

## The College Physical Education Teaching Evaluation based on the Fuzzy AHP-Entropy and the Computer Simulation

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### Abstract

*At present, the higher education pays more attention to the improvement of the teaching quality, not the scale expansion. Constructing the scientific, reasonable evaluation index system of college physical education teaching is the basis and prerequisite for the education administrative department to launch the appraisal work. The rapid development of the computer technology not only brings the convenience in the daily life, but also provides the new ideals and methods for the college physical education teaching evaluation. The combination between the college physical education teaching evaluation and the computer technology becomes the development trend in current college physical education evaluation work. AHP method is an important assessment method. However, in traditional AHP method, human subjectivity may cause a certain impact on the assessment results. In this paper, we propose the Fuzzy AHP-Entropy method. This method can reduce the influence of the human subjectivity on the results. We apply this method to college physical education teaching evaluation. Then we use the computer simulation to obtain the evaluate results. Finally, the computer simulation experiment shows that the method is scientific, operability and efficient.*

**Keywords:** *Fuzzy AHP-Entropy, college physical evaluation, the computer simulation*

### 1. Introduction

21 century is the computer era. Computer technology is in people's daily life. It brings a lot of conveniences for us. At the same time, the computer technology combines with some non-computer field. And it takes the new change for the development of these fields. In recent years, the Ministry of Education puts forward to improving the quality of higher education. And Ministry of Education establishes the Higher Education Evaluation Center of the Ministry of Education. With the improvement of the concern about the health of young people, the evaluation work of the college physical education becomes more and more important.

The study of the college physical education evaluation attracts many scholars. Li Guodong and Wang Kunlun thought Physical education curriculum is an important part of higher education, which plays an important role in the process of improving college student quality. And they studied the evaluation system of the ordinary college physical curriculum quality [1]. Tian Wenxue discussed the questions of the content, dimensions, standard, subject and process etc about the current college physical education quality from the literature review [2]. Zhang Sushi used the questionnaire survey method, the mathematical statistics and the logical analysis to study the practice of the college physical education assessment of the developed and the undeveloped areas. He analyzed the existing problems and proposed the related suggestions [3]. Shang Bao-zeng and Li Shi-sheng constructed the ordinary university sports education evaluation index system and established the comprehensive evaluation formula [4].

In the reality life, there are many evaluation methods. We often use AHP[5-6],ANP[7-8], DEA[9-10] and TOPSIS[11-12]. With the development of the times, many assessment methods begin to combine for producing the new assessment methods. The AHP method is as an example. Through the combination with other methods, AHP method develops many other methods, such as DEA-AHP [13-15], TOPSIS-AHP [16-17], Fuzzy-AHP and SWOT-AHP [19-20] etc. In the existing AHP, the human subjectivity will greatly affects the results. This makes the evaluation results can not reflect the actual situation. Based on this, we propose the Fuzzy AHP-Entropy. The method is based on the traditional AHP. According to modify the weight by using the entropy method and get the evaluation scores by using the fuzzy method. The structure of this paper is as follows. The first part is the introduction. In this part, we introduce the related work. The second part is the calculation steps of AHP-Entropy method. The third part is the improved AHP-Entropy method. In these parts, we firstly introduce the traditional AHP-Entropy, then, we propose the Fuzzy AHP-Entropy. The fourth part is the distribution of the weight. In this part, we express how to distribute the weights. The fifth part is the simulation experiment and the results analysis and the last part is the conclusion.

## 2. The Calculation Steps of AHP-entropy Method

(1)According to the scaling theory, we structure the compared matrix  $A$  :

$$A = (a_{ij})_{n \times n} \quad (i = 1, 2, \dots, n), a_{ij} = 1, a_{ij} = 1/a_{ji} \quad (1)$$

(2)Normalizing the judgment matrix  $A$  :

$$a_{ij} = a_{ij} / \sum_{k=1}^n a_{kj} \quad (i = 1, 2, \dots, n) \quad (2)$$

(3)Calculating the sum of each row for the matrix  $A$  :

$$\omega_i = \sum_{j=1}^n a_{ij} \quad (i = 1, 2, \dots, n) \quad (3)$$

(4)Normalizing the sum of each row about the matrix  $A$  :

$$\omega_i = \omega_i / \sum_{i=1}^n \omega_i \quad (i = 1, 2, \dots, n) \quad (4)$$

(5)According to  $A\omega = \lambda_{\max}\omega$ , we derive the maximum eigenvalue and its eigenvector.

(6)Check the consistency. If it goes through the consistency test, the feature vector will be as the weight of each index about the matrix.

(7)Calculating the entropy  $e_j$  of the  $j$  index:

$$e_j = -k \sum_{i=1}^m p_{ij} \ln p_{ij} \quad (5)$$

Among them,  $k > 0$   $e_j > 0$ . If  $x_{ij}$  is equal to each other for the given  $j$ .

$$P_{ij} = \frac{x_{ij}}{\sum_{i=1}^m x_{ij}} = \frac{1}{m} . \text{ At the same time, } e_j \text{ has the maximum value:}$$

$$e_j = k \ln m . k = \frac{1}{\ln m}, 0 \leq e_j \leq 1 .$$

(8)Use the alienation coefficient  $g_j$  ( $g_j = 1 - e_j$ ) of the entropy method to adjust the weight of AHP. Then we can get the comprehensive weight.

$$w_j = \frac{w g_j}{\sum_{j=1}^n w g_j} \quad (6)$$

(9) Getting the entropy coefficient matrix, we rank it comprehensively.

The process steps of the AHP-entropy method are as follows.

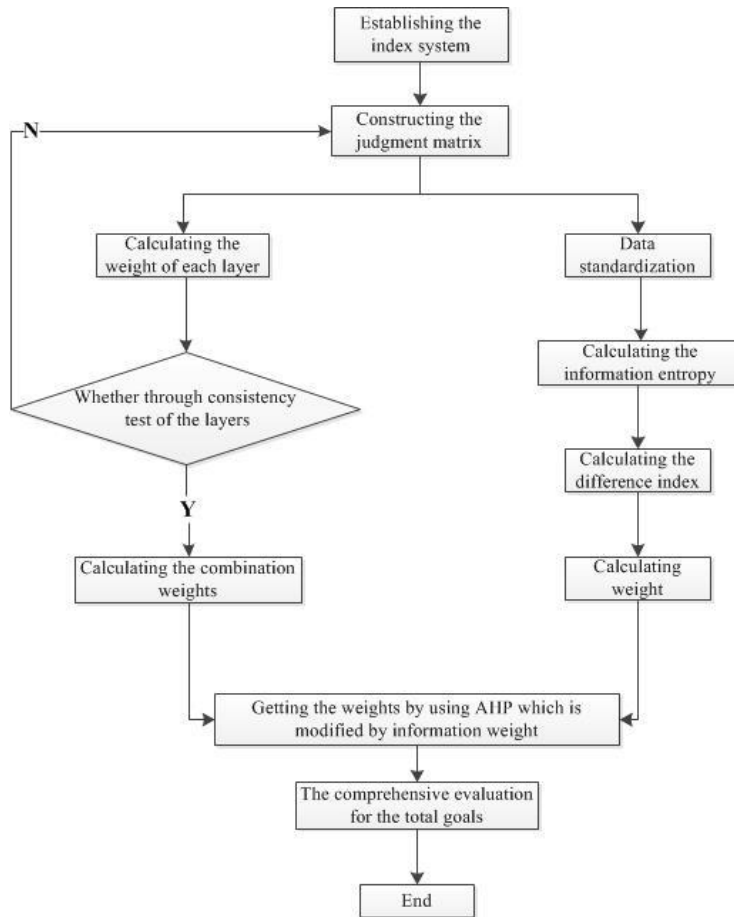


Figure 1. The Steps of the AHP-entropy

### 3. The Fuzzy AHP-Entropy Method

AHP-entropy method can only order the important degree for the targets. It cannot directly reflect the different degree about the sample. However, we need to evaluate the risk system of the electronic bank. We make the comment sets fuzzy processing and then we get the evaluated results of the evaluated scores. Firstly, we use the AHP method to get the weight of each index. Then we use the entropy method to adjust the weight and get the comprehensive weight. Lastly we combine the comprehensive weight with the comment sets and get the final evaluated scores.

In this paper, we propose the Fuzzy AHP-Entropy. Firstly, we get the weight through AHP. Then we adjust the weight and get the comprehensive weight through the entropy value. At last, we make the comment sets fuzzy processing and then we get the evaluated results of the evaluated scores. The steps of the improved AHP-entropy are as follows.

(1) We establish the index system  $L = \{L_1, L_2, \dots, L_n\}; (i = 1, 2, \dots, n)$  and the comment sets  $V = \{V_1, V_2, \dots, V_j\}; (j = 1, 2, \dots, m)$ .  $L_i$  is the evaluation indicator.

- (2) We construct the two level index judgment matrix and we derive the maximum eigenvalue and its eigenvector according to  $A\omega = \lambda_{\max}\omega$ ,
- (3) Repeating the step (2), we calculate the weight of the different index.
- (4) We calculate the entropy value  $e_j$  of the  $j$  indicator according to the formula (5).
- (5) We adjust the entropy difference coefficient  $g_j (g_j = 1 - e_j)$  to adjust the weight of the AHP according to the formula (6).
- (6) According to the comment sets, we obtain the third index evaluation matrix  $L = (L_{ij})$  which is normalized. We multiply the evaluation matrix and the comprehensive weight of the third index. Then we get the evaluated results of the second index  $C = w''' \cdot L_{ij}$ . We make the results as the input of the second indexes in order to make the first index evaluation result  $N = w'' \cdot B_{ij}$ . At last, we get the index evaluation result  $F = w' \cdot M_{ij} \cdot w'''$  is the comprehensive weight of the third index.  $w''$  is the comprehensive weight of the second index.  $w'$  is the comprehensive weight of the first index.
- (7) We use  $S = F \cdot V$  to get the final score of the e-commerce evaluation score.

#### 4. The Distribution of the Weight

After establishing the college physical education evaluation, we need to get the weights of the indicators. Firstly, we construct the judgment matrix of the index evaluation. Secondly, we calculate the maximum characteristic value and the feature vector of the judgment matrix. Thirdly, we check the consistency based on the feature vector normalization, and then we take the feature vector as the index weight of the judgment matrix. After establishing the index weight, we use the entropy method to modify the weight and get the comprehensive weight.

We take the weighted calculation of the first index as a sample. The judgment matrix is shown as Table 1.

**Table 1. The Judgment Matrix of the Criterion that is Relative to the Target Layer**

A	Ratio of teachers and students	Diploma and professional title structure	Teaching training	The workload and the treatment for the teachers
Ratio of teachers and students	1	2	3	5
Diploma and professional title structure	$\frac{1}{2}$	2	2	3
Teaching training	$\frac{1}{3}$	$\frac{1}{2}$	2	3
The workload and the treatment for the teachers	$\frac{1}{5}$	$\frac{1}{3}$	$\frac{1}{2}$	2

Firstly, we calculate the maximum eigenvalue and the corresponding feature vector of the second index layer which is relative to the first index layer A. We assume  $\lambda_{\max}$  is the maximum feature vector.  $w$  is the feature vector which  $\lambda_{\max}$  corresponds.  $\lambda_{\max} = 4.0145$ . The maximum eigenvalue and the maximum feature vector are as follows.

$$w_i^{(j)} = w_i / \sum_{i=1}^n w_i \quad (j = 1, 2, 3; i = 1, 2, 3, 4) \quad (7)$$

We make the corresponding feature vector  $W = (w_1, w_2, w_3, w_4) = (0.8278, 0.4667, 0.2694, 0.1513)$  which is obtained from the maximum eigenvalue into the formula (3). Then we can get the new weight

$$W^{(1)} = (w_1^{(1)}, w_2^{(1)}, w_3^{(1)}, w_4^{(1)}) = (0.8278, 0.4667, 0.2694, 0.1513) .$$

After we get the new weight, we check the consistency.  $CI$  is the consistent test index. The order number of the judgment is  $n$ . The expression of  $CI$  is as follows.

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (8)$$

The order number of the second index layer of the judgment matrix is five. Therefore,  $n = 5$ . We have known that  $\lambda_{\max} = 4.0145$  and  $n = 4$ .

$$CI = \frac{\lambda_{\max} - n}{n - 1} = \frac{4.0145 - 4}{4 - 1} = 0.0048$$

$$RI = 0.89$$

Then, we take  $CI$  and  $RI$  into the following formula.

$$CR = \frac{CI}{RI} = \frac{0.048}{0.89} = 0.0054 < 0.1$$

Due to  $CR = 0.0054 < 0.1$ , the consistency test is right.

From the consistency test, we can know that the second index weights have passed the consistency test in the weight calculation.

Repeating the above method, we can obtain the weight of the second index layer about the electronic bank assessment system. Then, we modify the weights and get the comprehensive weights according to the formula (5) and (6).

## 5. The Simulation Experiment and the Results Analysis

At this part, we evaluate the college physical education teaching for one college. After collecting the data, we conduct the computer simulation. We get the weights of the first indexes firstly through the computer simulation. Then, we use the same method to get the weight of the second indexes and the third index. The results of the indexes are showed in the Table 2.

**Table 2. The Weights of the Different Indexes**

The first index	The second index	The third index	weight
The basic resource allocation	The teachers	Ratio of teachers and students	0.361
		Diploma and professional title structure	0.394
		Teaching training	0.082
		The workload and the treatment for the teachers	0.173
	The teaching conditions	The sports funds	0.252
		The sports facilities	0.354

		The sports information	0.404
The curriculum and the teaching	The effect teaching	The curriculum provision	0.215
		The curriculum design	0.141
		The teaching running and management	0.312
		The teaching monitoring	0.342
	The curriculum structure and the teaching reform	The curriculum construction	0.603
		The teaching reform	0.407
The extracurricular achievements	The group activities	The organization and management	0.226
		Morning exercises and the extracurricular activities	0.191
		The sunshine sports festival	0.262
		The collective honor	0.331
	The training competition	The sports training	0.374
		The sports competition performance	0.343
		The sports association competition	0.293
The teaching effect	The physical fitness test	The test site and equipment	0.148
		Test regulations and monitoring files	0.160
		The qualified rate of the physical fitness for the students	0.331
		The excellent rate of the physical fitness for the students	0.371
	The daily teaching	The lively lectures	0.153
		Movement skills	0.322
		Mobilizing the enthusiasm of the students	0.180
		Fostering the sports consciousness	0.355

After we get the weights of the different indexes, we calculate the entropy weight and the comprehensive weight of the electronic bank assessment system according to the formula (5) and (6) through the computer simulation. The result is shown in Table 3.

**Table 3. The Comparison Among the AHP Weight, the Adjusted Weight and the Comprehensive**

The third index	The index weight $w$ of the AHP method	The index weight $\bar{w}$ of the entropy method	The comprehensive weight $w'''$
Ratio of teachers and students	0.361	0.358	0.359
Diploma and professional title structure	0.394	0.396	0.396
Teaching training	0.082	0.083	0.081
The workload and the treatment for the teachers	0.173	0.163	0.164
The sports funds	0.252	0.253	0.248
The sports facilities	0.354	0.355	0.354

The sports information	0.404	0.392	0.398
The curriculum provision	0.215	0.213	0.212
The curriculum design	0.141	0.139	0.140
The teaching running and management	0.312	0.313	0.313
The teaching monitoring	0.342	0.335	0.335
The curriculum construction	0.603	0.605	0.595
The teaching reform	0.397	0.395	0.405
The organization and management	0.226	0.227	0.225
Morning exercises and the extracurricular activities	0.191	0.192	0.193
The sunshine sports festival	0.262	0.261	0.259
The collective honor	0.331	0.320	0.323
The sports training	0.374	0.376	0.377
The sports competition performance	0.343	0.348	0.347
The sports association competition	0.283	0.276	0.276
The test site and equipment	0.148	0.146	0.147
Test regulations and monitoring files	0.160	0.157	0.158
The qualified rate of the physical fitness for the students	0.331	0.329	0.329
The excellent rate of the physical fitness for the students	0.371	0.368	0.366
The lively lectures	0.153	0.155	0.148
Movement skills	0.322	0.332	0.328
Mobilizing the enthusiasm of the students	0.180	0.178	0.177
Fostering the sports consciousness	0.355	0.335	0.347

From the above steps, we get the comprehensive weight  $w''$ . We normalize the scores of the index. Because of space reasons, we only show the evaluation information of the first two third index layers for the college physical education teaching evaluation. The scores of evaluation information for the first two third index layers are as follows.

**Table 4. The Index Scores of the College Physical Education Teaching Evaluation**

The first index layer	The second index layer	The third index layer	Comment	grade	normalize
The basic resource allocation	The teachers	Ratio of teachers and students	excellent	0	0
			fine	5	1
			good	0	0

			qualified	0	0	
			poor	0	0	
		Diploma and professional title structure	excellent	1	0.2	
			fine	4	0.8	
			good	0	0	
			qualified	0	0	
			poor	0	0	
		Teaching training	excellent	0	0	
			fine	5	1	
			good	0	0	
	qualified		0	0		
	poor		0	0		
	The teaching conditions	The sports funds	excellent	1	0.2	
			fine	3	0.6	
			good	1	0.2	
			qualified	0	0	
			poor	0	0	
		The sports facilities	excellent	0	0	
			fine	5	1	
			good	0	0	
qualified			0	0		
poor			0	0		
The sports information		excellent	0	0		
		fine	4	0.8		
		good	1	0.2		
		qualified	0	0		
		poor	0	0		
The curriculum and the teaching	The effect teaching	The curriculum provision	excellent	1	0.2	
			fine	2	0.4	
			good	2	0.4	
			qualified	0	0	
			poor	0	0	
		The curriculum design	excellent	0	0	
			fine	5	1	
			good	0	0	
			qualified	0	0	
		The teaching running and management	poor	0	0	
			excellent	0	0	
			fine	4	0.8	
				good	1	0.2



			qualified	0	0
			poor	0	0
		The teaching monitoring	excellent	0	0
			fine	5	1
			good	0	0
			qualified	0	0
			poor	0	0
	The curriculum structure and the teaching reform	The curriculum construction	excellent	0	0
			fine	5	1
			good	0	0
			qualified	0	0
			poor	0	0
		The teaching reform	excellent	1	0.2
			fine	3	0.6
			good	1	0.2
qualified	0		0		
poor	0		0		

Then, we define the comment sets as follows.

$$V = \{V_1, V_2, V_3, V_4, V_5\} = \{excellent, fine, good, pass, poor\} = \{90, 80, 70, 60, 50\}$$

We input the third index scores and the last evaluation index is as follows.

$$S = F \cdot V = [0.0341 \quad 0.823 \quad 0.1357 \quad 0.0072 \quad 0] \cdot (90, 80, 70, 60, 50)^T \\ = 82.728$$

From the computer simulation, we can see that the experiment result is exact and exact. So, this method is scientific, operability and efficient. The Fuzzy AHP-Entropy method can be as an assessment method of strong adaptability.

## 6. The Conclusion

The rapid development of the computer technology not only leads to a lot of new industries, but also provides new vitality for the development of the traditional industries. In college physical education teaching evaluation work, we combine the evaluation work with the computer technology. It can not only get the accurate assessment results quickly, but also provide a new thought for other education evaluation work. The paper did the following works. (1)Firstly, we establish the university sports teaching evaluation system. (2)Secondly, we propose a new AHP method. This method is Fuzzy AHP entropy method. The method can reduce the influence of human subjective on the evaluation results. (3)Lastly, by using the computer simulation, we apply the method to the university sports teaching evaluation. The experimental results show that this method is scientific, operability and effective.

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