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# Hierarchical analysis model under the university sports education model research in the form of the club

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## ABSTRACT

With the reform and opening to the foreign advanced system introduced our country sports club geared to the needs of all students, expand the degrees of freedom, is suitable for our country university sports education. Based on hierarchical analysis model, from entertainment, physical exercise, mental relaxation, security, square in the face of university sports education model research, the main contrast club form of college sports education is different from ordinary ways of teaching are studied. Education mode by results showed that the sports club accounted for 55.3%, while traditional teaching only accounted for 24%, the teaching management type accounted for 29%, thus, can explain university sports teaching, mode of the club holds a large proportion of education.

## KEYWORDS

Analytic hierarchy process; Club form; University sports; Education form; Physical health.

## INTRODUCTION

Club in the form of sports has a long history in abroad, for example, in Japan, after a slow start in just 40 years, for the club in the form of sports management and operation should have a higher level of development, in some of the western world, the club in the form of sports but also received the support of the masses, it is the place where sports activities occur most frequently, for the masses residents, the emergence of sports club form has become the main form to fitness. Is obtained by analysis, foreign sports club has the nature of non-profit, with the principle of voluntary and mass, and the club, for business. And most of the sports clubs are government funding and support

Along with our country economic growth, introducing foreign advanced system in the reform and opening to the outside world, study for sports clubs in China increased year by year, and seek to conform to the characteristic of our country sports club mode and management method, also many scholars to study.

### Model establishments

Analytic hierarchy process is originated from 1970s that discovered by an American operational research expert, he classified objects relative factors into target layer, criterion layer, scheme layer, and formed into good qualitative and quantitative analysis.

### Establish hierarchical structure

The paper based on analytic hierarchy process, it quantizes university physical education. Establish target layer, criterion layer, scheme layer relations.

**Target layer**: University sports education mode.

**Criterion layer**: Scheme influence factors, $c_1$ is entertainment、 $c_2$ is mental relaxation, $c_3$ is physical exercise, $c_4$ is safety.

**Scheme layer**: $A_1$ is sports club, $A_2$ is general physical teaching, $A_3$ is non-management teaching. It gets hierarchical structure as Figure 1 show:

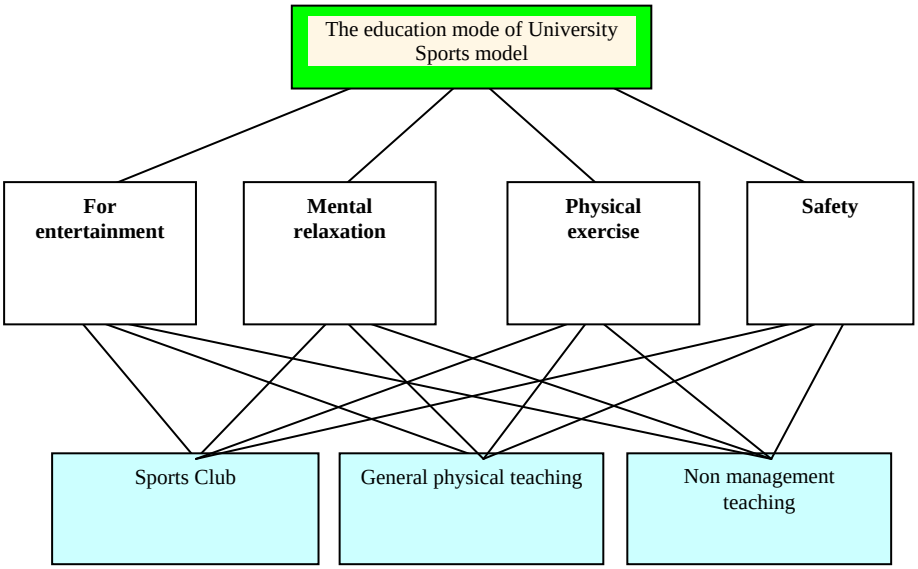

**Figure 1 : Hierarchical structure**

## Construct judgment (paired comparison) matrix

In criterion layer, each criterion target occupies different proportions, by researchers researching on criterion layer, and according to number 1～9 and its reciprocal to judge each criterion target occupied weights.

The paper takes TABLE 1 showed 1～9 scale table as evidence, it makes weight analysis.

**TABLE 1 : 1~9 scale table**

| 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 | If factor i and factor j are relative weak, obtained judgment is reciprocal |

Refer to Figure 2, it is 1~9 scale Figure.

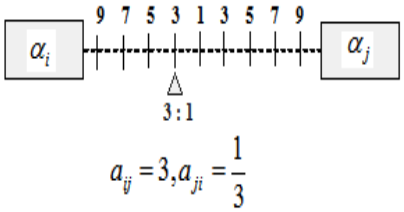


**Figure 2 : 1~9 scale Figure**

At first, solve judgment matrix, according to above principle, reference 1～9 scale setting, and according to experts' experiences and refer to lots of documents, it gets paired comparison matrix that are respective as TABLE 2-6.

**TABLE 2 : Comparison matrix**

| G | $c_1$ | $c_2$ | $c_3$ | $c_4$ |
|---|---|---|---|---|
| $c_1$ | 1 | 1/3 | 3 | 3 |
| $c_2$ | 31/8 | 1 | 5 | 5 |
| $c_3$ | 1/3 | 1/5 | 1 | 1 |
| $c_4$ | 1/3 | 1/5 | 1 | 1 |

**TABLE 3 : Comparison matrix**

| $c_1$ | $A_1$ | $A_2$ | $A_3$ |
|---|---|---|---|
| $A_1$ | 1 | 1 | 1/3 |

| | | | |
|---|---|---|---|
| $A_2$ | 1 | 1 | 1/3 |
| $A_3$ | 3 | 3 | 1 |

**TABLE 4 : Comparison matrix**

| $c_2$ | $A_1$ | $A_2$ | $A_3$ |
|---|---|---|---|
| $A_1$ | 1 | 5 | 5 |
| $A_2$ | 1/5 | 1 | 5 |
| $A_3$ | 1/5 | 1/5 | 1 |

**TABLE 5 : Comparison matrix**

| $c_3$ | $A_1$ | $A_2$ | $A_3$ |
|---|---|---|---|
| $A_1$ | 1 | 5 | 8 |
| $A_2$ | 1/5 | 1 | 5 |
| $A_3$ | 1/8 | 1/5 | 1 |

**TABLE 6 : Comparison matrix**

| $c_4$ | $A_1$ | $A_2$ | $A_3$ |
|---|---|---|---|
| $A_1$ | 1 | 5 | 8 |
| $A_2$ | 1/5 | 1 | 5 |
| $A_3$ | 1/8 | 1/5 | 1 |

## Hierarchical single arrangement and consistency test

Use consistency indicator to test: Set in comparison matrix, $\lambda_{\max}$ is maximum feature value, n is comparison matrix order: $CI = \frac{\lambda_{\max} - n}{n-1}$

$CI$ Value gets smaller; Judgment matrix gets closer to completely consistent. $CI$ gets bigger shows that known degree is lower.

## Hierarchy total sorting and its consistency test

$$A=\begin{Bmatrix}1 & 1/3 & 3 & 3\\ 3 & 1 & 5 & 5\\ 1/3 & 1/5 & 1 & 1\\ 1/3 & 1/5 & 1 & 1\end{Bmatrix}$$

$$\xrightarrow{\text{Column vector normalization}}\begin{Bmatrix}0.214 & 0.192 & 0.3 & 0.3\\ 0.075 & 0.577 & 0.5 & 0.5\\ 0.121 & 0.115 & 0.1 & 0.1\\ 0.201 & 0.115 & 0.1 & 0.1\end{Bmatrix}$$

$$\xrightarrow{\text{Solve sum by line}}\begin{Bmatrix}1.066\\ 2.22\\ 0.386\\ 0.386\end{Bmatrix}$$

$$\xrightarrow{\text{Normalization}}\begin{Bmatrix}0.2515\\ 0.555\\ 0.0965\\ 0.0965\end{Bmatrix}=W^{(0)}$$

$$AW^{(0)}=\begin{Bmatrix}1 & 1/3 & 3 & 3\\ 3 & 1 & 5 & 5\\ 1/3 & 1/5 & 1 & 1\\ 1/3 & 1/5 & 1 & 1\end{Bmatrix}\begin{Bmatrix}0.2514\\ 0.555\\ 0.0965\\ 0.0965\end{Bmatrix}=\begin{Bmatrix}1.012\\ 2.275\\ 0.387\\ 0.387\end{Bmatrix}$$

$$\lambda_{\max}^{(0)}=\frac{1}{4}\left(\frac{1.012}{0.251}+\frac{2.275}{0.555}+\frac{0.387}{0.0965}+\frac{0.387}{0.0965}\right)=4.037$$

$$w^{(0)}=\begin{pmatrix}0.251\\ 0.555\\ 0.097\\ 0.097\end{pmatrix}$$

Similarly, it can calculate judgment matrix

$$B_1=\begin{Bmatrix}1 & 1 & 1/3\\ 1 & 1 & 1/3\\ 3 & 3 & 1\end{Bmatrix},B_2=\begin{Bmatrix}1 & 5 & 5\\ 1/5 & 1 & 5\\ 1/5 & 1/5 & 1\end{Bmatrix},B_3=\begin{Bmatrix}1 & 5 & 8\\ 1/5 & 1 & 5\\ 1/8 & 1/5 & 1\end{Bmatrix},B_4=\begin{Bmatrix}1 & 5 & 8\\ 1/5 & 1 & 5\\ 1/8 & 1/5 & 1\end{Bmatrix}$$

Corresponding maximum feature value and feature vector are successive:

$$\lambda^{(1)}{}_{\max}=3.64,\omega^{(1)}{}_1=\begin{Bmatrix}0.244\\ 0.244\\ 0.512\end{Bmatrix}$$

$$\lambda^{(2)}{}_{\max}=3.29,\omega^{(1)}{}_2=\begin{Bmatrix}0.657\\ 0.251\\ 0.092\end{Bmatrix}$$

$$\lambda^{(3)}{}_{\max} = 3.31, \omega^{(1)}{}_3 = \begin{Bmatrix} 0.648 \\ 0.204 \\ 0.148 \end{Bmatrix}$$

$$\lambda^{(4)}{}_{\max} = 3.31, \omega^{(1)}{}_4 = \begin{Bmatrix} 0.648 \\ 0.204 \\ 0.148 \end{Bmatrix}$$

Use consistency indicator to test: $CI = \frac{\lambda_{\max} - n}{n-1}$, $CR = \frac{CI}{RI}$

**TABLE 7 : RI value**

| 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 |

(1) It gets judgment matrix $A$, $\lambda^{(0)}{}_{\max} = 4.073, RI = 0.9$

$$CI = \frac{4.073 - 4}{4 - 1} = 0.24$$

$$CR = \frac{CI}{RI} = \frac{0.024}{0.90} = 0.027 < 0.1$$

It shows A inconsistency test is valid and moves within permissible range, it can use A feature vector to replace weight vector.

(2) Similarly, make consistency test on judgment matrix $B_1$, $B_2$, $B_3$, $B_4$, it gets weight vectors.

Utilize hierarchical chart drawing out calculation results from target layer to scheme layer, as Figure 3 show.

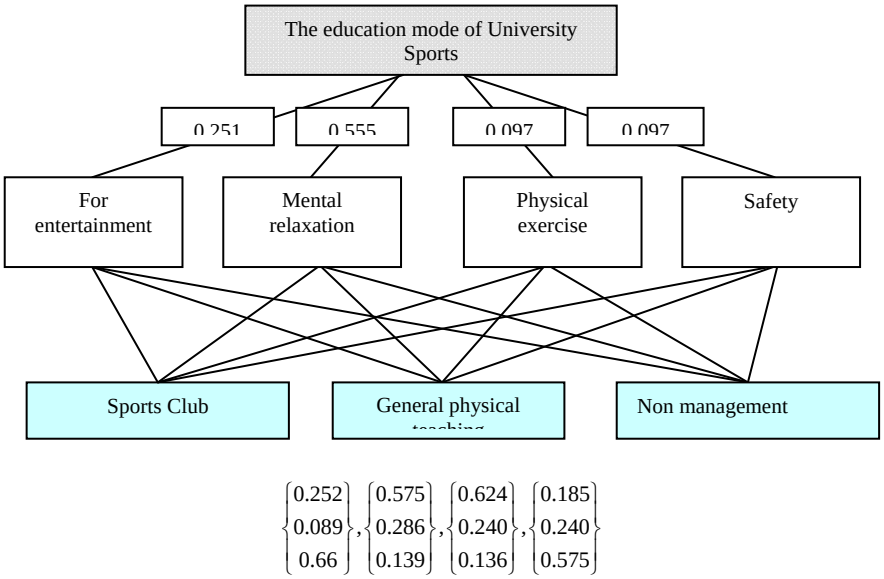


**Figure 3 : Hierarchical structure chart**

Calculation structure as following:

$$\omega^{(1)} = (\omega_1^{(1)}, \omega_2^{(1)}, \omega_3^{(1)}, \omega_3^{(1)}) = \begin{Bmatrix} 0.624 & 0.185 & 0.252 & 0.575 \\ 0.234 & 0.240 & 0.089 & 0.286 \\ 0.136 & 0.575 & 0.66 & 0.139 \end{Bmatrix}$$

$$w = w^{(1)} w^{(0)} = \begin{Bmatrix} 0.252 & 0.575 & 0.624 & 0.185 \\ 0.089 & 0.286 & 0.240 & 0.240 \\ 0.66 & 0.139 & 0.136 & 0.575 \end{Bmatrix} \begin{Bmatrix} 0.567 \\ 0.056 \\ 0.104 \\ 0.273 \end{Bmatrix} = \begin{Bmatrix} 0.290 \\ 0.157 \\ 0.553 \end{Bmatrix}$$

According to obtained weight, it is clear that sports club education mode occupies 55.3% while general physical teaching only occupies 24%, non management teaching occupies 29%, thereupon, and it can indicate that in university sports teaching mode, club education occupies great proportions.

## CONCLUSION

Analytic hierarchy process can dynamic integrate qualitative analysis with quantitative analysis to make multiple targets decision-making analysis, the method can analyze a problem according to its contained all kinds of factors occupied weights, and classifies a problem into different hierarchies and multiple, comprehensive influence factors, by paired factors comparing, it gets comparison matrix. And there are many analytic hierarchy process methods, as fuzzy analytic hierarchy process, grey analytic hierarchy process, improved analytic hierarchy process and so on. The paper studies university physical education mode from entertainment, mental relaxation, physical exercise, safety these four aspects, it gets sports club education mode superiorities.

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