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Analytic hierarchy process-based university students sports elective course development and influence factors research

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ABSTRACT

Contemporary university students are motherland beams and social construction main forces, only rely on passing on cultural knowledge is far from enough, we need to cultivate university students comprehensive quality all-round developed talents, only then can let contemporary university students to better go into socialism construction tide. Therefore, university students' sports elective course has become an indispensable part of university education. The paper utilizes analytic hierarchy process method, establishes university students elective course influential AHP model, by comparing weights, it gets sports option course of university students highest option rate. At first, start from students' themselves, teachers, teaching, management, field, apparatus and other aspects, analyzes numerous factors that affect university students sports elective courses, and then gets conclusions. Secondly, on this basis, utilize analytic hierarchy process to establish target layer, scheme layer and criterion layer, by calculating and analyzing, it gets conclusions that students' themselves, teachers, teaching, management, field, apparatus and others, all have certain impacts on university students' sports elective courses, current stage China universities' students of university sports elective course highest option rate is badminton, secondly is table tennis and basketball.

KEYWORDS

Sports elective course; Analytic hierarchy process; Hierarchical structure; Influence factor; University sports.



INTRODUCTION

With China universities education constant reformation and deepening, physical education has transformed from previous single sports general course into multiple sports elective course. The education reformation not only can enhance students' positivity in participating in sports, but also is helpful for school teachers' teaching management.

By consulting lots of relative literatures and discoveries, in 2008, Zheng Gui-Feng, Zhou Li-Bao in the article "Regular universities sports elective course setting status investigation", selected China five universities as investigation and research objects, analyzed present university students physical elective course status.

In 2006, Yao Yong-Wei in the article "Xingtai city higher vocational college sports elective course organization status research", collected a great deal of relevant literatures, and adopted investigation, statistics and other methods, by analyzing universities sports elective course status, got corresponding conclusions.

In 2001, Huang Song-Feng, Lin Yang-Suo in the article "University students sports elective courses selection influential factors research", took Yunnan Normal University public sports elective course grade 09 university students as research objects, adopted questionnaire survey, data analysis and other methods to analyze China university students sports elective course influential numerous factors.

The paper on the basis of researching on China university students sports elective course, references formers summarized experiences and literatures, starts from university students sports elective course influential factors perspective, comprehensive analyzes students themselves factor, teachers factor, teaching, management factor, venues and equipment factors influences on sports elective course. By mathematical methods, it establishes university students sports elective course analytic hierarchy process model, and then gets present China university students' sports elective course maximum selective odds physical education course.

RECENT YEARS' CHINESE UNIVERSITY STUDENTS' SPORTS ELECTIVE COURSES STATUS

Chinese vocational colleges setting sports elective course purpose analysis

Sports elective course is one compulsory course in higher vocational colleges; its setting not only promotes students' lifelong sports consciousness, but also can promote students' physical quality. Below TABLE 1 is Chinese universities sports elective course setting purposes statistical analysis table, make statistical analysis on them, analysis process is as following, and then get conclusions:

TABLE 1 : Chinese vocational colleges' sports elective course setting purpose

Content	School	Number of frequency
Cultivate the students' lifelong sports consciousness	5	100
Improve the comprehensive ability of students	2	50.00
To improve the students' ability of social adaptation	2	50.00
To cultivate the students to take an active part in sports	4	100
Improve the students' sports ability and technology	3	75.00
Cultivate the students' initiative	1	25.00
For satisfying the requirement of students' entertainment only	0	0
To improve students' social ability	1	25.00

In order to more convenient to observe and analyze, transform above table into pie Figure 1 as following:

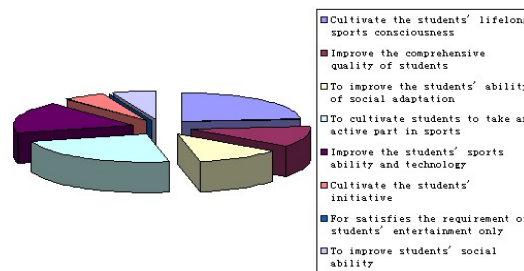


Figure 1 : Open the purpose of sports elective course in higher vocational colleges

From TABLE 1 and Figure 1, we can clearly see that cultivate students lifelong sports consciousness and cultivate students to take an active part in sports are main purposes of Chinese vocational colleges sports elective course setting purposes; secondly purpose is improving the students' sports ability and technology, the third one is improving the

comprehensive ability of students and improving the students' ability of social adaptation, finally is cultivating the students' initiative and improving students' social ability, schools that only for satisfying the requirement of students' entertainment almost don't exist.

Sports elective course teaching management analysis

TABLE 2 : Elective course syllabus status statistics table

	Bachelor degree (28)		Specialized subject (15)	
	n	%	n	%
Have the syllabus	8	28.6	3	20.0
With the teaching material	7	25.0	1	6.7
There are evaluation standard	21	75.0	13	86.7

In order to more intuitional and easier to observe, transform TABLE 2 into bar Figure 2, as following:

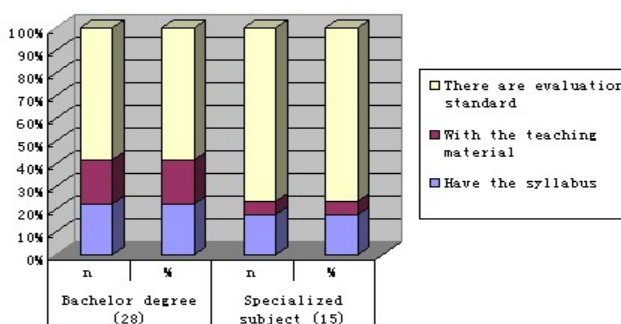


Figure 2 : Elective course syllabus of statistical list

By TABLE 2 and Figure 2, we can see that among vocational colleges, sports elective course that have syllabus and teaching materials are fewer, though most of colleges have evaluation standards on sports elective course, it still can see that Chinese vocational colleges sports elective course management exists imperfect status.

UNIVERSITY STUDENTS ELECTIVE COURSE INFLUENTIAL ANALYTIC HIERARCHY PROCESS MODEL

At present, contemporary university students' sports elective course influential factors are students' own factors, teachers factors, teaching、management factors, venues and equipment factors and so on. The paper establishes analytic hierarchy process model, makes quantization on university students sports elective course orientations, by establishing target layer, criterion layer, and scheme layer relations, finally gets present Chinese university students elective course highest selection odd sports course.

Model establishment

AHP is based on posed problems' requirements and properties, it divides contained factors into target layer, criterion layer and scheme layer, so that constitutes a hierarchical shape structure, and makes paired mutual comparison of each factor in the same layer, and defines next layer weight with respect to previous layer target. By analyzing every layer, finally rank target layer, criterion layer and scheme layer each factor that the factor importance degree to total target. Its main features are reasonable combining qualitative and quantitative decisions so that let decision process to be layering and quantified.

Target layer: College students' sports elective course

Criterion layer: Scheme influence factors, C_1 is students own factors, C_2 is teachers' factors, C_3 is teaching and management factors, C_4 is venues and equipment factors.

Scheme layer: A_1 is badminton, A_2 is table tennis, A_3 is basketball

By analyzing college students' sports elective course influence factors, layer relative influence factors from top to down, last layer suffers next layer influences, but each layer factors are relative independent. Then it gets following hierarchical structure Figure 3:

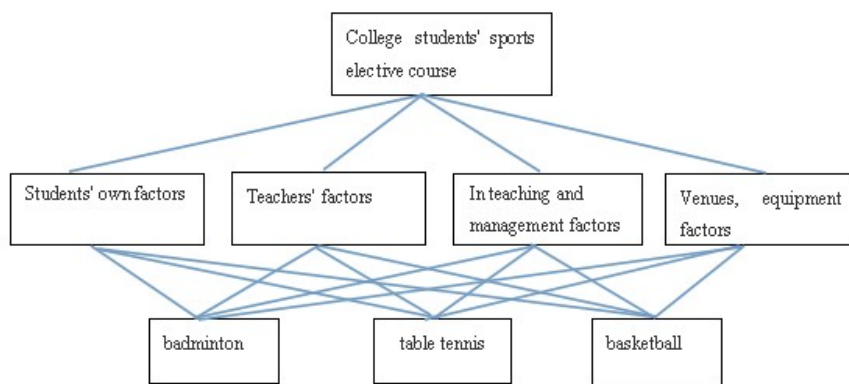


Figure 3 : The hierarchical structure of the university sports elective course

Factor analysis

Primary factor that affects university students sports elective course is university students own factors, from which it mainly includes every students interests and hobbies, selection purposes and motivations, genders differences, physiological and psychological endurance, self physical quality status, requirements on credit and future working practice and other elements.

When students select different sports courses, most of students, except for considering self factor, secondly all will consider teachers each aspect factors, such as: teachers’ professional ethics, teachers’ professional proficiency, teachers’ individual charm and teachers’ language orientation and other factors.

Elective course setting, faculty equipping, teaching hours and credits distribution are teaching and management factors in university students’ sports elective course. Whether elective course setting can meet students’ aspiration is very important for students selection; faculty equipping is an important guarantee to elective course quality, and meanwhile, it also reflects a school setting elective course strength to certain extents; students in elective course, except for learning one favorite sports course, they will consider whether class hours are more, credits are easier to acquire such factors, therefore, whether teaching hours and credits distribution is reasonable or not is one of multiple important factors that affects sports elective course.

Venues, equipment are sports hardware, the factors mainly include venues, equipment quantity, sports venue environment, equipment , facilities functions. Venues, equipment quantity have certain limitations on the elective course number of people, and then will cause some students cannot select their favorite sports course; sports venue environment divides into indoors venues and outdoors venues, some students may like exercising in outdoors, while some like exercising in indoors, therefore students can select different sports courses according to their requirements, equipment , facilities functions get more complete, students can exercise more contents, and meanwhile more number of students are attracted to participate.

Construct paired comparison matrix

Construct paired comparison matrix is carrying on paired comparison among elements, using matrix to express each layer every element importance to previous layer all elements, here apply operational research expert proposed 1~9 ratio scale, as TABLE 3.

TABLE 3 : 1-9 Scale definition

Scale a_{ij}	Definition
1	factor i and factor j have equal importance
3	factor i is slightly more important than factor j
5	factor i is relative more important than factor j
7	factor i is extremely more important than factor j
9	factor i is absolute more important than factor j
2,4,6,8	Indicates middle state corresponding scale value of above judgments
Reciprocal of above each value	If compare indicator i with indicator j , the relative importance use above one numeric value scale, then indicator j and indicator i relative importance use above numeric value reciprocal scale

According to above scale TABLE 3, set judgment matrix A as :

$$A = \begin{pmatrix} 1 & 2 & 4 & 3 \\ \frac{1}{2} & 1 & 5 & 5 \\ \frac{1}{4} & \frac{1}{5} & 1 & 1 \\ \frac{1}{3} & \frac{1}{5} & 1 & 1 \end{pmatrix}$$

Obviously, A is positive reciprocal matrix.

Calculate compared element relative weight on the criterion

Consistency matrix definitions and property:

a. Consistency matrix's definition : Positive reciprocal matrix that meets $a_{ij} * a_{jk} = a_{ik}, i, j = 1, 2, \dots, n$ is consistency matrix. For example :

$$A = \begin{pmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \dots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & \dots & \frac{w_2}{w_n} \\ \frac{w_3}{w_1} & \frac{w_3}{w_2} & \dots & \frac{w_3}{w_n} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \dots & \frac{w_n}{w_n} \end{pmatrix}$$

b. Consistency matrix property: matrix A order is n , A unique non-zero feature root is n . Matrix A any one column vector is a feature vector that corresponds to n . Matrix A normalized feature vector can be used as weight vector.

However, in above constructed comparison matrix $A = \begin{pmatrix} 1 & 2 & 4 & 3 \\ \frac{1}{2} & 1 & 5 & 5 \\ \frac{1}{4} & \frac{1}{5} & 1 & 1 \\ \frac{1}{3} & \frac{1}{5} & 1 & 1 \end{pmatrix}$

Because $a_{12} = \frac{C_1}{C_2} = 2, a_{13} = \frac{C_1}{C_3} = 4$, it can get $a_{23} = \frac{C_2}{C_3} = 2$, while actually $a_{23} = 5$. So A is not consistency

matrix. In general, for inconsistent (but in permissible range) paired comparison matrix A , it suggests to use feature vector that corresponds to maximum feature root λ as weight vector.

Consistency indicator: $CI = \frac{\lambda_{\max} - n}{n - 1}$. Among them, λ_{\max} is maximum feature value of comparison matrix, n is

order of comparison matrix. When n order positive reciprocal matrix maximum feature root $\lambda \geq n$, and $\lambda = n$, it is consistency matrix. CI Value gets smaller; judgment gets closer to fully consistent. On the contrary, judgment matrix consistency deflection degree will be bigger.

Random consistency indicator TABLE 4: Randomly generate multiple matrixes, add every matrix consistency indicator and then take average value, it gets RI .

TABLE 4 : Random consistency indicator

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

Consistency ratio: If $CR = \frac{CI}{RI} < 0.1$, constructed paired comparison matrix A passes consistency test.

By calculation, it can get paired comparison matrix A maximum feature value $\lambda_{max} = 4.239$, $RI = 0.89$

By consistency indicator $CI = \frac{\lambda_{max} - n}{n - 1}$, input data, it can calculate and get $CI = \frac{4.239 - 4}{4 - 1} = 0.08$

And by consistency ratio $CR = \frac{CI}{RI} = \frac{0.08}{0.89} = 0.089 < 0.1$, so constructed paired comparison matrix A passes consistency test.

Constructed scheme layer judgment matrixes correspond to different criterion layers are as TABLE 5-8.

TABLE 5 : Criterion layer judgment matrix B_1

C_1	A_1	A_2	A_3
A_1	1	1	1/3
A_2	1	1	1/3
A_3	3	3	1

TABLE 6 : Criterion layer judgment matrix B_2

c_2	A_1	A_2	A_3
A_1	1	5	5
A_2	1/5	1	5
A_3	1/5	1/5	1

TABLE 7 : Criterion layer judgment matrix B_3

c_3	A_1	A_2	A_3
A_1	1	5	8
A_2	1/5	1	5
A_3	1/8	1/5	1

TABLE 8 : Criterion layer judgment matrix B_4

c_4	A_1	A_2	A_3
A_1	1	5	8
A_2	1/5	1	5
A_3	1/8	1/5	1

Calculate weight vector, to $A = \begin{pmatrix} 1 & 2 & 4 & 3 \\ \frac{1}{2} & 1 & 5 & 5 \\ \frac{1}{4} & \frac{1}{5} & 1 & 1 \\ \frac{1}{3} & \frac{1}{5} & 1 & 1 \end{pmatrix}$, firstly handling as following:

$$\begin{array}{c}
 \xrightarrow{\text{Column vector normalization}} \begin{pmatrix} 0.859 & 0.963 & 0.509 & 0.509 \\ 0.279 & 0.305 & 0.83 & 0.83 \\ 0.278 & 0.061 & 0.159 & 0.159 \\ 0.278 & 0.061 & 0.159 & 0.159 \end{pmatrix} \\
 \\
 \xrightarrow{\text{According to the row sum}} \begin{pmatrix} 2.801 \\ 2.254 \\ 0.673 \\ 0.673 \end{pmatrix} \xrightarrow{\text{The normalized}} \begin{pmatrix} 0.701 \\ 0.547 \\ 0.169 \\ 0.169 \end{pmatrix} = W^0
 \end{array}$$

And then, by $A \times W^0$ it further solves $\lambda_{\max}^0 = 4.239$.

Similarly, it can solve criterion layer judgment matrix maximum feature value and weight as following:

$$\lambda_{\max}^1 = 3.62, W_1 = \begin{pmatrix} 0.213 \\ 0.223 \\ 0.492 \end{pmatrix}; \lambda_{\max}^2 = 3.31, W_2 = \begin{pmatrix} 0.647 \\ 0.249 \\ 0.061 \end{pmatrix}; \lambda_{\max}^3 = 3.29, W_3 = \begin{pmatrix} 0.607 \\ 0.195 \\ 0.137 \end{pmatrix}; \\
 \lambda_{\max}^4 = 3.29, W_4 = \begin{pmatrix} 0.597 \\ 0.199 \\ 0.146 \end{pmatrix}$$

And utilize above principle to judge, it is clear that all passes consistency test.

Calculate combination weight vector

$$\text{By } W^1 = (W_1, W_2, W_3, W_4), \text{ and } W = W^1 \times W^0 \text{ it can calculate and get } W = \begin{pmatrix} 0.479 \\ 0.220 \\ 0.301 \end{pmatrix}.$$

By above combination weight calculation result, it can analyze that in Chinese university students main sports elective courses, badminton occupies 47.9%, table tennis occupies 22%, basketball occupies 30.1%. And then it can get conclusions, badminton selective rate in university students sports elective courses are the highest, secondly is table tennis and basketball.

CONCLUSION

The paper targeted at recent years' Chinese university students' sports elective course status, by researching Chinese universities sports elective course setting purposes and universities sports elective course teaching management, it analyzes and gets that main purposes of setting sports elective course are cultivating students to take an active part in sports and cultivating students lifelong sports consciousness, by researching on teaching management, it is clear that presently Chinese vocational colleges teaching management on university students' elective course is still not so perfect.

The paper selects university students' sports elective course as research objects, analyzes university students' sports elective course influence factors, utilizes analytic hierarchy process to establish AHP model, and then gets conclusions, badminton selective rate in university students sports elective courses are the highest, secondly is table tennis and basketball.

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