

# A Method for Evaluating the Achievement of Teaching Objectives in College Balloon Volleyball Based on Principal Component Analysis

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**Abstract:** In order to grasp the effectiveness of university balloon volleyball teaching, principal component analysis method is introduced. Taking a certain university as an example, the design and research of the evaluation method for the achievement of university balloon volleyball teaching objectives are carried out. Divide the teaching content of balloon volleyball course into two types, namely theoretical courses and practical courses, and design evaluation indicators for the achievement of teaching objectives for different types of courses; Use the Z-Score method in principal component analysis to standardize the evaluation data, and based on this, determine the indicator weights; Determine the amount of principal component scores in the evaluation indicators, calculate the contribution of principal components, and thus achieve the evaluation and comprehensive evaluation of the achievement of the goals of university volleyball teaching. The experimental results show that the designed evaluation method has a good application effect, and can achieve objective evaluation of the degree of achievement of teaching objectives by different students in their learning.

**Keywords:** Principal component analysis method; Evaluation method; Degree of achievement; Teaching objectives; Balloon volleyball; College students

## 1. Introduction

Compared with other sports, balloon volleyball has obvious advantages such as simple technology and easy to use. At the same time, balloon volleyball is also a group and comprehensive sport, so many college students are willing to accept and take the initiative to participate in this sport [1]. However, in the in-depth market research of a university, it is found that some universities have not yet carried out large-scale publicity for the balloon volleyball project. Freshmen and sophomores are not very familiar with the balloon volleyball project. When they choose the balloon volleyball teaching club, they pay special attention to the teaching environment, while ignoring the content and interest of the teacher's lectures. In order to solve this problem and deepen the teaching of balloon volleyball in colleges and universities, some colleges and universities have strengthened the publicity of balloon volleyball in their phased work, taking the balloon volleyball competition on campus as a breakthrough, introducing some powerful events to more students, so that college students can have more understanding of balloon volleyball [2]. Only by widely popularizing the teaching knowledge of balloon volleyball can students have a deeper understanding and cognition of balloon volleyball. Although relevant work has been implemented, it is still unknown whether the teaching of balloon volleyball can achieve the expected teaching effect according to the standards. In order to grasp the progress of teaching work, the Ministry of Education has proposed the concept of teaching goal achievement, which is an important indicator used to measure the teaching quality of this subject or course. In order to achieve a more objective evaluation of the degree of achievement of teaching objectives, this article will introduce the principal component analysis method in this study. Taking a certain university as an example, the design and research of the evaluation method for the degree of achievement of university balloon volleyball teaching objectives will be carried out. The aim of this design is to truly grasp the quality of university curriculum teaching and ensure the comprehensive optimization and continuous improvement of student quality education plans.

## 2. Design evaluation indicators for achieving the goals of balloon volleyball teaching in universities

In order to grasp the degree of college students' achievement of balloon volleyball teaching goals, before the research, the teaching content of balloon volleyball courses was divided into two types, namely theoretical courses and practical courses, and evaluation indicators for the achievement of teaching goals of different types of courses were designed, as shown in Table 1 below [3].

Table 1: Evaluation indicators for achieving the goals of college balloon volleyball teaching

| Serial Number | Course type         | Teaching objectives                | Achievement evaluation content (evaluation indicators)   |
|---------------|---------------------|------------------------------------|--|
| (1)           | Theoretical courses | Professional Capability Objectives | Can students actively and actively participate in classroom learning when teachers teach balloon volleyball  |
|               |                     | Method Capability Objectives       | After completing the teaching of the classroom content, students' understanding of the techniques of balloon volleyball  |
|               |                     | Social Capability Goals            | The cultivation of students' sports spirit through theoretical learning in the classroom   |
| (2)           | Practical courses   | Professional Capability Objectives | Do you actively exchange learning experiences and sports skills with other students in the practical classroom   |
|               |                     | Method Capability Objectives       | Can you proficiently master the essentials of balloon volleyball movements and whether the movements meet the standards  |
|               |                     | Social Capability Goals            | Can you learn to cooperate and communicate with others in activities after practical learning  |
|               |                     | Social satisfaction level          | After specialized practical teaching, can students enter society and in their positions, whether they can affirm others, respect others, express themselves, and compete friendly and fair |

According to the specific situation in the evaluation process, some evaluation indexes (evaluation contents) can be appropriately adjusted, added and deleted, so as to achieve the evaluation index design of college volleyball teaching goal achievement.

## 3. Determination of index weights based on principal component analysis

On the basis of the above content, the principal component analysis method is introduced to determine the weight of evaluation indicators [4]. In this process, it should be clarified that principal component analysis belongs to a multivariate statistical method, which can convert multiple indicators into a few comprehensive indicators for calculation, avoiding the excessive statistical data caused by too many indicators. In the evaluation, the Z-Score method in principal component analysis is first used to standardize the evaluation data. The processing process is shown in the following calculation formula.

$$Z = \frac{x_{ij} - \bar{x}_j}{S_j} \quad (1)$$

In formula (1):  $Z$  represents the standardized processing of data;  $x_{ij}$  represents the value of the  $j$  index in the  $i$  sample data;  $\bar{x}_j$  represents the average statistical value of the  $j$  index;  $S_j$  indicates the data dimension of the  $j$  th indicator.  $\bar{x}_j$  and  $S_j$  in the above formula can be calculated by the following formula.

$$\bar{x}_j = \frac{1}{n} \sum_{i>1}^n x_{ij} \quad (2)$$

$$S_j = \left[ \frac{1}{n-1} \sum_{i>1}^n (x_{ij} - \bar{x}_j)^2 \right] \quad (3)$$

In the formula,  $n$  represents the total number of sample data. After completing the above

calculation, in order to better reflect the actual situation of achieving the goals of university balloon volleyball teaching and ensure the scientific nature of the comprehensive evaluation results, it is necessary to determine the weight of the non quantified indicators. This process is shown in the following calculation formula.

$$R = \left( r_{jk} \right)_p \cdot Z \quad (4)$$

In formula (4),  $R$  represents the index weight;  $r_{jk}$  represents the correlation coefficient of the  $k$  type feature in the  $J$  index;  $p$  represents the feature root. According to the above method, the index weight determination based on principal component analysis is completed.

#### 4. Calculation of principal component contribution and comprehensive evaluation results

After mastering the weight of indicators, it should be clear that different indicators make different contributions in the evaluation. To understand the contribution of different indicators, it is necessary to first determine the principal component score in the evaluation indicators, and based on this, calculate the principal component contribution. The calculation formula is as follows [5].

$$G = \sum_{g>1}^k \lambda_g \cdot R / \sum_{g>1}^p \lambda_p g \quad (5)$$

In formula (5),  $G$  represents the contribution of principal components;  $\lambda$  represents the linear weighted value of the principal component;  $g$  represents the  $g$  principal component. Based on the above calculation results, a comprehensive evaluation of the degree of achievement of college balloon volleyball teaching objectives is conducted, and the calculation formula for the evaluation results is as follows.

$$F = \sum_{g>1}^k \left( G / \sum_{g>1}^p \lambda_p g \right) \quad (6)$$

In formula (6),  $F$  represents the comprehensive evaluation result of the degree of achievement of the teaching goal of college animated volleyball, and  $F$  can also be expressed as the comprehensive score of the degree of achievement evaluation. In order to grasp the score result more intuitively, the scoring standard and evaluation basis of the comprehensive evaluation result are designed according to Table 2 below.

Table 2: Scoring standards and evaluation basis for comprehensive evaluation results

| Serial Number | Value range of achievement degree | Comprehensive score (points) $F$ | Evaluation basis  |
|---------------|-----------------------------------|----------------------------------|---|
| (1)           | 0~0.2                             | 0~20                             | Almost all teaching objectives have not been achieved                               |
| (2)           | 0.2~0.4                           | 20~40                            | Only a few teaching objectives were achieved, and the results were poor             |
| (3)           | 0.4~0.6                           | 40~60                            | Achieve some teaching objectives with average achievement level                     |
| (4)           | 0.6~0.8                           | 60~80                            | Achieve most of the teaching objectives with a high degree of achievement           |
| (5)           | 0.8~1.0                           | 80~100                           | Almost all teaching objectives have been achieved with a high degree of achievement |

According to the above table 2 and the calculation result  $F$ , the calculation of the principal component contribution degree and the comprehensive evaluation result are completed, and the evaluation method design of the college volleyball teaching goal achievement degree based on the principal component analysis method is realized.

#### 5. Example application analysis

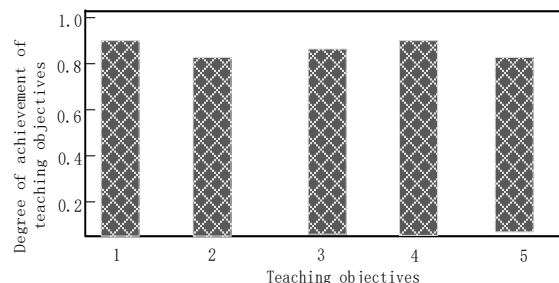
The above article conducted a research on the design of an evaluation method for the achievement of goals in university balloon volleyball teaching based on principal component analysis. In order to

test the evaluation effect of this method in practical application, a certain class of students majoring in physical education in a pilot university in a certain region was selected as the research object of this experiment. There are a total of 30 students in this class. After excluding the influence of external factors on the teaching effectiveness, 11 students in the class were selected to participate in this experiment. Before the experiment, negotiations were made with the department counselor and the students themselves to ensure that the students voluntarily participated in the experiment.

In the in-depth investigation of this university, it is found that balloon volleyball is a new type of physical education teaching course introduced by this university in recent years to meet the innovation and entrepreneurship teaching proposed by the education market. In order to attract more students to take the initiative to participate in this sport and actively participate in balloon volleyball activities, the university has not only carried out a lot of publicity work on campus, but also hired professional balloon volleyball coaches. Through special guidance and technical training for school physical education teachers, the teaching team of balloon volleyball has been perfected on the basis of improving the comprehensive teaching level of school physical education teachers. In order to grasp the implementation effect of the phased work, the following will be in accordance with the method designed in this paper, the pilot student balloon volleyball teaching goal achievement evaluation.

During the experiment, several students who participated in the experiment were taught balloon volleyball according to the established teaching plan. Design several teaching objectives based on the teaching tasks of the physical education discipline in universities. In the evaluation process, the design of evaluation indicators for achieving the goals of university balloon volleyball teaching is advanced, and corresponding evaluation indicators are proposed based on different teaching methods. On this basis, the principal component analysis method is introduced to perform non quantitative processing on the original indicator data, ensuring the standardization of the indicator data. Based on the feature roots and eigenvectors of different indicators, the indicator weights are calculated and determined. Finally, by calculating the principal component contribution of corresponding indicators in the evaluation process, the evaluation of the degree of achievement of the goals of university balloon volleyball teaching is achieved.

After the evaluation is completed, a student in the class is taken as an example to evaluate the degree of achievement of different goals in the balloon volleyball teaching. By referring to the content in Table 2 above, the evaluation result of the degree of achievement of teaching goals for this student is calculated. As shown in Figure 1 below.



*Figure 1: Evaluation results of different goal achievement in a student's volleyball teaching*

From the results shown in FIG. 1 above, it can be seen that the achievement degrees of different goals in the teaching of balloon volleyball for students are all above 0.8, indicating that the current teaching method has a good effect in practical application.

On the basis of the above content, the method in this paper is used to evaluate the achievement degree of balloon volleyball teaching goals of 11 students participating in the experiment, and the comprehensive evaluation results are output by referring to the corresponding values of the scores, as shown in Table 3.

From the experimental results shown in Table 3 above, it can be seen that using the method designed in this paper to evaluate the degree of achievement of the teaching goals of college volleyball, this method can not only grasp the degree of students' achievement of the teaching goals of the course, but also more intuitively rank the students participating in the learning. Grasp the understanding degree of different students in the class to the knowledge points in the study.

Table 3: Comprehensive score of achievement of teaching objectives for balloon volleyball among 11 students in the experiment

| Student ID | Comprehensive score for achieving the teaching objectives of balloon volleyball (points) | Ranking |
|------------|--|---------|
| (1)        | 95.15  | 2       |
| (2)        | 96.18  | 1       |
| (3)        | 77.14  | 8       |
| (4)        | 85.12  | 5       |
| (5)        | 72.16  | 11      |
| (6)        | 79.15  | 7       |
| (7)        | 82.06  | 6       |
| (8)        | 89.14  | 4       |
| (9)        | 90.23  | 3       |
| (10)       | 76.18  | 9       |
| (11)       | 74.91  | 10      |

Based on the above content, the experimental results are as follows: The evaluation method for the achievement of teaching objectives in university balloon volleyball based on principal component analysis designed in this article has good application effect, and this method can achieve objective evaluation of the achievement of teaching objectives by different students in their learning.

## 6. Conclusion

Compared to sports such as basketball and football, balloon volleyball belongs to niche sports. If universities do not do a good job in promoting it, it will affect students' understanding and interest in balloon volleyball. It is also difficult to achieve the goals of the school curriculum efficiently and with high quality. Students lack motivation to learn this sport and have little interest in balloon volleyball, resulting in a stagnant implementation of teaching related to this sport. In order to solve this problem, colleges and universities have put forward a variety of measures to improve and perfect the teaching work of balloon volleyball. In order to grasp the application effect of the existing teaching program, this paper introduces the principal component analysis method, takes a university as an example, and designs the evaluation index of the achievement degree of the teaching goal of college balloon volleyball, the determination of the weight of the index, the contribution degree of the principal component and the calculation of the comprehensive evaluation results. After the design of this method is completed, it is proved that this method can realize the objective evaluation of different students' achievement degree of teaching goals in learning through the application of examples.

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