

# Modeling and Analysis of Students' Sports Training Efficiency Based on Supervised Learning and Nonparametric Random Forest Model

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## **Abstract:**

With the steady development of China's education, education is gradually developing to the concept of quality education. Compared with other models, nonparametric random forest method is often better than the benchmark logical model and SVC model. Therefore, nonparametric random forest method is often used in data analysis. This makes the form of physical education has also changed a lot. In order to effectively improve the quality and efficiency of sports training in physical education classroom, and enhance the enthusiasm and initiative of students to participate in sports training, this paper studies the modeling analysis of students' sports training efficiency based on supervised learning. This paper makes a comprehensive analysis of the importance of sports training in the current physical education classroom and formulates reasonable teaching strategies Sports training is highly professional and has high requirements for training methods. This paper focuses on how to choose the appropriate training strategy to optimize the sports training plan and help athletes achieve training objectives. This paper also analyzes how to improve the effect of sports training, in order to provide some reference for the construction and development of students' sports classroom.

**Keywords:** *Nonparametric random forest model, sports teaching, sports training quality, training efficiency, participation.*

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## I. INTRODUCTION

Sports training is a special and scientific learning and training process. Under the patient guidance of the coach, the athletes should be guided by skills, physical training and tactical

training, so as to improve the comprehensive level of athletes, achieve the sports goals and complete the sports training tasks. In terms of sports training activities, it is necessary to use the method of physical practice to ensure the realization of training purpose. From the overall analysis, sports training focuses on practical training, and organizes the sports training practice as the main content, but it can not ignore the point of theoretical education. Only focusing on training practice and ignoring theoretical guidance will significantly reduce the professionalism and comprehensiveness of sports training. In view of this situation, in the sports training activities, we need to combine theory and practice education, integrate physical training and psychological training, and take the whole sports training process as a unified and coordinated whole in all aspects, and promote the overall improvement of water level in sports training activities.

Sports training is a professional and complex practice activity. It is necessary to carry out targeted sports training for athletes, which is an essential condition to improve their comprehensive sports level and make them play smoothly and even abnormally in competitions and daily exercises. Athletes have a large amount of sports, which requires higher requirements for each part of the body, and also requires coordination and coordination of each body part. Corresponding training items should be arranged at different stages. Each athlete should not only receive special sports training, but also strengthen the protection of his own physical condition to avoid injury in training and competition. But the overall task of sports training is more heavy, and the situation of athletes injury is more common. In order to reduce the physical injury to athletes, we should improve the efficiency of sports training as much as possible, that is to say, in the training process, we should emphasize the quality and efficiency of sports training, and strive to spend the least physical strength to achieve the training goal in the shortest time. Only in this way can they bring greater benefits to the athletes. From this level, it is an important way to improve the efficiency of sports training, so we need to actively explore the reasonable and effective training principles and methods to achieve the goal of efficiency improvement.

## **II. THE PRINCIPLE OF IMPROVING THE EFFICIENCY OF SPORTS TRAINING**

It is a complex work to improve the efficiency of sports training. Whether it is to make training plan or choose appropriate training methods, we must follow certain principles in order to ensure the scientific and orderly promotion of sports training. First, the principle of organic integration of basic training and professional training. The differences between basic training and professional training are mainly reflected in the different levels of requirements, specifications and target range. In order to improve the professional sports skills of athletes fundamentally, we need to combine these two training, unify them in the comprehensive

training system, lay a solid foundation for the development of professional training activities of athletes through effective basic training, and standardize the basic training through professional training, so as to improve the professional ability of athletes; Second, the principle of comprehensive training. The meaning of comprehensive training is to ensure the comprehensive improvement of athletes' quality in all aspects. Special attention should be paid to the integrity of human body in sports training, and it cannot be limited to the training of a certain part. Only by comprehensive training can the athletes' functions be comprehensively improved. In addition, sports training itself will promote the overall development of athletes as the goal and direction of efforts, so in the comprehensive training, we should constantly strengthen the weak project training, to achieve both strength and weakness; Third, the principle of health training.

The primary purpose of sports training is to improve the health index. Therefore, the whole training activities must be carried out on the basis and premise of ensuring the physical health of athletes. Besides, we should pay special attention to the importance of Ideological Education in physical exercise. While paying attention to the development of potential, we should not blindly pursue the limit mining, but control the training in the acceptable range of athletes and maintain the physical and mental health of athletes; Fourth, the principle of targeted training. The principle requires that the physical fitness and the quality of the trainees should be considered in the physical training, and the students should be taught according to their aptitude so as to obtain the rational sports effect. In addition, only to ensure the targeted training, can we make up for the weak links of trainees and comprehensively improve their physical quality.

### **III. ANALYSIS OF STUDENTS' SPORTS TRAINING EFFICIENCY BASED ON SUPERVISED LEARNING**

#### **3.1 Application of Physical Training Load Analysis System**

In this system, we choose three-layer BP neural network structure. The input layer selected urea nitrogen (BUN), myosin kinase (CK), lactate dehydrogenase (LDB), hemoglobin (HGB), red cell count (RBC), hematocrit (HCT) and mean red cell hemoglobin content (MCH). Average red blood cell hemoglobin concentration (MCHC), white blood cells (WBC), transaminase (ALT), calcium (Ca), sodium (Na) and potassium (K) are 13 indexes, and athletes' height, weight, age, sex and training years are 18, so the number of neurons in the input layer is 18. The output layer is the athlete's state, and the value is taken in the real number interval  $[-1,1]$ . Finally, according to this value, the athlete's state is classified into three categories: good, qualified and unqualified. Therefore, the number of neurons in the output layer is 1. There are 10 neurons in the middle layer. In this algorithm, the input vector is 18-dimensional vector, while the output vector is 1-dimensional vector.

The sample data were collected from the blood test data of the National Fencing Team during the four years of winter training from 2002 to 2005. A total of 2 016 samples were divided into six groups. The first five groups of 2000 as training samples, each group of 400 data, the sixth group of 16 as test samples. First, we use training samples to train the neural network, the network learning efficiency parameter is 0.85, the error parameter is 0.15. Then, the iterations needed to train the neural network before and after using CDPA are compared. The test results are shown in Table 1.

**TABLE I. Test result**

<b>COMPARE</b>	<b>GR OUP 1</b>	<b>GR OUP 2</b>	<b>GR OUP 3</b>	<b>GR OUP 4</b>	<b>GR OUP 5</b>
The number of iterations trained using unprocessed data	721	805	740	669	784
The number of iterations trained using CDPA preprocessed data	609	671	653	665	673
The remaining data after CDPA pretreatment (original 400)	386	363	380	392	338

The experimental results show that: this algorithm can significantly reduce the number of iterations of BP network training in the same situation, and the more noise data group, the greater the degree of reduction of iterations, which proves that our proposed CDPA algorithm can better improve the learning efficiency and convergence speed of BP network learning algorithm.

Finally, we use 16 test samples to test the effect of the trained neural network, and the test results are shown in Figure 1. The average error of the network is 0.14543.

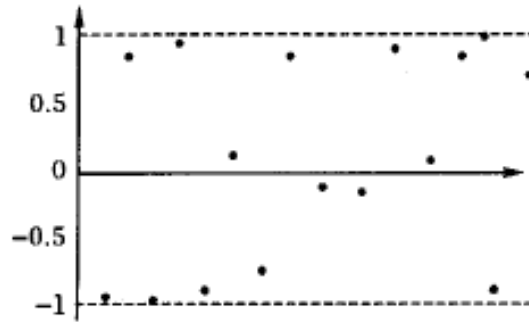


Fig 1: Test results of test samples

### 3.2 The influence of different cardiopulmonary exercise capacity on the endurance of teenagers

In this part of the study, taking the amount of exercise and gender as independent variables, and the baseline value of CRF related indicators as covariates, the pre analysis of covariance analysis was carried out to meet the conditions of covariance analysis, and then the formal analysis was carried out. The results show that there is no interaction between different exercise amount and gender. Therefore, this part of the study combines the test results of boys and girls for analysis.

Table 2 shows the changes of CRF related indicators in each group before and after 12 weeks of intervention. The results showed that compared with before intervention, VO<sub>2</sub>peak, exercise duration, peak oxygen pulse and relative value of peak oxygen pulse in group L and group H increased significantly after intervention ( $P < 0.01$ ). In the control group, after 12 weeks, VO<sub>2</sub>peak had no significant change, but the exercise duration ( $P < 0.01$ ) and the relative value of peak oxygen pulse ( $P < 0.05$ ) were significantly increased compared with those before 12 weeks, with statistical significance.

**TABLE II. Changes of indexes related to cardiopulmonary endurance in each group before and after intervention**

VARIABLE	GROUP L (N = 20)		GROUP H (N = 23)		GROUP C (N = 24)	
	Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention

VO <sub>2</sub> peak (ml/kg/min)	32.49±7.24	38.75±7.68	31.33±5.56	37.37±6.98	35.01±8.32	36.19±8.79
Exercise duration (s)	547.0±96.92	630.40±103.21	523.70±115.88	649.78±126.76	490.5±93.14	544.0±88.68
Peak oxygen pulse (ml / time)	9.66±2.32	11.36±2.17	9.70±2.09	11.49±2.56	10.15±2.34	10.62±2.88
Relative value of peak oxygen pulse (ml / time)	0.18±0.04	0.22±0.04	0.18±0.03	0.21±0.03	0.20±0.05	0.21±0.04

Comparison of changes in body composition before and after intervention with different amount of exercise

Table 3 and table 4 show the changes of body composition related indexes of male and female students before and after the intervention of different amount of exercise for 12 weeks. The results showed that compared with before intervention, BMI of boys in group L and group H decreased significantly ( $P < 0.01$ ,  $P < 0.05$ ), BF% of the two groups decreased significantly, lean body weight increased significantly ( $P < 0.01$ ), waist circumference of the two exercise groups had no significant change. Compared with 12 weeks ago, BMI and BF% of group C were significantly decreased, and lean body weight was significantly increased ( $P < 0.05$ ). Female students: compared with before intervention, BMI of group L and group H were significantly decreased, with statistical differences ( $P < 0.01$ ,  $P < 0.05$ ). BF% of group H was significantly decreased ( $P < 0.01$ ), and lean weight was significantly increased ( $P < 0.05$ ). However, there was no significant change in BF% and lean body weight in group L, and there was no significant change in waist circumference in group L and group h. in group C, waist circumference increased significantly before and after 12 weeks, but BMI, BF% and lean body weight did not change significantly.

**TABLE III. Comparison of intra group changes in body composition of boys before and after intervention**

VARIA BLE	GROUP L (N = 11)		GROUP H (N = 12)		GROUP C (N = 11)	
	Before interventi on	After interventi on	Before interventio n	After interventi on	Before interventi on	After interventi on
BMI ( kg/m <sup>2</sup> )	19.83 ±2.47	19.04 ±2.33	22.43± 3.27	21.93 ±2.91	19.75 ±2.87	19.34 ±2.56
BF%	18.24 ±7.82	14.54 ±7.03	22.94± 10.45	19.68 ±9.52	17.37 ±7.58	14.60 ±8.60
Lean body weight (kg)	42.45 ±6.83	43.52 ±6.94	44.99± 7.01	47.12 ±7.59	44.42 ±3.72	45.74 ±4.74
Waist circumferen ce (cm)	66.79 ±8.21	66.70 ±6.96	75.80± 10.57	76.09 ±9.04	69.26 ±6.79	70.41 ±7.14

**TABLE IV. Comparison of changes in body composition of female students before and after intervention**

VARIA BLE	GROUP L (N = 9)		GROUP H (N = 11)		GROUP C (N = 13)	
	Before interventi on	After interventi on	Before interventi on	After interventi on	Before interventi on	After interventi on
BMI ( kg/m <sup>2</sup> )	20.54 ±2.53	20.05 ±2.75	20.47 ±3.05	20.01 ±3.14	19.51 ±3.65	19.31 ±3.54
BF%	26.92 ±5.17	25.97 ±5.18	27.63 ±7.59	24.90 ±6.80	24.04 ±6.89	24.68 ±7.42
Lean body weight (kg)	40.43 ±5.72	40.30 ±4.46	37.28 ±3.45	38.22 ±3.66	37.34 ±5.11	36.86 ±5.11
Waist circumferen ce (cm)	68.43 ±5.63	67.83 ±6.37	67.72 ±8.25	67.94 ±8.36	64.70 ±8.09	66.25 ±7.93

#### IV. DISCUSSION

### (1) Effective cultivation of sports spirit

There is no doubt that sports training is a very difficult process, the whole process requires the long-term persistence of athletes, and to go through this process smoothly, there must be spiritual support. Sports spirit is a comprehensive concept, covering sports belief, sentiment and many other elements, specifically reflected in the indomitable struggle, fear of failure, hard struggle and other sports features and style, and sports spirit is gradually cultivated and strengthened in the daily sports training, which has a positive role in promoting the efficiency of sports training. One of the basis and guarantee of sports training is to cultivate athletes' sports spirit, so that they can realize the importance and necessity of receiving special training in mind, especially change their ideas, so as to strengthen their will and quality and cultivate the spirit of hard work by establishing a good sports spirit, Have more positive performance in sports. Coaches need to pay special attention to the cultivation and exercise of sports spirit in daily training. At the same time, they should take the guidance of theoretical knowledge as an important opportunity for the infiltration of sports spirit, so that coaches can accurately understand and grasp sports spirit, and establish a stable cognition of sports spirit in the heart.

### (2) Strengthen psychological training

If athletes want to play better in the competition and daily training, they must have good psychological quality, and the advantages and disadvantages of psychological quality will be reflected in all links before the competition and in the process of the competition, as well as in all movements, which will naturally have different degrees of impact on the competition results and sports effect. In sports training, coaches should not only pay attention to physical fitness, tactics, skills and other aspects of training, but also pay more attention to psychological quality. They should realize that the above abilities need to be reflected through competition results, and psychological quality will have a direct impact on competition results. In view of this situation, athletes should be good at using diversified methods in psychological quality training. First of all, they should pay attention to in-depth interactive communication with athletes, understand their psychological problems and confusion, and guide them to master certain psychological counseling methods, so that they can self solve their bad emotional state. Before the competition, the coach should specially carry out psychological quality training and psychological guidance, so that the athletes can actively control the psychological state before and during the competition, improve the psychological endurance and psychological moral quality, so as to obtain the expected training effect.

### (3) Make training plan scientifically



Sports training is a long-lasting and needs to accumulate over time, so the whole training activity can not be achieved overnight, but pay attention to the scientific development of training plan, take sports training as a continuous activity, persevere. As early as before training, coaches need to make scientific training plans for athletes, taking into account the individual differences of athletes, to meet their reasonable needs. After making a good plan, it can not be easily changed due to subjective factors, but to overcome difficulties and obstacles, and constantly improve physical fitness and sports ability in an all-round way. Athletes' training intensity is relatively large, so they need to work hard and persist in their daily practice. Therefore, it is necessary to formulate a strict and scientific training plan and implement it firmly. Because the sports training plan is formulated by the coach combining with the coaching experience and integrating the athletes' sports level and physical condition, it can not be changed at will after the formulation, so that the principle and step-by-step adherence can be achieved and the training goal can be achieved efficiently.

#### (4) Flexible use of training methods

In order to improve the effectiveness of sports training and enhance the overall training efficiency, in addition to the scientific plan, we also need to stress the methods and flexible skills. Many athletes in sports training concentrate on hard work, and do not stress methods and skills, the result is usually half the result with half the effort, so that athletes lose confidence in training, extend training time. However, the methods and skills of sports training will show some differences because of the different sports, which requires a comprehensive analysis of sports, based on the core of the project using methods and skills. For example, in the training of the 100 meter race, we need to pay special attention to the starting skills, so as to avoid the occurrence of rush fouls without delay; In swimming training, we need to pay special attention to the breathing skills in training, because breathing is a skill and method that must be applied in swimming competition activities; In the long-distance training, it is necessary to guide athletes to master sprint skills in order to accumulate strength and gain advantages in the sprint stage.

#### (5) Focus on the study of proprioception

Proprioception is one of the most basic and important sensory systems of human body, which can provide information about the position of the body and limbs when the human body is engaged in various activities. Proprioception can effectively sense body posture, spatial position changes, relative position of body parts and so on, so it plays a vital role in sports training. The overall feeling can not be directly reflected in the participating sports, but brings

indirect effect to sports training. With the help of effective control of various joints and other parts, we can coordinate the posture of various parts of the body, maintain body balance and coordination. Proprioception plays an important role in the recovery of sports injury, which can play a positive role in the prevention of sports injury and the protection of sports body. In view of this situation, coaches should pay close attention to the role of proprioception, understand the proprioception ability of athletes, and reduce sports injuries as much as possible in sports training. Coaches need to do a good job in proprioception research, actively absorb a series of current theoretical and practical research results, and apply the research results in sports training reasonably.

## V. CONCLUSION

Nowadays, the national sports industry is developing towards a more scientific and innovative direction. In today's fast-paced social background, no matter what kind of things are focused on improving efficiency, for sports training, this kind of practical activity, is to focus on improving efficiency and quality. In this regard, in the actual training, coaches should pay more attention to enhancing the efficiency of sports training, innovate in ideas, actively introduce innovative sports training methods, and at the same time, pay attention to summing up experience in sports training practice, explore research and innovation, and constantly increase the vitality of sports training, Find a way of sports training development with Chinese characteristics.

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