11.95	31	10.18
NO.19	12.26	2.18	4.38	12.26	31	9.54
NO.20	12.09	2.13	4.41	12.31	29	10.35
NO.21	12.26	2.19	4.35	12.25	28	10.32
NO.22	12.42	2.23	4.38	12.26	31	10.15
NO.23	12.42	2.23	4.35	12.03	28	11.05
NO.24	12.26	2.22	4.28	12.21	33	9.32
NO.25	12.31	2.17	4.46	11.95	28	9.13
NO.26	12.43	2.19	4.35	12.26	31	9.58
NO.27	12.26	2.22	4.28	12.03	28	11.05
NO.28	12.42	2.23	4.46	11.95	28	9.13
NO.29	12.26	2.22	4.41	11.88	30	10.15
NO.30	12.26	2.22	4.38	11.95	28	9.13
$\bar{x}$	12.30	2.20	4.37	12.12	29	9.85

Table 4.6 Post-Test Athletics Specialized Test Data

Name	100m	800m	1500m	Triple jump	Javelin	Shot-put
NO.1	11.87	2.12	4.29	12.40	36	10.53
NO.2	11.95	2.11	4.21	12.18	31	9.89
NO.3	11.70	2.12	4.24	12.36	34	9.67
NO.4	12.02	2.16	4.21	12.10	29	9.48
NO.5	11.87	2.14	4.27	12.48	27	10.53
NO.6	11.87	2.09	4.23	12.40	32	10.57
NO.7	12.05	2.09	4.24	12.23	32	9.93
NO.8	11.91	2.16	4.15	12.33	28	10.74
NO.9	11.64	2.09	4.21	12.18	29	11.47
NO.10	11.70	2.12	4.24	12.36	34	9.67

Table 4.6 Post-Test Athletics Specialized Test Data (Cont.)

Name	100m	800m	1500m	Triple jump	Javelin	Shot-put
NO.11	12.02	2.16	4.21	12.10	29	9.48
NO.12	12.03	2.12	4.25	12.41	32	10.53
NO.13	11.87	2.15	4.24	12.41	32	9.94
NO.14	12.02	2.16	4.21	12.10	29	9.48
NO.15	11.87	2.15	4.14	12.03	31	10.53
NO.16	11.91	2.10	4.32	12.33	28	9.67
NO.17	11.87	2.11	4.28	12.40	27	10.53
NO.18	11.95	2.12	4.21	12.10	32	10.57
NO.19	11.87	2.11	4.24	12.41	32	9.90
NO.20	11.70	2.06	4.27	12.46	30	10.74
NO.21	11.87	2.12	4.21	12.40	29	10.71
NO.22	12.02	2.16	4.24	12.41	32	10.53
NO.23	12.02	2.16	4.21	12.18	29	11.47
NO.24	11.87	2.15	4.14	12.36	34	9.67
NO.25	11.91	2.10	4.32	12.10	29	9.48
NO.26	12.03	2.12	4.21	12.41	32	9.94
NO.27	11.87	2.15	4.14	12.18	29	11.47
NO.28	12.02	2.16	4.32	12.10	29	9.48
NO.29	11.87	2.15	4.27	12.03	31	10.53
NO.30	11.87	2.15	4.24	12.10	29	9.48
$\bar{x}$	11.90	2.13	4.23	12.27	30	10.22

The fundamental requirement of the training of trainees using the combination training method was to be able to improve the trainee's speed and endurance quality in a short period of time. In the course of each training, in principle, the development of the athlete's various special abilities should be the main focus, and the training methods and the amount of loads set were all designed to satisfy the special abilities. Specialized deepening emphasizes that the muscular system and the motor nervous system could be highly coordinated, as well as could make reasonable use of the elastic potential energy of muscle fibers, and with the trainee highly skilled technical movement system. But from

the motor nervous system and muscle system and so on many different aspects to analyze, they would go to ask for time, which makes the trainee using a combination of training methods must follow the process of systematic science, but also had to take into account the principle of physiological adaptive mechanism and the principle of human body recovery mechanism, to sum up the above athletes followed the principle of deepening the specialization and at the same time followed the principle of integration and balancing.

## 4.2 Test Scores Analysis

Collect and organize the experimental data of the experimental subjects, and analyze and process the experimental data by using SPSS 27.0 and Excel. In the process of pre- and post-testing of the experiment, the obtained students' index test scores were effectively counted and analyzed by means of SPSS27.0 application calculation and tabulation, etc. The data were expressed as mean + standard deviation ( $\bar{x} + S.D.$ ).

### 4.2.1 Test Scores of Blood Lactate Indicators

The blood lactate related indexes were selected by reviewing the information related to speed endurance, combining the opinions of coaches and experts, and taking into account the actual situation, and finally picking out the values of blood lactate concentration in the immediate post-exercise period, and the value of blood lactate concentration in the 15-min post-exercise period.

Table 4.7 Test Scores of Blood Lactate Indicators

Blood Lactate Indicators	Pre-test		Post-test	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Immediate post-exercise blood lactate values	14.41	1.92	14.21	1.81
Blood lactate value after exercise in 15-min	12.80	2.32	12.71	2.18

As shown in Table 4.7, the Pre-test and Post-test group of data, blood lactate value were remarkably difference.

Table 4.8 Test Scores of Heart Rate Indicators

Heart Rate Indicators	Pre-test		Post-test	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Maximum heart rate	172	8	171	8
Heart rate after exercise in 3-min	140	8	140	7

#### 4.2.2 Test Scores of Heart Rate Indicators

The heart rate related indexes were selected by reviewing the information related to speed endurance, combining the opinions of coaches and experts with the actual situation, and finally picking out the values of the maximum heart rate and the 3-minute post-exercise heart rate.

As shown in Table 4.8, the Pre-test and Post-test group of data, heart rate indicators value were remarkably difference.

#### 4.2.3 Test Scores of Anaerobic Power

The anaerobic power related indexes were selected by reviewing the information related to speed endurance and combining the opinions of coaches and experts, and finally picking out the values of maximal power of the upper limb, average power of the upper limb, maximal power of the lower limb, and average power of the lower limb.

Table 4.9 Test Scores of Upper Limb Anaerobic Power

Upper Limb Anaerobic Power	Pre-test		Post-test	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Maximum Anaerobic Power	525.5	77.8	535.4	72.1
Average Anaerobic Power	277.4	20.0	275.8	19.4

As shown in Table 4.9, the Pre-test and Post-test group of data, upper limb anaerobic power value were remarkably difference.

Table 4.10 Test Scores of Upper Limb Anaerobic Power

Lower Limb Anaerobic Power	Pre-test		Post-test	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Maximum Anaerobic Power	11.01	1.39	11.12	0.72
Average Anaerobic Power	8.46	0.77	8.52	0.85

As shown in Table 4.10, the Pre-test and Post-test group of data, lower limb anaerobic power value were remarkably difference.

In conclusion, according to Pre-test and Post-test, there was no significant difference between the participants in the test in terms of physical indicators and sports performance, indicating that they belonged to the same level and met the basic requirements of the experiment.

At the beginning of each training session, the subjects should arrive at the training ground 15 minutes in advance to warm up. In the training process, there were two auxiliary staff to assist in the training, and the training movements and contents were strictly controlled and responsible to ensure that the majority of the players could successfully complete the training contents.

The two groups were evaluated and controlled according to the subjects' pulse, subjective feeling and inquiries, etc. If there was a phenomenon of maladaptation such as excessive load or intensity in most of the subjects, the intensity or difficulty of the training should be reduced to ensure the quality of the experiment.

It was strictly prohibited for the personnel to had behaviors that affect the effect of the experiment outside the experiment, and the subjects were questioned in every experiment to ensure the accuracy and scientificity of the experiment.

### 4.3 Questionnaire Analysis

Table 4.11 Questionnaire Analysis

NO.	Items	$\bar{x}$	S.D.	Interpretation
<b>Statistical of Students' Learning Interest</b>				
1.	I liked the learning process of the combination training method.	4.44	0.70	Highest
2.	I was interested in the results of the combination training method.	4.44	0.58	Highest
3.	The combination training method improved my physical fitness.	4.52	0.51	Highest
4.	I took the initiative to ask questions during the learning process of the combination training method.	4.26	0.71	Highest
5.	I consulted information and research problems in the process of learning the combination training method.	4.30	0.91	Highest
<b>Statistical of Students' Ability to Discover, Analyze, And Solve Problems</b>				
6.	I asked my teacher for guidance in solving problems in the process of learning the combination training method.	4.11	0.64	High
7.	I would take the initiative to research after class to solve the unsolved problems in class.	4.37	0.49	Highest

Table 4.11 Questionnaire Analysis (Cont.)

NO.	Items	$\bar{x}$	S.D.	Interpretation
8.	I could use what I had learned to solve problems in the process of learning the combination training method.	4.67	0.55	Highest
9.	I could find my own mistakes and try to solve them in the process of learning the combination training method.	4.37	0.49	Highest
10.	I could take the initiative to make plans in the process of learning the combination training method.	3.85	0.86	High
11.	I could reflect on the learning process in the combination training method learning process, and summarize the learning experience.	4.19	0.68	High
<b>Statistical of Students' Sense of Cooperation and Communication</b>				
12.	I was very willing to share the joy of harvesting with my classmates in the learning process of the combination training method.	4.89	0.42	Highest
13.	In the group discussion, I was serious and actively participate in the discussion to increase the spirit of cooperation among classmates.	4.96	0.19	Highest

Table 4.11 Questionnaire Analysis (Cont.)

NO.	Items	$\bar{x}$	S.D.	Interpretation
14.	In group discussions, I normally actively communicated with my classmates.	4.11	0.70	High
15.	I liked to communicate with my classmates in the research of combination training method.	4.26	0.59	Highest
16.	I normally shared my views on the combination training method with my teachers and classmates.	4.22	0.58	Highest
17.	I would do my best to win in the group competition of the combination training method.	4.56	0.64	Highest
18.	The combination training method helped me to develop my own training level.	4.70	0.47	Highest
<b>Statistical of Students' Ability of Specialized Knowledge and Apply It</b>				
19.	After the training of the combination training method, my physical fitness was improved.	4.85	0.36	Highest
20.	My physical fitness was improved through the combination training method.	4.44	0.64	Highest
21.	My training endurance was improved through the combination training method.	4.70	0.47	Highest

Table 4.11 Questionnaire Analysis (Cont.)

NO.	Items	$\bar{x}$	S.D.	Interpretation
22.	My running speed was improved through the combination training method.	4.81	0.40	Highest
23.	My heart rate level was increased as a result of the combination training method.	4.67	0.68	Highest
24.	My ability to study endurance was improved as a result of the combination training method.	4.74	0.53	Highest
25.	My ability to study speed was improved through a combination of training methods.	4.63	0.63	Highest
26.	After training with the Combined Training Method, my study of endurance was improved.	4.63	0.49	Highest
27.	My ability to study speed was improved as a result of the combination training method.	4.37	0.74	Highest

Thinking from a psychological point of view, “interest was a psychological characteristic of human beings when they acquire knowledge of a certain kind and learn, and interest was the best tutor for students”. For physical education, interest was “a signpost to guide people to engage in physical exercise, but also for students to be strong and healthy to better engage in the foundation of learning, when students had a strong interest in a subject, they would certainly be very serious and hard to learn this course until the subject had greater progress, the development of interest was a process, mainly divided into three stages: Interest development was a process, which was divided into

three stages: finding interesting, generating interest, and tendency to interest, therefore, in the sprinting course, teachers should first let students feel interesting, and then stimulate their interest in learning, and in the process of cultivating interest in learning, they could improve the students' motivation to learn and independent initiative, and through the learning process, the students' attitude towards learning also changes from "I could learn, to I would learn". Whether the teaching could be successful, the teaching effect was good or bad, and students' interest in learning had a close correlation. Therefore, students' interest in learning was especially important in this experiment. The learning interest of the two groups of students in the combination training method pre and post-test was shown in the table below:

Table 4.12 Statistical of Students' Learning Interest

Items	Scores					$\chi^2$
	5	4	3	2	1	
	Sample Number					
I liked the learning process of the combination training method.	20	8	2	0	0	26.323
I was interested in the results of the combination training method.	20	10	0	0	0	5.719
The combination training method improved my physical fitness.	23	7	0	0	0	9.769
I took the initiative to ask questions during the learning process of the combination training method.	20	9	1	0	0	3.071
I consulted information and research problems in the process of learning the combination training method.	21	9	0	0	0	24.45

The results of the students' interest in learning before and after the test were statistically analyzed by using SPSS 27.0 software. Tests from Table 4.12 data could be seen, for the students of the combination of training method of interest in

the survey report, 1, 3, 5 questions the difference was very significant, the comparison of the two groups of data was very obvious.

“The ability to discover, analyze and solve problems was a comprehensive ability, and its core objective was to cultivate students' ability of creative thinking, specifically including the ability of experimental investigation and observation, the ability of experimental investigation and research and the ability to ask questions, the ability to use the scientific method to solve practical problems, etc., people want to solve a problem, then they need to analyze and solve the problem through the reasons for the problem. Explore, think about the process of the problem occurs, find the root cause to discover the problem, so as to analyze and solve the problem, in this process, respectively, using the human ability to discover the problem, analyze the problem and solve the problem, and in the solution of sprinting problems, it was the same”. When teachers use the combination teaching method to teach, they had to “let students go to active problem solving, in a freer learning environment, students could take the initiative to discover problems, analyze problems, explore and communicate problems, find out the answers by searching for relevant teaching materials and contents, so as to solve the problems”. The data on the ability to discover, analyze and solve problems were analyzed by using SPSS 27.0 statistical software to analyze the questionnaire data and the results were obtained as shown in Table 4.12.

Table 4.13 Statistical of Students' Ability to Discover, Analyze, And Solve Problems

Items	Scores					$\chi^2$
	5	4	3	2	1	
	Sample Number					
I asked my teacher for guidance in solving problems in the process of learning the combination training method.	22	8	0	0	0	26.458
I would take the initiative to research after class to solve the unsolved problems in class.	19	10	1	0	0	11.257

Table 4.13 Statistical of Students' Ability to Discover, Analyze, And Solve Problems  
(Cont.)

Items	Scores					$\chi^2$
	5	4	3	2	1	
	Sample Number					
I could use what I had learned to solve problems in the process of learning the combination training method.	21	9	0	0	0	18.600
I could find my own mistakes and try to solve them in the process of learning the combination training method.	23	7	0	0	0	15.434
I could take the initiative to make plans in the process of learning the combination training method.	20	9	1	0	0	12.972
I could reflect on the learning process in the combination training method learning process, and summarize the learning experience.	23	7	0	0	0	22.125

As could be seen from Table 4.13, of the 6 topics in the pre-test students' questionnaire on the ability to discover, analyze and solve problems in sprinting, all the test results had  $\chi^2$  of less than 3.00, which indicates that there was a very significant difference and was statistically significant. It could be shown that the combination teaching method had a very good effect on improving students' ability to discover, analyze and solve problems.

The reasons were as follows: students' ability to discover, analyze and solve problems was cultivated through continuous thinking in learning, and the combination teaching method creates a thinking situation for students by creating a situation, so that students could continuously think in the teaching situation, improve their ability to discover, analyze and solve problems in the situation, and express their own views on problem solving in a group, and then combine with other people in the group to solve problems. Through the group, express their views on problem solving, and then

combined with the views and suggestions of other people in the group, and finally find a solution to the problem, in this teaching process, the students through the teacher to create a scenario to find problems, problem solving, in the scenario through the framework of their own knowledge to find problems, problem solving, and finally through the group way to the problem to explore and exchange”. In teaching, the use of video uploaded to the microblogging group, each person could download and watch their own or others' mastery of technical movements, the second class in the classroom when the group discussion and exchange, report on their own analysis of the situation, and put forward solutions.

Physical education was “a discipline with strong practicality, students majoring in physical education would have some unique personality traits compatible with this discipline due to their long-term engagement in physical education. Compared with students of other majors, students majoring in physical education were extroverted, cheerful, sociable, and had strong teamwork and collaboration ability, and students majoring in physical education would usually go to the sports games and related events when they were held. would go to participate in them, and they communicate and compete with each other either as opponents or teammates, and the experiences of these competitions also paint a strong picture of their character traits”. The effect on students' cooperative communication and innovation ability in sprinting was analyzed and counted by using SPSS 27.0 statistical software and Excel data processing software to analyze and count the measured data, and the results were shown in Table 4.14.

Table 4.14 Statistical of Students' Sense of Cooperation and Communication

Items	Scores					X <sup>2</sup>
	5	4	3	2	1	
	Sample Number					
I was very willing to share the joy of harvesting with my classmates in the learning process of the combination training method.	20	9	1	0	0	18.318

Table 4.14 Statistical of Students' Sense of Cooperation and Communication (Cont.)

Items	Scores					X <sup>2</sup>
	5	4	3	2	1	
	Sample Number					
In the group discussion, I was serious and actively participate in the discussion to increase the spirit of cooperation among classmates.	22	8	0	0	0	6.857
In group discussions, I normally actively communicated with my classmates.	24	5	1	0	0	10.522
I liked to communicate with my classmates in the research of combination training method.	19	11	0	0	0	11.779
I normally shared my views on the combination training method with my teachers and classmates.	21	8	1	0	0	5.567
I would do my best to win in the group competition of the combination training method.	25	5	5	0	0	21.258
The combination training method helped me to develop my own training level.	24	6	0	0	0	5.69

From Table 4.14, it could be seen that: of the seven questions in the questionnaire on students' cooperative communication and innovation ability, the analyzed  $\chi^2$  of questions 1, 3, 4 and 6 were all less than 4.50, which indicates that there was a significant difference and statistically significant; the analyzed  $\chi^2$  of questions 2, 5 and 7 were all greater than 5.30, which makes the difference non-significant and needs to be further analyzed. It shows that the combination teaching method was effective in improving students' ability in cooperative communication and creativity.

“Knowledge application ability was relative to both knowledge production and innovation ability and skill application ability. Knowledge production and innovation ability was the main ability to carry out cognitive practice, the core of which was based on the problem orientation of knowledge logic, solving the cognitive problems such as faults, gaps and updating in the chain of knowledge, while knowledge application and innovation ability was based on professional knowledge and skills, able to creatively solve complex and changing practical problems. On the basis of professional knowledge and skills, it was the ability to creatively solve complex and changing practical problems. Physical education belongs to the activity course, which was a subject with the basic attributes of activity course with the basic features of physical practice, and physical education had the characteristics of strong practicability, and it was a comprehensive course form combining the theory and practice” . Therefore, the ability to apply knowledge was the core of the practical ability of physical education professional knowledge. SPSS 27.0 software data analysis, the results were shown in Table 4.15.

Table 4.15 Statistical of Students' Ability of Specialized Knowledge and Apply It

Items	Scores					Items
	5	4	3	2	1	
	Sample Number					
After the training of the combination training method, my physical fitness was improved.	29	1	0	0	0	9.634
My physical fitness was improved through the combination training method.	22	8	0	0	0	12.398
My training endurance was improved through the combination training method.	25	5	0	0	0	15.023
My running speed was improved through the combination training method.	23	7	0	0	0	10.482
My heart rate level was increased as a result of the combination training method.	22	8	0	0	0	9.725

Table 4.15 Statistical of Students' Ability of Specialized Knowledge and Apply It  
(Cont.)

Items	Scores					Items
	5	4	3	2	1	
	Sample Number					
My ability to study endurance was improved as a result of the combination training method.	23	7	0	0	0	21.861
My ability to study speed was improved through a combination of training methods.	26	4	0	0	0	18.872
After training with the Combined Training Method, my study of endurance was improved.	23	7	0	0	0	15.328
My ability to study speed was improved as a result of the combination training method.	27	3	0	0	0	17.571

From Table 4.15, it could be seen that: in the nine topics of the questionnaire on the application of specialized knowledge, all the test results had a  $x^-$  less than 5.00, indicating a significant difference and statistical significance. It shows that the combination training teaching method had a good effect on improving students' ability to apply specialized knowledge. The reasons were analyzed as follows.

According to the classroom teaching process of the combination training teaching method, the content to be studied was assigned to the students in the form of posing questions, and the students collected relevant information outside the classroom and put forward the corresponding requirements (such as consulting the reference books related to the study) the next day in class to discuss the content of the study in small groups, and finally check the effect of the student's discussion by the following way: arranging the classroom time for each group to Show the results, followed by students and teacher questions and discussion, and finally the teacher commented on the explanation, this mode of learning greatly exercise the skills of students to collect information, but also cultivate the students to summarize, summarize the ability, in the period of the display, the questions, discussion and to the

teacher's comments, could prompt the students to recognize their own strengths and weaknesses, and to further improve their practical ability.



## CHAPTER 5

### CONCLUSION, DISCUSSION, AND RECOMMENDATIONS

This chapter contained the study's summary, which were presented in the following order:

- 5.1 Conclusion
- 5.2 Discussion
- 5.3 Recommendations

#### 5.1 Conclusion

The two research objectives were stated for this research:

- 1) To compare speed endurance level before and after using Combination Training Method in Physical Education for Freshmen students in China.
- 2) To investigate freshmen students' satisfaction towards using the Combination Training Method in Physical Education for Freshmen students in China.

##### 5.1.1 The Result of Pre-test and Post-test Data Analysis

After 4 weeks of training, the blood lactate related indexes of the 2 groups of people Pre-test and Post-test were tested respectively, and the test data were subjected to the independent sample test, the blood lactate concentration was reduced after the experiment, and the blood lactate clearance rate was increased after the experiment, in which, the blood lactate clearance rate = (immediate blood lactate value - blood lactate value after 15min) / immediate blood lactate value, but the effect of the experimental group was significantly more effective than that of the control group. The p-values of immediate blood lactate and blood lactate after 15 min in the experimental group before and after the experiment were 0.024 and 0.005, respectively,

with significant differences ( $p < 0.05$ ) and highly significant differences ( $p < 0.01$ ), and the ability of lactate to produce an inhibitory effect as well as the ability of lactic acid clearance were significantly improved, and aerobic metabolism was developed.

The reason for the difference in blood lactate indexes was that the combination training method had significantly improved the ability to inhibit blood lactate and the ability to eliminate lactate, and the aerobic metabolism had been enhanced, so that the students could insist on exercising for a longer period of time under the same loading conditions as before, which demonstrates that the combination training method could improve the students' speed endurance quality more effectively. Combination training method was based on the physical education major track and field programs, sports level, stage and other conditions, the use of scientific sports training, physiology and other principles, the rational use of multiple training units, the different nature of the unit arrangement of different ratios, to improve the speed of endurance training methods. Combination training method of action, training method organic combination, interval time flexibility, while reducing the impact of speed endurance training implementation effect of factors (Anderson, 2017). Implemented from the general endurance, speed endurance improvement, maintenance of three stages, including short intervals selected to develop the student's speed endurance and lactate supply capacity of maximum lactate training, long repetition training method focuses on the development of lactate energy metabolism system and aerobic metabolism system mixed energy supply capacity. The combination training method on the one hand implements an effective training method, on the other hand reduces the factors affecting the implementation of speed endurance training, and achieves the effect of improving the blood lactate clearance rate, so that the student's body would not easily produce the feeling of fatigue. In the process of adopting the combination training method, the interval training method of training students' lactate tolerance was integrated. The usual lactate tolerance training was the method of overload, the principle was that after the first training, the student's blood lactate value reaches about 12mmol/L, at this time rest for 4-5min, when the student's body blood lactate concentration decreases and then carry out the next training. After this was repeated, the blood lactate concentration in the student's

body would be maintained at a high level. The purpose of this training method was to allow the body to maintain a prolonged period of lactate stimulation, resulting in physiological adaptation and improved lactate tolerance. On the basis of this method to increase the load, the exercise time was 1-2min of high-intensity exercise, the interval time was 3- 5min, adjusting the interval time and the ratio of the exercise time to the interval time, in order to control the lactic acid content in the student's body, so that the lactic acid realization of the body could be maximized to build up, which in turn improves the body's maximum lactic acid production capacity, as a result of which the student's ability of glycolytic energy supply was improved, which in turn Improved speed endurance qualities (Carlson, 2018).

The research of Gao (2016) and other scholars also confirmed the argument that after 4 weeks of combination training, the experimental group showed that the rate of decrease of blood lactate was significantly faster than that before the experiment, which indicated that the combination training method was effective for the enhancement of students'anti-lactic acid accumulation ability and endurance quality. Relevant literature also shows that: in the process of intermittent anaerobic exercise, the earlier the maximum blood lactate value appears in the body, the faster the body's clearance rate of blood lactate, as the final results of the experiment show: the average clearance rate of blood lactate measured by the combination training had a greater advantage over the control group's clearance rate of blood lactate, which indicates that the experimental group's level of lactate clearance had been developed. Moreover, according to the relevant literature, it was known that the rate of blood lactate elimination had a greater correlation with the body's oxygen uptake, and the use of aerobic and anaerobic combination training had a more pronounced effect on the results. Field experts clearly indicate that there was a positive correlation between the level of recovery of lactic acid by the organism after exercise and its own level of aerobic metabolism.

The use of combination training method had improved the ability of lactic acid production inhibition and lactic acid elimination ability of the selected students, which indirectly indicates that the development of aerobic metabolism of the students

was also beneficial, so that the students could adhere to the exercise for a longer period of time under the same loading conditions as before, which demonstrates that the combination training method could be more effective in improving the speed endurance qualities of the students. In the control group, the final blood lactate index changes, the effect of improvement was not obvious (Cheng, 2018).

The use of combination training method had improved the ability of lactic acid production inhibition and lactic acid elimination ability of the selected students, which indirectly indicates that the development of aerobic metabolism of the students was also beneficial, so that the students could adhere to the exercise for a longer period of time under the same loading conditions as before, which demonstrates that the combination training method could be more effective in improving the speed endurance qualities of the students (Daniels, 2019). In the control group, the final blood lactate index changes, the effect of improvement was not obvious.

The combination training method was a more effective training method to enhance the trainee's ability to tolerate acid. The reason for this was that the combination training method was systematic in nature and could always stimulate the performance of the student's body functions, making the student's internal energy conversion system work efficiently, whereas the single training method, although also effective in improving the student's acid tolerance level in some cases, was not effective enough in promoting the energy conversion system, as well as not effective enough in improving the ability to rapidly break down the lactic acid that accumulates in the body (Evans, 2019).

After 4 weeks of training, the heart rate related indexes of the 2 groups were tested separately, and the test data were subjected to independent samples test, and the maximum heart rate and the heart rate 3 minutes after exercise decreased after the experiment, and the recovery rate increased after the experiment, but the effect was obvious Pre-test and Post-test. There was a significant difference in maximum heart rate Pre and Post-test ( $p < 0.05$ ). There was a highly significant difference in heart rate 3 minutes after exercise ( $p < 0.01$ ), and a highly significant difference in

recovery rate Pre-test and Post-test ( $p < 0.01$ ), indicating that the use of the combination training method could be more effective in improving the recovery level of the students' heart rate, improving the fatigue resilience of the organism, and improving the quality of the students' speed endurance.

After 4 weeks of training, the heart rate related indexes of the 2 groups were tested separately, and the test data were subjected to independent samples test, and the maximum heart rate and the heart rate 3 minutes after exercise decreased after the experiment, and the recovery rate increased after the experiment, but the effect was obvious before and after the test. There was a significant difference in maximum heart rate before and after testing ( $p < 0.05$ ). There was a highly significant difference in heart rate 3 minutes after exercise ( $p < 0.01$ ), and a highly significant difference in recovery rate before and after the test ( $p < 0.01$ ), indicating that the use of the combination training method could be more effective in improving the recovery level of the students' heart rate, improving the fatigue resilience of the organism, and improving the quality of the students' speed endurance.

The reason for the difference in the changes in heart rate indicators was that the combination training method was more effective in increasing the level of heart rate recovery of students and improving the body's fatigue recovery. The combination training method combines movements, training methods, aerobic training from general endurance, running, jumping and throwing as well as circuit training to stimulate the potential of the students, as well as to prepare the students psychologically and mentally. Aerobic training was carried through to the second stage of strength training and the third stage of the level of retention, from beginning to end to pay attention to the development of the student's would quality (Garcia, 2018). Speed endurance training consists of both aerobic and anaerobic training, heart rate was the basis for evaluating aerobic capacity, and the combination training method implements effective training methods on the one hand, and on the other hand, the combination training method reduces the factors affecting the effectiveness of training implementation, which helps the student's energy supply system to recover quickly after strong training. Maximum heart rate was the key to reflecting the level of students' physical function, Ding (2019)

shows that after a period of training, due to the heart's myocardial acetylcholine content would become more and more, choline acetyltransferase activity becomes higher, and changes in the level of integration of the body's central nervous system maybe caused by the reduction of the maximum heart rate. The heart rate and its rhythm were controlled by the vegetative nervous system (sympathetic and parasympathetic). The effect of parasympathetic nerves on the heart rate was to cause inhibitory effects such as slowing down of the heart rate and slowing down of conduction, while sympathetic nerves had an effect on the heart rate as an increase in the heart rate (Gu, 2018). Some studies had shown that regular exercise increases parasympathetic activity, down-regulates the adrenal glands and receptors of the renin-angiotensin-aldosterone system, and slows the heart rate during quiet times. The combination training method, based on the different conditions of the students to develop training programs, could make the training of the students more regular training, so that their parasympathetic activity, cardiovascular function of the adaptive enhancement of the reduction of the maximum heart rate after exercise, the rate of heart rate recovery increased. It shows that the use of combination training method could more effectively improve the students' heart rate recovery level, improve the body's fatigue recovery, and improve the students' speed endurance quality (Kim, 2021).

After 4 weeks of training, the upper limb anaerobic power and lower limb anaerobic power related indexes of the 2 groups were tested respectively, and the test data were subjected to independent test, and the maximum anaerobic power and the average anaerobic power of the 2 groups before and after the experiment were increased, and there was no significant change in the two groups before and after the experiment of upper limb anaerobic power, and the effect of the experimental group on the lower limb anaerobic power before and after the experiment was obvious compared with that of the control group. The maximum anaerobic power and average anaerobic power of the 2 groups before and after the experiment were significantly different ( $p < 0.05$ ). The results show that the combination training method could effectively improve students' anaerobic exercise capacity and enhance their speed endurance quality.

The reason for the difference in the change in anaerobic power was that the combination training method improves the level of phosphagen energy supply and the ability of the glycolytic system to supply energy, and improves the anaerobic exercise capacity of students. The combination training method uses multiple training units rationally, arranges different ratios of units of different natures, and organically combines movements and training methods to improve speed endurance. Combination training method of the second stage of strength training in the speed endurance improvement stage to make full preparation, applied in the speed endurance improvement stage had jumping class project and sprinting project, short distance interval method selected to develop the students speed endurance and lactate supply capacity of maximum lactate training, long time repetition training method focuses on the development of lactic acid energy metabolism system and aerobic metabolism system mixing energy supply capacity, these were all to improve the anaerobic The training of explosive power develops maximal power and the training of speed endurance develops average power. The combination of training methods on the one hand implements an effective training method and on the other hand reduces the factors affecting the effectiveness of the implementation of speed endurance training and effectively improves the anaerobic work capacity. First of all, the level of phosphagen supply was the basis for the high and low anaerobic power of the trainee, the higher the value, the stronger the anaerobic endurance (Powell, 2019). The level of muscle endurance was better maintained under the glycolytic system of energy supply. In today's competitions, both aerobic and anaerobic sports programs place a higher demand on anaerobic power in that final sprint phase. He (2021) verified that the students could effectively improve the blood lactate clearance rate and glycolysis energy supply level after low oxygen training, and the anaerobic power of the students was significantly improved, which also indirectly indicates that the use of combination training method could effectively improve the anaerobic energy supply level of the students. After 10 weeks of special combination training, the maximum anaerobic power of the track and field students increased significantly, and the average anaerobic power increased significantly, which indicated that the combination training method made the phosphagen energy supply capacity improved significantly, the anaerobic glycolysis system energy supply capacity improved significantly, and the muscle capacity of

sustained output of anaerobic power in a short period of time was enhanced, which indicated that the speed and endurance qualities of the track and field students increased, which was very favorable for the track and field students to maintain high-intensity running during the competition. This was very favorable for the students to maintain high-intensity running in the competition, which was the basis for achieving ideal results (Reilly, 2018).

### **5.1.2 The Analysis of Track and Field Performance**

The period of this experiment was ten weeks, which was a long period of time, so the natural improvement of the quality of each trained individual may be a reason for the improvement of the performance (Thomas, 2016). In the same training period, the physical quality of the trainees all improved, and the age of the trainees were all in their 20s, which was the period when all the physiological functions of the organism were developing and improving, and also the training was continuous, which was not the main reason for the improvement of the performance of a student.

If the traditional single training method was used, it means that it only focuses on the development of a single body energy supply system, so it would produce a large load on the body's single energy supply system, and the load on the other body energy supply system was relatively small, it was for this reason that the result of a single training was often to develop only a single supply system, and only by relying on a number of times of training would it develop more than one body energy supply system, which would produce a load stimulation, but it would not be produced continuously, so the connection and conversion between different energy supply systems would not be very strong, and the training effect was not satisfactory (Norris, 2018). However, it would not be produced continuously, and therefore the connection and conversion between different energy supply systems would not be very strong, and the training would not be as effective as it should be. Considering the student's body as a whole, the enhancement of its athletic level and competition performance requires the cooperation of all energy supply systems of the body, the single training method precisely trains only one of the body's energy supply

system, the training of the whole body was relatively weak, and cannot train the whole body effectively, the student's training level, the goal cannot meet the expectations of the student, the student's level of the level of intensity required for the competition level. The athletic level and the improvement of competition results would be very slow, students for training and competition enthusiasm would also be a big blow, in the long run, was not conducive to the long-term development of the students, this research compares the performance changes in the 4-week training, the combination of training method could improve the speed and endurance qualities of the track and field specialization of the students and special performance in a short period of time.

The use of combination training method refers to the trainee in each training content to take a variety of training methods combination of ways, the training process of body energy metabolism both for aerobic metabolism endurance training, but also for the anaerobic metabolism speed training, the student's body as a whole, to the theory of the mechanism of body energy metabolism theory as a theoretical basis for the special ability of the multilevel structure of the training goal, the various factors were integrated into the Each training content, reflecting the innovative idea of synchronous development of anaerobic metabolism and aerobic metabolism (Liu, 2017).

There were changes in the speed quality and endurance quality of the 2 groups of students before and after the experiment, firstly, the development of the trainees' general endurance and speed endurance was dominated, and secondly, the development of the trainees' lower limb strength and speed endurance was mainly dominated. In the combined speed and speed endurance training of both groups of students, the stimulation of the ATP-CP energy supply system of the organism may be greater during each training session, but in terms of the whole training, the content of a single quality for a long period of time was detrimental to the mobilization of students (Ivanov, 2020). The development of speed quality must be stable when the physical development, strength development and movement technology development of far mobilization were coordinated. Combination training method would be the

same content of the speed training class was divided into multiple training time periods, and these time periods were grouped into each training session, and the total time of training was the same as the total time of training using a single training method to be the same, although the 2 groups of conditions were the same, were the quality of the speed of the development of the quality of the main qualities, but the combination of training method in the training of the peak time and the time of the test there was a corresponding combination of the quality of the student speed continued to develop. The final results showed some improvement in the quality of speed, some improvement in the quality of endurance, and a little improvement in the quality of strength in both groups, mainly in the strength of the lower limbs. In summary, the results of the 2 groups before and after the experiment in terms of physiological indicators and training indicators show that the combination training method could significantly improve the level of speed endurance of the track and field special selection students (Jones, 2020).

In the results of the track and field special test, it could be seen that the experimental group using a combination of training methods to improve the performance of the 800-meter project was the most obvious. 800 meters belongs to the middle-distance running program, but also the speed and endurance quality of the dominant projects. For improving the speed endurance level of middle-distance runners, the main means of training was the application of short-time high-intensity training methods, common training means was the basic training of variable-speed running, the characteristics of its variable-speed running based on the characteristics of the track and field competition to develop the distance, speed, interval and the number of groups of changes to realize the multi-group, high-speed, effective training, to be able to improve students' speed endurance on the basis of the development of the students at the same time. technical movement proprioception. The change in speed of middle-distance runners was characterized by the dependence on the body's neuromuscular system to effectively complete regular technical movements in the shortest time and with the greatest capacity. The use of combined training programs in preparation for competitions was more conducive to improving the level of muscular speed endurance of students than single training programs (Frank, 2018). The

characteristics of 800 meters in track and field sports require endurance qualities based on speed endurance, and the form of energy supply was analyzed from the exercise time to anaerobic energy supply. The specialized performance of both groups of students was improved. The basis of the trainees' performance improvement was the comprehensive quality of aerobic and anaerobic endurance, while the improvement of speed endurance was based on the development of a scientific and reasonable training program, and the scientific and reasonable combination of training methods to improve the performance of the track and field specialization students (Dean, 2020).

## 5.2 Discussion

The use of combination training method effectively improves the average blood lactate clearance rate of students (Gu, 2018). Combination training method was a training method to improve speed endurance by rationalizing the use of multiple training units and arranging different ratios of units of different natures. It was implemented in three stages: general endurance, speed endurance improvement, and maintenance, in which the short-distance interval method was selected to develop students' speed endurance and lactic acid supply capacity of maximal lactic acid training, and the long- distance repetition training method focuses on the development of lactate energy metabolism system and aerobic metabolism system mixed energy supply capacity (Huo, 2019). The combined training method implements an effective training method on the one hand, and reduces the factors affecting the implementation of speed endurance training on the other hand, to achieve the effect of improving the blood lactate clearance rate, so that the student's body would not easily produce fatigue.

The use of combination training method could effectively make the heart rate recovery faster, combination training method of action, training methods organic combination, from the general endurance for aerobic training, running, jumping and throwing as well as cycle training to stimulate the student's potential (Frank, 2018). At the same time, the students were prepared for the psychological and

ideological preparation. Aerobic training was carried through to the second stage of strength training and the third stage of the level of retention, from beginning to end to pay attention to the development of students' willpower. Speed endurance training consists of both aerobic and anaerobic training, and heart rate was the basis for evaluating aerobic capacity (Foster, 2021). The combination training method implements effective training methods on the one hand, and reduces the factors affecting the implementation of speed endurance training on the other hand, which helps the student's energy supply system to recover quickly after strong training.

Training using the combination training method could also effectively improve anaerobic work capacity, anaerobic work comes from anaerobic metabolic capacity (Häkkinen et al., 2016). The second stage of the combination training method of power training in the speed endurance improvement stage to make adequate preparation, applied in the speed endurance improvement stage had jumping class project and sprinting project, short distance interval method selected to develop students speed endurance and lactate energy supply capacity of the maximum lactate training, long time repetitive training method focuses on the development of lactate energy metabolism system and aerobic metabolism system mixed energy supply capacity, these were all to improve the anaerobic. The training of explosive power develops maximal power and the training of speed endurance develops average power. The combination of training methods was effective in improving anaerobic work capacity by implementing effective training methods while reducing the factors that affect the implementation of speed and endurance training (Evans, 2017).

After experimental research, it could be known that the combination training method was a fast, scientific and effective training method to improve speed endurance. Combination training method would be more than one training unit reasonable use, would be different nature unit arrangement. Different ratios, from the three stages of the implementation of effective training methods, while reducing the factors affecting the implementation of the effect of speed endurance training, better enhance the average blood lactate clearance rate, heart rate recovery faster, improve the anaerobic work capacity, better improve the level of speed endurance.

## **5.3 Recommendations**

### **5.3.1 Recommendation for Implementation**

Teachers in the combination of training method applied to improve the quality of student's speed endurance training process, must be a combination of training method of the advantages of the characteristics of a more comprehensive embodiment, always pay attention to a variety of reasonable combination of training methods.

In the development of a combination of training programs, training plans to reflect the comprehensive consideration of the characteristics of the project itself, the project oxygen supply mode, training intensity and load, the combination of training method had not yet been verified for all track and field events, the corresponding training program should be more consideration of the actual operation.

During the implementation of the program of combined training, due to the characteristics of some projects themselves, there may be a large amount of training, which must pay attention to the allocation of sufficient interval time, reasonable adjustment of training breaks, to prevent students at anytime the emergence of injuries and illnesses.

### **5.3.2 Recommendation for Future Research**

This research took the use of combination training method to improve the speed endurance quality of track and field specialization students of physical education as an innovative starting point, focusing on exploring a set of scientific, reasonable, effective and new training methods for the speed endurance quality of track and field specialization students of physical education. Combination of training program design, special combinations and many other considerations were still insufficient, coupled with the number of participants in the test was limited, geographically limited, age was limited, so the data had certain limitations, I hope to

be able to make a contribution to similar studies in the future, learn from each other, learn from each other, and make progress together.



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**APPENDIX A**  
**LETTER OF APPROVAL**

## Certificate of Approval

### Hengyang Normal University Administration Department

Subject: Approval of data collection for M.Ed. Thesis

Dear Sir/Madam,

I am currently enrolled in the master in Curriculum and Instruction at Rangsit University, Thailand. I am conducting research on " The Application of combination Training Method on The Speed Endurance Level in Physical Education for Freshmen Students in China". This research requires students' participation. The instruments involved during the study pretest and protest for obtaining the required data. Therefore, I would like to seek permission from the administration to allow me to collect data at this school where the names and identities of the students will be kept confidential and undisclosed.

Yours Sincerely, LeYao Zhang, Student  
Rangsit University Thailand

Since the study requires data for analysis purposes, LeYao Zhang would collecting data from this school and you are kindly requested so allow he to collect data with the following conditions:

Providing research participants with information to make an informed decision as to whether to take part in research (informed consent).

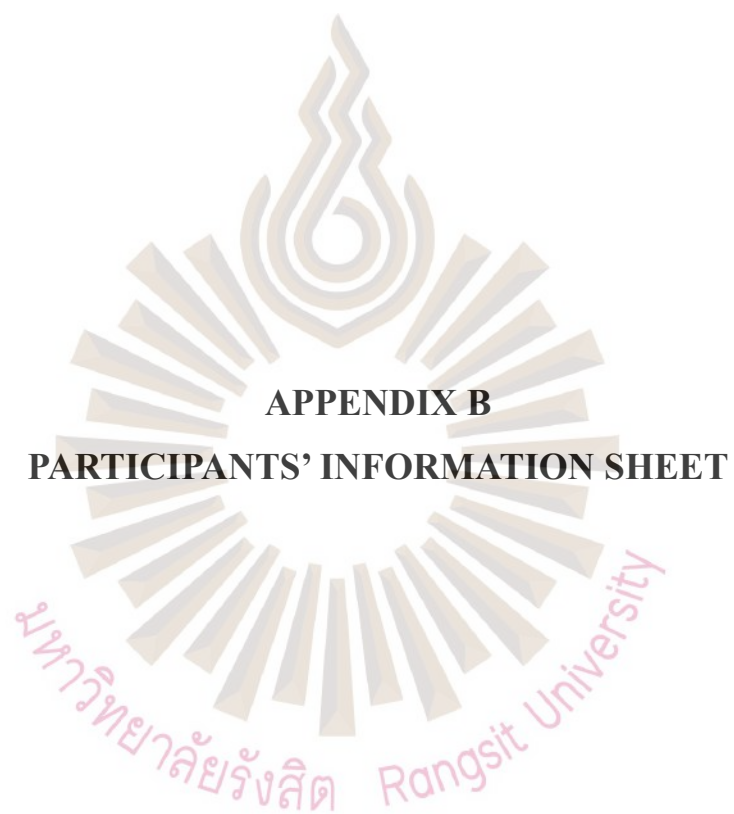
Follow the prior mentioned document have been reviewed and approved by the administration of Hengyang Normal University.

Signature:

Date:2024.6.1

Hengyang Normal University





**APPENDIX B**  
**PARTICIPANTS' INFORMATION SHEET**

### Participant's Legal Guardian Information Sheet

Dear Participant:

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully. Talk to others about the study if you wish.

Research School: Hengyang Normal University

Name: LeYao Zhang      Student ID:6509863

Studying University: Suryadhep Teachers College of Rangsit University, Thailand

Research Title:

The Application of combination Training Method on The Speed Endurance Level in Physical Education for Freshmen Students in China

Signature:

Date:2024.6.1


Hengyang Normal University



The research period will be four weeks in length, including 8 sessions.

There is no possible risk in her research

The school has asked students who have volunteered to participate to inform their parents and have obtained consent to volunteer for the research, and the data from the study are true and valid. The school also allow students to assist her with her thesis research, either voluntarily or by voluntary experiments, by agreeing to (Wenzhi Pu), who is enrolled at Rangsit University in Thailand to research her thesis.

Signature: 

Date: 

Heze Luxi New District Chenxi School, Administration



มหาวิทยาลัยรังสิต Rangsit University



**APPENDIX C**  
**SATISFACTION QUESTIONNAIRE**

## Satisfaction Questionnaire

Dear students.

Hello, in order to make the teaching to a better direction, the need for students to study the situation of the survey, designed this questionnaire, the purpose is to improve teaching methods, improve the quality of learning. The questionnaire adopts anonymous way, will not affect you, please feel free to fill in please combined with their own actual situation in the corresponding options hit "√", thankyou for your cooperation, thankyou for your support and understanding!

**5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree**

NO.	ITEMS					
		5	4	3	2	1
1.	I liked the learning process of the combination training method.					
2.	I was interested in the results of the combination training method.					
3.	The combination training method improved my physical fitness.					
4.	I took the initiative to ask questions during the learning process of the combination training method.					
5.	I consulted information and research problems in the process of learning the combination training method.					
6.	I asked my teacher for guidance in solving problems in the process of learning the combination training method.					
7.	I would take the initiative to research after class to solve the unsolved problems in class.					
8.	I could use what I had learned to solve problems in the process of learning the combination training method.					
9.	I could find my own mistakes and try to solve them in the process of learning the combination training method.					
10.	I could take the initiative to make plans in the process of learning the combination training method.					

NO.	ITEMS					
		5	4	3	2	1
11.	I could reflect on the learning process in the combination training method learning process, and summarize the learning experience.					
12.	I was very willing to share the joy of harvesting with my classmates in the learning process of the combination training method.					
13.	In the group discussion, I was serious and actively participate in the discussion to increase the spirit of cooperation among classmates.					
14.	In group discussions, I normally actively communicated with my classmates.					
15.	I liked to communicate with my classmates in the research of combination training method.					
16.	I normally shared my views on the combination training method with my teachers and classmates.					
17.	I would do my best to win in the group competition of the combination training method.					
18.	The combination training method helped me to develop my own training level.					
19.	After the training of the combination training method, my physical fitness was improved.					
20.	My physical fitness was improved through the combination training method.					
21.	My training endurance was improved through the combination training method.					
22.	My running speed was improved through the combination training method.					
23.	My heart rate level was increased as a result of the combination training method.					
24.	My ability to study endurance was improved as a result of the combination training method.					
25.	My ability to study speed was improved through a combination of training methods.					
26.	After training with the Combined Training Method, my study of endurance was improved.					

NO.	ITEMS					
		5	4	3	2	1
27.	My ability to study speed was improved as a result of the combination training method.					
An Open-ended Question						
Please give additional comments and suggestions						





**Basic Information for Experts**

<b>NO.</b>	<b>Name</b>	<b>Position/Title</b>	<b>Institutes</b>
<b>1</b>			
<b>2</b>			
<b>3</b>			



The logo of Rangsit University is a circular emblem. At the top is a stylized flame or sunburst. Below it is a central circle containing a Thai character. The bottom half of the emblem consists of a semi-circle of radiating lines. The text 'มหาวิทยาลัยรังสิต Rangsit University' is written in a semi-circle at the bottom of the emblem.

**APPENDIX E**  
**IOC OF TRAINING PLAN**

มหาวิทยาลัยรังสิต Rangsit University

Items	Expert 1	Expert 2	Expert 3	Average	Congruence
100m					
800m					
1500m					
Triple jump					
Javelin					
Shot-put					



### Basic Part of The Training Plan

The goal of the 4-week training is a significant increase in the speed endurance level of the experimental and control group, which is carried out in 3 phases.

Categories	Time	Arm setting	Training content	Scientific basis of training
Phase 1	1 week	Improve general endurance	<ul style="list-style-type: none"> <li>1 Timed runs</li> <li>1 Quantitative Running</li> <li>1 Cross- country running</li> <li>1 Ball activities</li> </ul>	<p>According to the theoretical basis of speed endurance, the pre-training phase requires the development of general endurance and aerobic training. The students' psychological factors and willpower are the factors affecting the implementation of speed endurance training. The combination training method adjusts the content and intensity of the training so that the students' psychological state is good and they slowly adapt to the beginning of the training, while the stage-by-stage goals subconsciously develop their willpower.</p>

Categories	Time	Arm setting	Training content	Scientific basis of training
Phase 2	1 week	Increased speed and endurance	<p>1 Aerobic training as a supplement</p> <p>1 Strength Training</p> <p>1 Strength Training:</p> <p>1 Maximum Strength</p> <p>1 Strength Endurance</p>	<p>The aim is to train the lower limb explosive force and absolute speed, the development of speed endurance needs to pay attention to absolute speed and upper and lower limb coordination. Running, jumping and throwing power for cycle combination action organic combination, at the sametime in line with the student's psychology and the same amount of training when the sense of purpose one by one rapid implementation of the training is more state of the</p>
			1 Coordination	<p>art good vitality. Cycle training method, through the exercise, the potential can be stimulated. Maximum strength training applies to all phases of the training period.</p>

Categories	Time	Arm setting	Training content	Scientific basis of training
	1 week		<p>1 Strength training as a supplement</p> <p>1 Speed endurance is the main focus</p> <p>1 Speed Endurance:</p> <p>1 Slow Interval Training</p> <p>1 Fast Interval Training</p> <p>1 Long repetitions</p>	<p>The movements are organically combined and the training methods are organically combined. The long repetition method focuses on the development of the athlete's lactate energy metabolic system and the aerobic metabolic system mixed energy supply capacity. The main function of the short distance interval method is to develop the athlete's speed and speed endurance. Medium-distance intervals focus on the development of the athlete's mixed-oxygen metabolism. Circuit training, through which the potential of the athlete is stimulated and the quality of will is developed. Maximum strength training is used in all phases of training. Repetitions are used in the recovery phase and intervals in the pre-competition phase.</p>

<b>Categories</b>	<b>Time</b>	<b>Arm setting</b>	<b>Training content</b>	<b>Scientific basis of training</b>
Phase 3	1 week	Holding the level	1 General Endurance 1 Speed Endurance	Cross-country running can be structured as a fun aerobic workout, with mid-distance intervals to develop mixed-metabolic capacity.





**APPENDIX G**  
**TRAINING CONTENT**

### Content Of Training in The Experimental and Control Groups in the 3 Phases

Categories	Time	Experimental Groups	Control Groups
Phase 1	1 week	<p>Session 1</p> <p>Timed run 5mins-Badminton in-situ highball 5mins-Running 1000m at regular intervals 10mins</p> <p>Running 1500m-Badminton in-situ highball 5mins-Running 5mins-Interval 10mins</p> <p>Running 500m-badminton small range of motion overhead 5mins-running 5mins on a timer</p> <p>Session 2</p> <p>Cross Country Running 5mins-Shuttlecock 5mins- Cross Country Running 10mins-Interval 15mins Cross-country running 10mins-Shuttlecock 10mins- Cross-country running 5mins</p> <p>Session 3</p> <p>Timed run 5mins-Badminton in-situ highball 5mins-Interval 10mins</p> <p>Timed run 1000m-Shuttlecock 5mins-Interval 10mins</p> <p>Cross-country running 10mins-Badminton small movement highball 5mins</p>	<p>Session 1</p> <p>Running 15mins interval 8mins</p> <p>Running 15mins interval 6mins</p> <p>Badminton 10mins interval 6mins in place</p> <p>Badminton small range shuttlecock for 5mins.</p> <p>Session 2</p> <p>Cross Country Running 25mins-10mins interval Cross country running 15mins-5mins interval- shuttlecock 15mins</p> <p>Session 3</p> <p>Distance running 1.5km with 8 minutes interval</p> <p>Running 1km with a 6mins interval</p> <p>Badminton 10mins intervals of 10mins intervals of 6mins-highballs in place</p> <p>Badminton small range shuttlecock 5mins interval</p>

Categories	Time	Experimental Groups	Control Groups
Phase 2	1 week	<p>Session 1</p> <p>Badminton highball, push ball</p> <p>Circuit practice, 1min 1 exchange, 1min position and interval;</p> <p>2-3 groups, 8-10 minutes interval between groups</p> <p>15m/group of high leg run- 30m frog jump-15 hip wraps/group</p>	<p>Session 1</p> <p>Badminton highball, push ball</p> <p>Sequential exercises, each item 2-3 groups, 1 min rest between groups, 3-5 minutes rest between items Hip Circle 15/group-forward alternating</p>
		<p>50m backpedal run-lunge jumps 30/set-bench press 75% 1RM8-12/set</p> <p>50m stride run-30m single leg exchange jumps-30m single leg exchange jumps</p>	<p>arrow squat 10/group-deep squat up 70% 1RM5-9/group-30m frog jump-lunge jump 30/group-one-legged exchange jump 30m</p>
		<p>Session 2</p> <p>Badminton highball, point kill</p> <p>Circular exercise, 1 min 1 exchange, 1 minute position and interval</p> <p>2-3 groups, 8-10 mins rest between groups</p> <p>15m high leg run/group-30m frog jump-30 elastic ball sit-ups/group</p> <p>50m backpedal run-lunge jumps 30/set-deep squats 70% 1RM 5-9/set</p> <p>50m stride run-single leg exchange jump 30m-weighted vest 5kg heel raises 15/set</p>	<p>Session 2</p> <p>Badminton highball, point kill</p> <p>According to the order of exercises, each item 2-3 groups, 1 min rest between groups, 3-5mins rest between items bench press 75% 1RM8-12 / group-elastic ball sit-ups 30 / group-weighted vest 5kg heel lift 15 / group-high leg run 15m / group-50m backpedal run-50m stride run</p>

Categories	Time	Experimental Groups	Control Groups
	1 week	Session 1: strength training, slow intervals Session 2: strength training, fast intervals Session 3: strength training, repetitions Session 4: Slow Intervals, Fast Intervals Session 5: Slow Intervals, Repetitions Session 6: fast intervals, repetitions	Session 1 : repetition training Session 2: interval training Session 3: Increase strength training
Phase 3	1 week	Cross country 10 mins with 8 mins intervals, middle distance intervals 600* (2-3) reps*(1-2) sets	Timed run 10 mins, intervals 8 mins, middle distance intervals 600*(2-3) reps*(1- 2) sets



**APPENDIX H**

**TRAINING DETAILS DATA RECORD TABLES**

**Blood Lactate Test Data**

<b>Name</b>	<b>Pre-test blood lactate</b>	<b>Post-test blood lactate</b>
NO.1		
NO.2		
NO.3		
NO.4		
NO.5		
NO.6		
NO.7		
NO.8		
NO.9		
NO.10		
NO.11		
NO.12		
NO.13		
NO.14		
NO.15		
NO.16		
NO.17		
NO.18		
NO.19		
NO.20		
NO.21		
NO.22		
NO.23		
NO.24		
NO.25		
NO.26		
NO.27		
NO.28		

Name	Pre-test blood lactate	Post-test blood lactate
NO.29		
NO.30		



**Heart Rate Indicator Test Data**

<b>Name</b>	<b>Pre-test heart rate</b>	<b>Post-test heart rate</b>
<b>NO.1</b>		
<b>NO.2</b>		
<b>NO.3</b>		
<b>NO.4</b>		
<b>NO.5</b>		
<b>NO.6</b>		
<b>NO.7</b>		
<b>NO.8</b>		
<b>NO.9</b>		
<b>NO.10</b>		
<b>NO.11</b>		
<b>NO.12</b>		
<b>NO.13</b>		
<b>NO.14</b>		
<b>NO.15</b>		
<b>NO.16</b>		
<b>NO.17</b>		
<b>NO.18</b>		
<b>NO.19</b>		
<b>NO.20</b>		
<b>NO.21</b>		
<b>NO.22</b>		
<b>NO.23</b>		
<b>NO.24</b>		
<b>NO.25</b>		
<b>NO.26</b>		
<b>NO.27</b>		
<b>NO.28</b>		

Name	Pre-test heart rate	Post-test heart rate
NO.29		
NO.30		



### Lower Extremity Anaerobic Power Index Test Data

Name	Pre-test lower extremity anaerobic power index	Post-test lower extremity anaerobic power index
NO.1		
NO.2		
NO.3		
NO.4		
NO.5		
NO.6		
NO.7		
NO.8		
NO.9		
NO.10		
NO.11		
NO.12		
NO.13		
NO.14		
NO.15		
NO.16		
NO.17		
NO.18		
NO.19		
NO.20		
NO.21		
NO.22		
NO.23		
NO.24		
NO.25		
NO.26		
NO.27		

Name	Pre-test lower extremity anaerobic power index	Post-test lower extremity anaerobic power index
NO.28		
NO.29		
NO.30		



### Upper extremity anaerobic power index test data

Name	Pre-test upper extremity anaerobic power index	Post-test upper extremity anaerobic power index
NO.1		
NO.2		
NO.3		
NO.4		
NO.5		
NO.6		
NO.7		
NO.8		
NO.9		
NO.10		
NO.11		
NO.12		
NO.13		
NO.14		
NO.15		
NO.16		
NO.17		
NO.18		
NO.19		
NO.20		
NO.21		
NO.22		
NO.23		
NO.24		
NO.25		
NO.26		

<b>Name</b>	<b>Pre-test upper extremity anaerobic power index</b>	<b>Post-test upper extremity anaerobic power index</b>
<b>NO.27</b>		
<b>NO.28</b>		
<b>NO.29</b>		
<b>NO.30</b>		



### Pre-test athletics specialized test data

Name	100m	800m	1500m	Triple jump	Javelin	Shot-put
NO.1						
NO.2						
NO.3						
NO.4						
NO.5						
NO.6						
NO.7						
NO.8						
NO.9						
NO.10						
NO.11						
NO.12						
NO.13						
NO.14						
NO.15						
NO.16						
NO.17						
NO.18						
NO.19						
NO.20						
NO.21						
NO.22						
NO.23						
NO.24						
NO.25						
NO.26						
NO.27						
NO.28						

Name	100m	800m	1500m	Triple jump	Javelin	Shot-put
NO.29						
NO.30						



### Post-test athletics specialized test data

Name	100m	800m	1500m	Triple jump	Javelin	Shot-put
NO.1						
NO.2						
NO.3						
NO.4						
NO.5						
NO.6						
NO.7						
NO.8						
NO.9						
NO.10						
NO.11						
NO.12						
NO.13						
NO.14						
NO.15						
NO.16						
NO.17						
NO.18						
NO.19						
NO.20						
NO.21						
NO.22						
NO.23						
NO.24						
NO.25						
NO.26						
NO.27						
NO.28						

Name	100m	800m	1500m	Triple jump	Javelin	Shot-put
NO.29						
NO.30						



## BIOGRAPHY

Name	Leyao Zhang
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