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## AHP-based college students aerobics teaching method reformation development research

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### ABSTRACT

On the basis of combining with lots of literatures information and formers' researches, utilize analytic hierarchy process method to make analytic research on aerobics teaching four kinds of methods: basic composition aerobics teaching method, integrated and decomposing model aerobics teaching method, collective and group practice combinative method, the game aerobics teaching method under the impacts of factors influence of the classroom, aerobics students' receiving degrees, aerobics teachers' teaching difficulty, aerobics popular degree in students. It gets that uses integrated and decomposing combinative aerobics teaching method can let teaching efficiency to arrive at optimum; secondly successively is the game aerobics teaching method, basic composition aerobics teaching method and collective and group practice combinative method. The model provides theoretical guidance for aerobics teaching research, it has profound significances in researching aerobics teaching.

### KEYWORDS

Aerobics; Teaching reformation; Analytic hierarchy process; Teaching methods; Physiological functions.



### INTRODUCTION

In regular institution of higher learning sports teaching, aerobics course takes important roles, the event is loved by broad females, aerobics teaching reformation is one of Chinese new class reformation advocated new thought, aerobics teaching advocates independent, explorative learning way, comparing to general sports teaching, aerobics teaching not only has general teaching features but also has its own uniqueness, it has strong openness, can adapt to school all students' hobbies, and meanwhile can also effective organize teachers to teach.

Regarding aerobics aspect research, many scholars have made correlation researches and got certain achievements, such as : Guo Dan had ever put forward aerobics cooperative type teaching mode was through body dynamics, teaching thought, teaching engineering theory, social cohesion in regular institution of higher learning aerobics teaching, cooperative type aerobics teaching mode had important significances in students comprehensive quality promotion, from which it reflected extreme superiority in teamwork, innovation capacity and teacher-student relations ; Wu Wen-Wen in Chinese aerobics culture development, she proposed that Chinese aerobics were established and developed in the background of cultural globalization background, aerobics education had gradually been concluded as important part in education.

The paper just on the basis of above formers researches, targeted at college students' aerobics teaching methods reformation, it makes further research, by applying questionnaire survey, mathematical statistics, AHP and other methods, it makes analysis of aerobics teaching influential factors, finally gets results that conforms to practice that provides theoretical guidance for further researching aerobics teaching reformation plans' researches.

### COLLEGE STUDENTS' AEROBICS TEACHING METHODS REFORMATION MODEL

By consulting China's statistical yearbook, it can get China's major college students situation of interests in aerobics teaching and China's major college students aerobics class attitudes status, corresponding broken line Figure 1 is as following shows:

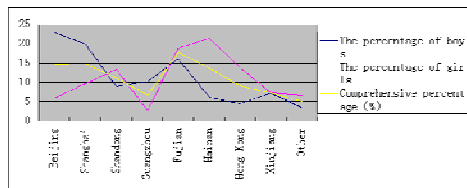


Figure 1: Students across the country survey of the situation of interest aerobics courses (N = 863)

For China's major college students' attitudes towards aerobics class, the paper selects 1000 people to make questionnaire survey, draw the obtained result into bar figure, as following Figure 2 shows:

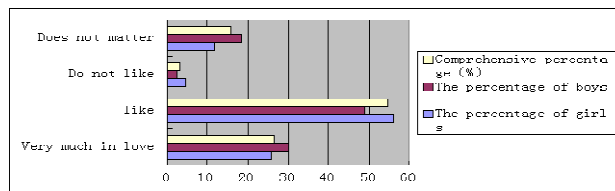


Figure 2 : China's major college students on aerobics class attitude (N = 1000)

From above Figure 2, it is clear that in Chinese college students likability on aerobics, Beijing, Fujian and other places are deeper with respect to Xinjiang and other places, it shows coastal cities prefer to aerobics. However schoolboys and schoolgirls interests and hobbies on aerobics teaching item are also different, for aerobics class attendance attitudes, schoolgirls that like attending aerobics class occupy 81.9%, and schoolboys occupy 78.9%, it is clear, schoolgirls prefer to aerobics with respect to schoolboys. Therefore, in order to let more students to love aerobics and participate in aerobics, find out most suitable Chinese college aerobics teaching mode is one of important problems that by far we confront.

Aerobics teaching mode suffers multiple factors impacts, such as old -fashioned teaching ideals, aerobics field, and aerobics class learning time and so on. The paper establishes analytic hierarchy process model, makes quantization on aerobics teaching mode orientations, by establishing target layer, criterion layer, and scheme layer relations, finally it gets future most suitable Chinese college aerobics teaching mode.

The paper selects four kinds of teaching ways; they are respectively basic composition aerobics teaching method, integrated and decomposing model aerobics teaching method, collective and group practice combinative method, the game aerobics teaching method. Go ahead with analytic hierarchy process with them, factors that need to consider are aerobics students' receiving degrees, aerobics teachers' teaching difficulty, influence of the classroom, aerobics popular degree in students.

**Analytic hierarchy process principles**

Firstly, use simple examples analysis to illustrate analytic hierarchy process basic principles. If there are n pieces of objects  $T_1, T_2, \dots, T_n$ , their corresponding weights are respectively  $\omega_1, \omega_2, \dots, \omega_n$ . Make mutual comparison, after that, it can get corresponding comparison matrix, corresponding table is as following TABLE 1 shows:

**TABLE 1 : N pieces of objects weights paired comparison table**

	$T_1$	$T_2$	L	$T_n$
$T_1$	$\omega_1 / \omega_1$	$\omega_1 / \omega_2$	L	$\omega_1 / \omega_n$
$T_2$	$\omega_2 / \omega_1$	$\omega_2 / \omega_2$	L	$\omega_2 / \omega_n$
M	M	M	O	M
$T_n$	$\omega_n / \omega_1$	$\omega_n / \omega_2$	L	$\omega_n / \omega_n$

If use matrix to express the mutual weight relations, that is:

$$T = \begin{pmatrix} \frac{\omega_1}{\omega_1} & \frac{\omega_1}{\omega_2} & \dots & \frac{\omega_1}{\omega_n} \\ \frac{\omega_2}{\omega_1} & \frac{\omega_2}{\omega_2} & \dots & \frac{\omega_2}{\omega_n} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{\omega_n}{\omega_1} & \frac{\omega_n}{\omega_2} & \dots & \frac{\omega_n}{\omega_n} \end{pmatrix} \tag{1}$$

Then T is judgment matrix. If assign weight vector  $\omega = (\omega_1 \ \omega_2 \ \dots \ \omega_n)^T$ , then it has:

$$T\omega = \lambda\omega \tag{2}$$

Among then,  $\omega$  is T feature vector,  $\lambda$  is one feature value of T. In fact, according to linear algebra knowledge, it is clear that  $\lambda$  is matrix T unique non-zero that is maximum feature value, and  $\omega$  is its corresponding feature vector, and for such factors that cannot measure, only introduce reasonable scale, it can also use the method to measure each factor relative importance, and then provide relative evidence for relevant decisions.

**Analytic Hierarchy Process basic steps**

Analytic hierarchy process model roughly needs following four steps:

- Hierarchical structure establishment;
- Construct every layer that fully used in judgment matrix;
- Hierarchical single arrangement and consistency test;
- Hierarchical total arrangement and consistency test

① Hierarchical model establishment

Analytic hierarchy process solved problems are required to be hierarchic, orderly and logic. Only then it can construct hierarchical scheme. Let tedious problems' elements to form into multiple hierarchies according to its attributes, membership and its relations. From which, it mainly contains 3 hierarchies that are respectively:

Target layer(U): The reform of teaching methods of Aerobics.

Criterion layer(K):scheme influence factors,  $K_1$  is influence of the classroom,  $K_2$  is students' receiving degrees,  $K_3$  is aerobics teachers' teaching difficulty,  $K_4$  is popular degree.

Scheme layer (T):  $T_1$  is basic composition aerobics teaching method,  $T_2$  is integrated and decomposing model aerobics teaching method,  $T_3$  is collective and group practice combinative method,  $T_4$  is the game aerobics teaching method.

Hierarchical structure is as Figure 3:

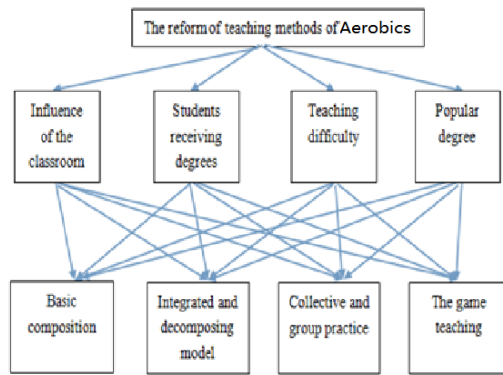


Figure 3 : Hierarchical structure chart

② Construct judgment matrix

According to hierarchical structure, it can construct judgment matrix.

According to linear algebra theoretical knowledge, if matrix  $U = (u_{ij})_{n \times n}$  meets  $u_{ij} > 0$  and  $u_{ji} = \frac{1}{u_{ij}}$  ( $i, j = 1, 2, \dots, n$ ),

then matrix  $U$  is positive reciprocal matrix.

Among them,  $u_{ij}$  value respectively is expressed by 1~9 scale number and its reciprocal, Saaty thought after researching that used 1~9 to express comparison structure, number respectively expressed definition is as following TABLE 2:

TABLE 2 : Importance scale definition table

Scale $u_{ij}$	Definition
1	Indicates two factors have equal importance by comparing
3	Indicates the former is slightly more important than the later by comparing two factors
5	Indicates the former is obviously more important than the later by comparing two factors
7	Indicates the former is intensely more important than the later by comparing two factors
9	Indicates the former is extremely more important than the later by comparing two factors
2, 4, 6, 8	Indicates middle level of above judgment
Reciprocal	If the former element and later element importance ratio is $u_{ij}$ , then later element and former element importance ratio is $u_{ij} = 1 / u_{ji}$

According to above scale TABLE 2, set judgment matrix U is:

$$U = \begin{pmatrix} 1 & 1/6 & 1/5 & 3 \\ 6 & 1 & 2 & 4 \\ 5 & 1/2 & 1 & 3 \\ 3 & 1/4 & 1/3 & 1 \end{pmatrix} \tag{3}$$

Combine with the paper’s aerobics research, it can get different criterions scheme layers, its result is as following TABLE 3-6 shows:

TABLE 3 : K-T judgment matrix one

$K_1$	$T_1$	$T_2$	$T_3$	$T_4$
$T_1$	1	2	2	3
$T_2$	1/2	1	3	4
$T_3$	1/2	1/3	1	2
$T_4$	1/3	1/4	1/2	1

**TABLE 4 : P-C judgment matrix two**

$K_2$	$T_1$	$T_2$	$T_3$	$T_4$
$T_1$	1	2	3	5
$T_2$	1/2	1	2	4
$T_3$	1/3	1/2	1	3
$T_4$	1/5	1/4	1/3	1

**TABLE 5 : P-C judgment matrix three**

$K_3$	$T_1$	$T_2$	$T_3$	$T_4$
$T_1$	1	1/2	2	3
$T_2$	2	1	3	3
$T_3$	1/2	1/3	1	2
$T_4$	1/3	1/3	1/2	1

**TABLE 6 : C-P judgment matrix four**

$K_4$	$T_1$	$T_2$	$T_3$	$T_4$
$T_1$	1	3	1/2	3
$T_2$	1/3	1	3	3
$T_3$	2	1/3	1	1/3
$T_4$	1/3	1/3	3	1

③ Consistency test

Matrix U corresponding maximum feature value  $\lambda_{max}$  feature vector  $W$ , it can get corresponding weight by normalization processing. Though the process can reduce other factors interference, it is hard to avoid appearing inconsistency to some extent when integrate all comparison results. If comparison results are consistent, then U factor should also meet:

$$u_{ij}u_{jk} = u_{ik}, \forall i, j, k = 1, 2, \dots, n \tag{4}$$

The positive reciprocal matrix that meets above formula is called consistent matrix. To easy define  $U$  can be accepted or not, it should test  $U$  inconsistency is very serious or not.

If  $U$  is consistent matrix, then  $U$  surely is positive reciprocal matrix, transposed matrix  $U^T$  is consistent matrix,  $U$  matrix any two lines are in proportions, and factors are above 0, therefore  $rank(U)=1$ , so is the column, in  $U$ ,  $\lambda_{max} = n$ ,  $n$  is  $U$  matrix order number. Other features roots of  $U$  is 0,  $\lambda_{max}$  corresponding feature vector

$$W = (w_1, \dots, w_n)^T, \text{ then } u_{ij} = \frac{w_i}{w_j}, \forall i, j = 1, 2, \dots, n, \text{ so :}$$

$$U = \begin{pmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \dots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & \dots & \frac{w_2}{w_n} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \dots & \frac{w_n}{w_n} \end{pmatrix} \tag{5}$$

$U$  is  $n$  order positive reciprocal matrix, when it is consistent matrix, when and only when  $\lambda_{\max} = n$  as well as when  $U$  is inconsistent, it surely has  $\lambda_{\max} > n$ . Thereupon, use  $\lambda_{\max}$  and  $n$  relationship to test whether  $U$  is consistent matrix or not.

$U$  consistency test calculation steps:  
 Firstly, according to data, it can get:

$$\lambda_{\max} = \sum_{i=1}^4 \frac{(U\omega_A)_i}{n\omega_{Ai}} = 4.231 \tag{6}$$

And go ahead with consistency indicator  $C.I.$  calculation,

$$C.I. = \frac{\lambda_{\max} - n}{n - 1} = \frac{4.2310 - 4}{4 - 1} = 0.077 \tag{7}$$

Secondly, consult corresponding average random consistency indicator  $R.I.$ .  $RI$  Value could refer to TABLE 7:

**TABLE 7 : Average random consistency indicator R.I. table**

Matrix order number	1	2	3	4	5	6	7	8
R.I.	0	0	0.52	0.89	1.12	1.26	1.36	1.41
Matrix order number	9	10	11	12	13	14	15	
R.I.	1.46	1.49	1.52	1.54	1.56	1.58	1.59	

$R.I.$  Value is got in this way that randomly constructs 1000 sample matrixes. Random select numbers from 1 to 9 as well as its reciprocals to construct positive reciprocal matrix, and determine average value of maximum feature root  $\lambda'_{\max}$ , and define:

$$RI = \frac{\lambda'_{\max} - n}{n - 1} = 0.89 \tag{8}$$

Finally, solve consistency ratio  $C.R.$ .

$$C.R. = \frac{C.I.}{R.I.} = 0.0865 < 0.1 \tag{9}$$

When  $CR < 0.10$ , it is thought that  $U$  consistency is acceptable, when  $CR > 0.10$ , it is thought that  $U$  consistency cannot pass, it should make adjustment. According to formula (8), consistency passes. In the process, it also includes hierarchical total arrangement and consistency test, due to article lengths are limited, no theoretical statements here, directly apply it in the following.

④ Computed result

The model involved algorithm can implement by *Matlab* software programming, therefore it can get hierarchical single arrangement and total arrangement computed result as following TABLE 8 shows:

By above TABLE 8, we can get integrated and decomposing combination aerobics teaching method total arrangement weight is the largest, and meanwhile it also gets four kinds of aerobics teaching methods importance degree. Among them, integrated and decomposing combination aerobics teaching method is better. Secondly is the game aerobics teaching method, and then is basic composition aerobics teaching method, finally is collective and group practice aerobics teaching method.

**TABLE 8 : Hierarchical total arrangement**

Criterion	Aerobics popular degree in students	Aerobics teachers' teaching difficulty	Influence of the classroom	Aerobics students' receiving degrees	Total arrangement weight
Criterion layer weight	0.1794	0.3606	0.1783	0.5284	
Scheme layer single arrangement	Collective and group practice	0.1744	0.4322	0.3314	0.3347
	Integrated and decomposing combination	0.0948	0.2758	0.4233	0.4353
	Basic composition	0.0785	0.1663	0.2835	0.3751
	The game aerobics teaching	0.2080	0.1199	0.5773	0.3886

**CONCLUSION**

The paper makes analysis and researches on college students aerobics teaching method reformation, from which it analyzes aerobics basic combination way four kinds of teaching methods, selects aerobics teaching reformation main influence factors are influence of the classroom, aerobics students' receiving degrees, aerobics teachers' teaching difficulty, aerobics popular degree in students, by applying analytic hierarchy process and other methods, it makes analysis, and gets that uses integrated and decomposing combinative aerobics teaching method can let teaching efficiency to arrive at optimum; secondly successively is the game aerobics teaching method, basic composition aerobics teaching method and collective and group practice combinative method. The result basically conforms to investigation practical status; it shows the model rationality and effectiveness, so it has popularization.

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