



Research on the Teaching Quality Evaluation for the Physical Education in Colleges Based on the AHPTOPSIS

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With the comprehensive development of the quality education, more and more colleges begin to pay attention to the physical education for the college students. Evaluating the teaching quality for the physical education can enhance the physical teaching management of the colleges. In this paper, we combine the AHP method with the TOPSIS method and propose the RAHPTOPSIS method in order to evaluate accurately the teaching quality for the college physical education. Then, we use the method to evaluate the teaching quality evaluation of the college physical education. The evaluation results show that the method is validity and accuracy.

1. Introduction

In recent years, more and more colleges begin to pay attention to the physical education work for the college students. And they put the improvement of the physical education teaching quality for the college students on the agenda. The continuous development for the teaching evaluation of the college physical education is to enhance the management of the ordinary colleges. And it is the effective way to ensure the teaching education for the college physical education.

Qiuhe Huang et al. (2014) researched the college teachers' teaching ability. Shang Baozeng and Li Shisheng (2010) applied the evaluation company to evaluate the physical education teaching quality which was based on the evaluation index system of constructing the college physical education. Yan Linlin, Zhang Wenge and Wu Jingxi (2009) studied the college comprehensive evaluation system and analyzed the current situation of the physical index system. The author thought that the colleges should give full play to the guiding function and incentive function in the college comprehensive evaluation system. Zhang Sushi (2012) applied the mathematical statistics method and the logic analysis method to study the teaching evaluation for the college physical education in different areas. And he proposed the related suggestions. Tian Wenxue (2013) applied the investigation to evaluate the teaching quality for the college physical quality in our country. He discussed the existing problems from the aspects of the content, dimension, standard, the main body and the process of the evaluation. Li Dong (2004) thought that the positive effect and the negative influence existed in the process of evaluating the college physical education. Then, the author discussed the evaluation function of the college physical education.

AHP was proposed by the American operation research expert T.L.Saaty in the seventies of the 20th century. Po-Lin Lai, et al. (2015) used the multi-criteria decision making method AHP to incorporate the weightings of input and output variables into DEA and DEA-AR models. Zhang Lina (2006) compared and studied the grey clustering method, analytic hierarchy process method and the fuzzy cognitive mapping method. Pan Renfei et al. (2008) applied the reliability theory and the related theory of the uncertain AHP. On the basis, they proposed the uncertain AHP method which was based on the uncertain judgment matrix similarity and the credibility of the different experts. Song Zeyang et al. (2014) proposed the triangular extent fuzzy AHP method. They found that the triangular extent fuzzy AHP approach was more effective to evaluate self-ignition risks of coal piles. With the continuous development of the AHP method, many scholars combined the AHP method with other methods and got the new methods. Xie Chuansheng et al. (2012) used the Entropy AHP method to research the safety evaluation. Ajay Kumar et al. (2015) studies the A hybrid fuzzy AHP/DEA method

TOPSIS was a kind of method to approximate the ideal solution. According to calculating the distance from each scheme to the ideal solution, we got the corresponding evaluation to order. Chandra Sekhar, Manoj Patwardhan, Vishal Vyas (2015) used AHP to determine the weight of indicators as criteria and technique.

Chandra Prakash, M.K. Barua (2015) proposed a methodology based on fuzzy analytical hierarchy process (AHP) and fuzzy technique. Zhou Ya (2009) combined the Euclid distance with the grey correlation degree and constructed a new relative closeness as the standard of judging the quality of the schemes. Zhu Zhu (2012) applied the TOPSIS method to evaluate quantitatively the comprehensive agricultural benefit, the comprehensive benefit of the construction usage and the comprehensive benefit of the land usage. Yang Guang (2015) et al. also researched the evaluation.

In order to evaluate better the teaching quality for the college physical education, we construct the quality evaluation system and we c proposed the RAHPTOPSIS method. The structure of this paper is as follows. The first part is the introduction. The second part is the construction of the evaluation system. In this part, we establish the quality evaluation system of the college physical education. In the third part, we combine the AHP method with the TOPSIS method and propose the RAHPTOPSIS method. The fourth part is the experiment and the last part is the conclusion.

2. The construction of the evaluation system

Before evaluating the teaching quality of the college physical education, we must establish the evaluation index. The evaluation index is not only related to the specific aspects, but also the final evaluation results. The good evaluation index can get the objective, comprehensive and fair evaluation results. Then we can better evaluate the objects. We get the quality evaluation system of the college physical education.

Table 1: Quality evaluation system of the college physical education

First index	Second index	Third index
The quality evaluation system of the college physical education	Teaching content A	Teaching goal A_1
		Teaching management A_2
		Teaching practice A_3
		Teaching time A_4
	Teaching method B	Teaching model B_1
		Teaching demonstration B_2
		Simulating the interest of students B_3
		Teaching feedback B_4
		Teaching attitude B_5
	The self-evaluation for students C	Improvement of physical quality C_1
		Love physical education C_2
		Independent of physical exercise after class C_3
	Teaching efficiency D	Students' autonomous learning D_1
		Mastering the skill D_2
		Cultivating the spirit of cooperation and competition D_3
Other E	Teaching equipment E_1	
	Teaching style E_2	
	Competition results E_3	

3. RAHPTOPSIS algorithm

3.1 AHP

When the AHP method analyzes, it can evaluate the interrelated and interdependent system which is consist of many factors from different aspects. According to the system, we can make the decision object hierarchical and structured. Then we establish the hierarchical structure and form a multi-level structure model. In general, it divides into the target layer, the criterion layer and the index layer from the high to the low. We use the relative importance that the lower layer to the higher layer to evaluate the weight of the evaluated factors.

Firstly, we construct the judgment matrix according to the scale meaning of the important degree. The index factor of each layer is based on the adjacent layer as the reference. Therefore, we can construct the judgment matrix according to the comparison scale method.

$$R = \begin{bmatrix} A_{11} & A_{12} & \cdots & A_{1n} \\ A_{21} & A_{22} & \cdots & A_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ A_{m1} & A_{m2} & \cdots & A_{mn} \end{bmatrix} \quad (1)$$

Where, $A_{mm} > 0, A_{mm} = \frac{1}{A_{mm}}, A_{mm} = 1$.

R is the positive reciprocal matrix. The eigenvalue is λ_{\max} and it is unique. We need to calculate the maximum eigenvalue λ_{\max} and the eigenvector W . Then, we can obtain the weights of each factor. In general, the calculated methods have sum and product method and the root method. We adopt the root method.

(1) The factors in the judgment matrix multiply by row

$$U_{ij} = \prod_{j=1}^n a_{ij} \quad (2)$$

(2) Turning evolution for products respectively

$$u_i = n \sqrt[n]{U_{ij}} \quad (3)$$

(3) Normalizing the vector quantity

$$\omega_i = \frac{u_i}{\sum_{i=1}^n u_i} \quad (4)$$

ω_i is eigenvector

(4) Calculating the largest eigenvalue

$$\lambda_{\max} = \sum_{i=1}^n \frac{(A\omega)_i}{n\omega_i} \quad (5)$$

3.2 TOPSIS

Firstly, we assume that the scheme set is $P = \{P_1, P_2, \dots, P_m\}$. The evaluated index set of each scheme is $r = \{r_1, r_2, \dots, r_n\}$. The evaluated index r_{ij} refers to the j judgment index of the i scheme. The initial matrix is as follows.

$$P = (r_{ij})_{m \times n} = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix} \quad (6)$$

Secondly, the evaluation index can divide into the consumption index and the benefit index.

For the benefit attribute,

$$b_{ij} = \frac{r_{ij} - \min_j(r_{ij})}{\max_j(r_{ij}) - \min_j(r_{ij})} \quad (7)$$

For the cost attribute,

$$b_{ij} = \frac{\min_j(r_{ij}) - r_{ij}}{\max_j(r_{ij}) - \min_j(r_{ij})} \quad (8)$$

Where $i = 1, 2, \dots, m$, $j = 1, 2, \dots, n$.

The third step to construct the weighted standardization decision matrix

$$R = (r_{ij})_{m \times n} = \begin{bmatrix} w_1 b_{11} & w_2 b_{12} & \cdots & w_n b_{1n} \\ w_1 b_{21} & w_2 b_{22} & \cdots & w_n b_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ w_1 b_{m1} & w_2 b_{m2} & \cdots & w_n b_{mn} \end{bmatrix} \quad (9)$$

Fourthly, the positive ideal solution of the benefit index set J_1 is the maximum value of the row vector. And the negative ideal solution is the minimum of the row vector. The consumption index set J_2 is on the contrary. It can express as follows.

$$R^+ = \{(\max_n w_n b_{mn} | m \in J_1), (\min_n w_n b_{mn} | m \in J_2)\} \tag{10}$$

$$R^- = \{(\min_n w_n b_{mn} | m \in J_1), (\max_n w_n b_{mn} | m \in J_2)\} \tag{11}$$

Where, R^+ and R^- are the positive ideal solution and the negative ideal solution. The distance between the judgment object and the ideal solution is as follows.

$$D_i^+ = \sqrt{\sum_{j=1}^n (r_{ij} - r_j^+)^2} \tag{12}$$

$$D_i^- = \sqrt{\sum_{j=1}^n (r_{ij} - r_j^-)^2} \tag{13}$$

D_i^+ is the distance between the judgment object and the positive ideal solution. D_i^- is the distance between the judgment object and the negative ideal solution. r_j^+ and r_j^- are the corresponding elements of D_i^+ and D_i^- . The fifth step is to calculate the relative degree C_i^+ for each scheme and the positive ideal solution.

$$C_i^+ = \frac{D_i^-}{D_i^+ + D_i^-} \tag{14}$$

Where $i = 1, 2, \dots, m$.

When the judgment object is the positive ideal solution, $C_i^+ = 1$. When the judgment object is the negative ideal solution, $C_i^+ = 0$. In general, the approach degree of the judgment object is C_i^+ . The value belongs to $(0,1)$. It reflects the degree that the judgment object is close to the positive ideal solution.

3.3 RAHPTOPSIS

In this paper, we combine the RAHP with TOPSIS method and propose the RAHPTOPSIS method. According to the approach analysis of the TOPSIS method, we construct the judgment matrix. Then, we combine the AHP method and calculate the weight. The comprehensive judgment vector Q of the judgment object is as follows.

$$Q = W \times C \tag{15}$$

C is the judgment matrix which is formed by each judgment object and the approach degree of the positive ideal solution. W is the weights in the criterion layer according to the AHP method.

4. Experiment

In this paper, we use the RAHPTOPSIS method to evaluate the teaching quality of the physical education for the four colleges. Firstly, we use the RAHP method to calculate the weights of the indexes. The dimension analysis results are as follows.

Table 2: The dimension analysis results

Model	Unstandardized Coefficients		Standardized Coefficients	t	sig
	B	Standardized error	Trial version		
Constant term	2.304	0.14		0.05	0.000
Teaching content A	0.213	0.14	0.189	3.145	0.000
Teaching method B	0.238	0.14	0.192	5.231	0.000
The self-evaluation for students C	0.194	0.14	0.208	7.811	0.000
Teaching efficiency D	0.203	0.14	0.87	6.542	0.000
Other E	0.144	0.14	0.231	4.233	0.000

We can get the regression equation of the teaching quality evaluation system of the college physical education is as follows.

$$Model = 0.213 \cdot A + 0.238 \cdot B + 0.194 \cdot C + 0.203 \cdot D + 0.144 \cdot E$$

After that, we normalize the regression coefficients. The weight of the teaching content is 0.215, the teaching method is 0.239, the students' self-evaluation is 0.196, the teaching efficiency is 0.205, the others is 0.145. After we get the weights, according to the evaluation value, we apply the TOPSIS method to get the approach degree. The evaluated results of the teaching content are as follows.

Table 3: The evaluated results of the teaching content

Evaluated grade	Teaching target A_1	Teaching management A_2	Teaching practice A_3	Teaching time A_4
College A	8	7	6	8
College B	7	9	9	8
College C	8	8	7	8
College D	6	8	7	9

So, the approach degree is,

$$C_A = \{0.421, 0.673, 0.422, 0.385\}$$

The evaluation results of the teaching method are as follows.

Table 4: The evaluation results of the teaching method

Evaluated grade	Teaching model B_1	Teaching demonstration B_2	Stimulating student interest B_3	Teaching feedback B_4	Teaching attitude B_5
excellent	2	3	2	2	1
good	3	2	5	4	4
general	4	4	3	2	4
poor	1	1	0	2	1

So, we can get

$$Q = W \cdot C$$

$$= [0.215, 0.239, 0.196, 0.205, 0.145] \cdot \begin{bmatrix} 0.221 & 0.373 & 0.422 & 0.285 \\ 0.213 & 0.296 & 0.276 & 0.238 \\ 0.181 & 0.242 & 0.173 & 0.204 \\ 0.245 & 0.310 & 0.281 & 0.176 \\ 0.143 & 0.311 & 0.282 & 0.154 \end{bmatrix}$$

$$= [0.4834, 0.5654, 0.4938, 0.4531]$$

In summary, the superiority of the four colleges are 48.34%, 56.54%, 49.38% and 45.31%.

Therefore, the order of the four colleges is $B > C > A > D$.

5. Conclusions

Evaluating the college physical education can achieve the teaching goal of the physical education and promote the development of the college physical education. The college physical education evaluation is one of the most important parts in the college physical education evaluation works. The work of this paper is as follows. Firstly, we introduce the status. Secondly, we establish the teaching quality evaluation system of the college physical education. Thirdly, we combine the RAHP and TOPSIS and propose the RAHPTOPSIS method. Fourthly, we use RAHPTOPSIS method to evaluate the college teaching quality. According to evaluating the teaching quality of the college physical education, it can promote the colleges to improve their own shortcomings and the teaching quality.

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