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An Algorithm for Comprehensive Evaluation of College Students' Physical Quality

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***Abstract* - In this paper, we consider comprehensive evaluation of college students' physical quality. Based on fuzzy pattern recognition and analytic hierarchy process, we give an algorithm for comprehensive evaluation. We also illustrate the efficiency of given algorithm through numerical example on college students' comprehensive quality.**

***Index Terms* - college students' physical quality, comprehensive evaluation, algorithm, classroom instruction.**

I. INTRODUCTION

Fuzzy Analytic Hierarchy Process (FAHP) is a systematic analysis method combining qualitative and quantitative methods. This method provides a basis for quantitative evaluation of indicators, selection of optimal solutions, and has been widely used. Wang and Sun ([1]) establishes the corresponding index of the evaluation system, using AHP determines the weights of indicators. According to the evaluation index, the fuzzy comprehensive evaluation was given. Researchers reported that about 40% to 50% of college students are physically inactive ([2]). In a modern society with highly developed science and technology, the physical quality of students is getting worse and worse, and the physical quality of college students is paid more and more attention. However, there are many factors that affect students' physical quality, and the relationship between these factors is also complicated. Therefore, these factors defining in evaluation is relative difficult; after defining factors, it is also not very realistic to make whole quantization of them, therefore, when carries out undergraduates' physical quality evaluation it should implement according to qualitative and quantitative combination method. There are scholars that use analytic hierarchy process to do researches on sports teaching quality evaluation, but traditional analytic hierarchy process normally use Saatyís weight approach to define each evaluation indicator weight, and require each paired comparative judgment matrix with satisfaction consistency, while in actual research, when orders are bigger, judgment matrix tends to be difficult to have satisfaction consistency, therefore established physical quality evaluation system may exist certain problems ([3,4]). Therefore, how to establish a scientific evaluation system becomes more and more important.

In this paper, we used a modified version of FAHP in physical quality evaluating application. a method combining fuzzy pattern recognition and AHP is used to establish a comprehensive evaluation model of students' physical quality. The scientific and practical methods are developed to improve their physical fitness by collecting the data of students.

II. SIGNIFICANCE FOR CONSTRUCTION OF PHYSICAL QUALITY EVALUATING SYSTEM

(1) Physical quality evaluating is an important part of the management of college physical education. It is well known that physical education attaches more and more attention, so knowing how to evaluate the college students' physical quality can improve the physical education teaching method ([5,6]). Particularly, the following two questions should be answered for each education manager. The first one is how to build a scientific and feasible management system for physical quality, and the second one is what kind of management mode is effective. On the other hand, the teaching quality evaluating system can timely get the feedback from the quality of physical accessment.

(2) Physical quality evaluating is an important means to ensure the quality of personnel training. We know that there are many factors which could influence the quality of personnel cultivating level, including specialized course performance, personal accomplishment and so on. However, all aspects base on physical quantity, so it is the limited factor to meet the requirement of personnel training in a school.

(3) Studying on physical quality evaluating has practical significance. Studying on physical quality evaluating has the benefit of clearing direction of development, firmly the concept of establishing the quality of personnel physical training is the lifeline of university. On the other hand, in the new situation, the above research can help us deal with the relationship between scale and quality, teaching and scientific

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research. At the same time, this study can standardize college students' performance in physical education, optimize aspects of teaching practice, and cultivate a new quality oriented education training model. University should cultivate integrated development students. Particularly, university should continue to deepen the educational system to adapt the environment of the contemporary international situation, and cultivate students to have the spirit of fitness enthusiast. In a word, all these goals need to evaluate the physical quality precisely. Particularly, college physical education is an important part of college education, in this paper, we study on how to design an effective model to evaluation the teaching results of college physical education.

III. THE ALGORITHM FOR COMPREHENSIVE EVALUATION OF COLLEGE STUDENTS' PHYSICAL QUALITY

Pattern recognition is the various categories of a thing, and then to determine which category a given object belongs to. Patterns here refer to standard styles, patterns, samples, graphics, etc. However, things in daily life often have a strong vagueness, that is, it cannot be clearly identified which category it belongs to. For this kind of thing with strong fuzziness can be described with the help of fuzzy theory, and the problem with fuzzy pattern recognition can be dealt with by fuzzy pattern recognition ([7]).

Set the set object $U=(u_1,u_2,\cdots,u_m)$ as a given object to be recognized, in which $u_i(i=1,2,\cdots,m)$ is m characteristic index of U, and each characteristic index characterizes a certain aspect of the identified object U. The decision comment set $V=(v_1,v_2,\cdots,v_n)$, where $v_i\ (i=1,2,\cdots,n)$ represents a category, $v_i=(v_{i1},v_{i2},\cdots,v_{im})$ represent the m attribute value corresponding to objects belonging to this category. Fuzzy pattern recognition is to classify object U into the most similar category to v_i.

Firstly, the single factor $u_i\in U(i=1,2,\cdots,m)$ was evaluated on the choice level $v_i(i=1,2,\cdots,m)$, the evaluation set were obtained, denotes by $a_i=(a_{i1},a_{i2},\cdots,a_{im})$, $\sum_{j=1}^{n}a_{ij}=1$, focusing factors constitutes a total evaluation matrix

$$A=\begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{pmatrix}$$

where $u_A(u_i,v_j)=a_{ij}$ denotes the membership degree of choice grade v_j of factor u_i.

The evaluation index of single factor is easy to get. For example, if the whole class is asked to evaluate the index of "physical and mental health" of a certain student (i.e., focus on factors). According to the survey, 15,25,10, and 0 people are rated as A,B,C,D,respectively, then the rating of "physical and mental health" of that student is $(0.3,0.5,0.2,0)$.

Secondly, when faced with multiple factors, the importance of another factor is also required to obscure the subset R, which is denoted as $R=r_1/u_1+r_2/u_2+\cdots+r_m/u_m$, where r_i is the membership of u_i to R It is a measure of the influence degree of single-factor u_i in the overall evaluation, and it also represents the ability of rating according to single-factor u_i to some extent. the following method is used to determine R.

Step1. Compute value of each factor u_i.

Each student who participated in the evaluation was supposed to evaluate other students in the class, and an K_i value of u_i for each factor was needed, where the value of K_i is some value in the number of $1,2,\cdots,m$, i.e. $K_i\in\{1,2,\cdots,m\}$. The most important factor is that its K_i value is 1, and the least important factor that K_i value is m. The assignment of factor u_i by the h member is K_{i-h}.

Step2. Draw the priority score table.

According to the students assigned the value K_i of each factor u_i through the following method. If $K_{j-h}/K_{i-h}>1$, then we take $R_{ij-h}=1$; If $K_{j-h}/K_{i-h}<1$, then we take $R_{ij-h}=0$.

A total of n students participated in the rating, and the R_{ij-h} values of all students were added up, i.e., $R_{ij}=\sum_{h=1}^{n}R_{ij-h}$ ($i=1,2,\cdots,m;\ j=1,2,\cdots,m$). In this way, a preferential statistical table consisting of $m\times m$ statistics and R_{ij} is obtained.

Step3. Compute value of $\sum R_{\max}$ and $\sum R_{\min}$.

Sum up the R_{ij} values of each row in the priority statistics table, and get: $\sum R_i=\sum_{j=1}^{m}R_{ij}, i=1,2,\cdots,m$, where $\sum R_i$ represents the sum of the R_{ij} values of i row

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$$\sum R_{\max} = \max\{\sum R_1, \sum R_2, \cdots, \sum R_n\},$$
$$\sum R_{\min} = \min\{\sum R_1, \sum R_2, \cdots, \sum R_n\}.$$

Among all factors, $\sum R_{\max}$ was the most important, while $\sum R_{\min}$ was the least important.

Step4. Calculate the level difference d .

Let $r_{\max} = 1, \ r_{\min} = 0.1$ and other r values belong to $[0,1]$, then

$$d = \frac{\sum R_{\max} - \sum R_{\min}}{r_{\max} - r_{\min}}.$$

Step5. Calculate factor significance coefficient r_i .

The formula of factor significance coefficient r_i is

$$r_i = \frac{\sum R_i - \sum R_{\min}}{d} + 0.1, \quad i = 1, 2, \cdots, m.$$

Therefore, the fuzzy subset of the importance degree of the factors to be determined is obtained $R = (r_1, r_2, \cdots, r_m)$.

Finally, after the fuzzy vector R and the fuzzy relation matrix A are obtained, we give the following fuzzy comprehensive evaluation model.

$$B = RA = (r_1, r_2, \cdots, r_m)\begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{pmatrix} = (b_1, b_2, \cdots, b_m).$$

where $\sum_{j=1}^{n} b_j = 1.$

Among them, B represents the hierarchical fuzzy subset on the decision evaluation set, and $b_i (i = 1, 2, \cdots, n)$ is the membership degree of the hierarchical fuzzy subset B obtained from the comprehensive evaluation by the decision level v_j. According to the principle of maximum membership degree, the hierarchical v_j corresponding to the maximum b_i can be selected as the result of comprehensive evaluation ([8]).

On the other hand, we also give the following an algorithm to obtain the final score for the integrated evaluation of some student([8]). For example, suppose that the value of v_j is c_j ($j = 1, 2, \cdots, n$), then we obtain the student's final score $\sum_{j=1}^{n} c_j b_j$.

IV. NUMERICAL EXAMPLE

Assume that A school student's comprehensive qualities can be divided into A (good) and B (good), C (pass), D (failed) level 4, i.e., $V = (A, B, C, D)$. The standing long jump (X1), 1000 meters (boys)/800 m (girl) (X2), pull-ups (boys)/sit-ups (girl) (X3), A minute jump rope (X4), height(X5), weight(X6), grip strength(X7), begin to bend(X8), vital capacity(X9), pulse(X10), 50 meters(X11) 11 index as the index system to judge the students' comprehensive quality.

Firstly, focusing factors constitutes evaluation matrix. The evaluation matrix needed in this paper is obtained by judging the importance of 11 indicators set by each group of 30 experts, and the results in Table 1 can be obtained (only two cases are listed in this paper).

TABLE I

Expert Evaluation Results

Group	α				β			
Grade	A	B	C	D	A	B	C	D
X1	10	12	8	0	12	9	9	0
X2	17	8	5	0	18	6	6	0
X3	17	9	4	0	10	11	9	0
X4	8	16	6	0	6	12	12	0
X5	5	21	4	0	9	16	5	0
X6	6	17	7	0	6	11	13	0
X7	9	12	9	0	11	11	8	0
X8	7	17	6	0	10	12	8	0
X9	10	11	9	0	8	16	6	0
X10	6	15	9	0	14	9	7	0
X11	18	8	4	0	13	9	8	0

The evaluation of each group of experts is unitized according to different levels, and the evaluation matrix obtained is shown in Table 2.

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TABLE II

Evaluation Matrix

Group / Grade	α				β			
	A	B	C	D	A	B	C	D
X1	0.33	0.40	0.27	0.00	0.40	0.30	0.30	0.00
X2	0.57	0.27	0.16	0.00	0.60	0.20	0.20	0.00
X3	0.57	0.3	0.13	0.00	0.33	0.37	0.3	0.00
X4	0.27	0.53	0.20	0.00	0.20	0.40	0.40	0.00
X5	0.17	0.70	0.13	0.00	0.30	0.53	0.17	0.00
X6	0.2	0.57	0.23	0.00	0.20	0.37	0.43	0.00
X7	0.3	0.4	0.30	0.00	0.37	0.37	0.26	0.00
X8	0.23	0.57	0.20	0.00	0.33	0.40	0.27	0.00
X9	0.33	0.37	0.30	0.00	0.27	0.53	0.20	0.00
X10	0.20	0.50	0.30	0.00	0.47	0.30	0.23	0.00
X11	0.60	0.27	0.13	0.00	0.43	0.30	0.27	0.00

Secondly, we given the vector R

(1) Experts are invited to evaluate the importance of indicators, and the judgment assignment matrix is obtained:

$$\begin{bmatrix} 1 & 5 & 6 & 7 & 9 & 3 & 2 & 11 & 4 & 10 & 8 \\ 2 & 5 & 1 & 9 & 3 & 6 & 7 & 10 & 4 & 11 & 8 \\ 1 & 4 & 7 & 10 & 5 & 3 & 8 & 11 & 6 & 9 & 2 \\ 1 & 3 & 2 & 8 & 4 & 5 & 6 & 7 & 9 & 10 & 11 \\ 1 & 2 & 4 & 10 & 5 & 8 & 7 & 6 & 3 & 9 & 11 \\ 7 & 6 & 5 & 10 & 1 & 4 & 3 & 9 & 8 & 11 & 2 \\ 1 & 2 & 4 & 10 & 8 & 9 & 6 & 7 & 3 & 11 & 5 \\ 3 & 4 & 10 & 9 & 8 & 1 & 7 & 2 & 5 & 11 & 6 \\ 5 & 6 & 4 & 8 & 1 & 9 & 7 & 3 & 10 & 11 & 2 \\ 1 & 2 & 4 & 9 & 7 & 5 & 3 & 6 & 8 & 10 & 11 \\ 3 & 2 & 1 & 4 & 9 & 11 & 6 & 8 & 7 & 10 & 5 \end{bmatrix}$$

Each row in the matrix represents the judgment of each expert, and the 11 elements in each row represent the expert's ranking of importance to each indicator. For example, the third column element in the first row is 6, indicating that the first expert thinks that 800 meters (girls) is the third most important item.

(2) draw the priority score table. Take the importance of the judgment of the first expert for example, if $K_{3-1} = 6, K_{4-1} = 7$, So,

$K_{3-1} / K_{4-1} = 6/7 < 1$, then $R_{43-1} = 0$, whereas $K_{4-1} / K_{3-1} = 7/6 > 1$, then $R_{34-1} = 1$.

In this way, the priority score of expert 1 for each factor evaluation is shown as follows.

TABLE III

Priority Score Table

—	1	1	1	1	1	1	1	1	1	1
0	—	1	1	1	0	0	1	0	1	1
0	0	—	1	1	0	0	1	0	1	1
0	0	0	—	1	0	0	1	0	1	1
0	0	0	0	—	0	0	1	0	1	0
0	1	1	1	1	—	0	1	1	1	1
0	1	1	1	1	1	—	1	1	1	1
0	0	0	0	0	0	0	—	0	0	0
0	1	1	1	1	0	0	1	—	1	1
0	0	0	0	0	0	0	1	0	—	0
0	0	0	0	1	0	0	1	0	1	—

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If the number of the j column in line i in the table is 1, it means that the i index is more important than the j index; otherwise, if it is 0, it means that the j index is more important than the i index. The results of the rest of the experts can be based on the above methods, as space limitations are not listed here. The results of the rest of the experts can be based on the above methods, as space limitations are not listed here.

Add up the same items in the priority score table obtained by 11 experts to get the following priority score table.

TABLE IV

Score Priority Table

Index	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	$\sum R_i$	r_i
1	—	9	7	11	9	9	10	9	11	11	9	96	1.00
2	2	—	6	11	8	7	9	9	9	11	8	82	0.84
3	4	5	—	10	7	7	7	9	6	11	7	76	0.77
4	0	0	1	—	2	2	1	4	3	9	5	31	0.25
5	2	3	4	9	—	7	7	7	6	11	6	67	0.67
6	2	4	4	9	4	—	4	7	7	10	6	63	0.62
7	1	2	4	10	4	7	—	8	6	11	5	65	0.64
8	2	2	2	7	4	4	3	—	4	9	4	49	0.46
9	0	2	5	8	5	4	5	7	—	11	7	63	0.62
10	0	0	0	2	0	1	0	2	0	—	3	18	0.1
11	2	3	4	6	5	5	6	7	4	8	—	61	0.60

(3) Compute value of $\sum R_i$. The $\sum R_i$ obtained by adding the rows in Table 4 is recorded in column 13. For example, $\sum R_i = 96$ said that 96 people in the expert group considered the standing jump to be more important than other indicators. From Table 4, $\sum R_{max} = \sum R_1 = 96$ and $\sum R_{min} = \sum R_{10} = 18$ indicate that the importance of standing long jump is the highest and that of pulse is the lowest.

(4) Compute value of level difference d. Let $r_{max} = 1$, $r_{min} = 0.1$, we have $d = (96-18)/(1-0.1) \approx 86.67$.

(5) Compute the factor importance coefficient r_i. The $\sum R_i$ value of column 13 in Table 4 is substituted into the following formula $r_i = (\sum R_i - 18)/86.67 + 0.1$. Then fill the calculation result r_i into column 14 of Table 4. Therefore, the obtained index importance degree fuzzy vector is

$$\gamma = (1.00, 0.84, 0.77, 0.25, 0.67, 0.62, 0.64, 0.46, 0.62, 0.1, 0.60).$$

Normalized vector γ, one has

$$R = (0.15, 0.13, 0.12, 0.04, 0.10, 0.09, 0.10, 0.07, 0.09, 0.02, 0.09).$$

Through the fuzzy vector of index importance obtained from the above calculation, we can conclude that the standing long jump is the most important and the pulse is the least important.

Finally, Fuzzy comprehensive evaluation. According to the formula

$$B = (r_1, r_2, \cdots, r_{11}) \cdot \begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ \vdots & \vdots & \vdots & \vdots \\ a_{11} & a_{12} & a_{13} & a_{14} \end{pmatrix}.$$

The comprehensive evaluation results of 11 indexes set by two groups of experts in α, β can be obtained respectively. Tables 5 can be obtained by calculating and uniting them with MATLAB software.

TABLE V

Comprehensive Evaluation Grading Weight

Group / Grade	α				β			
	A	B	C	D	A	B	C	D
Comprehensive evaluation result	0.37	0.42	0.21	0.00	0.37	0.36	0.27	0.00

With the above-mentioned grading weight table, the scores of each level can be multiplied by the weights to obtain the final comprehensive evaluation result, which is used as the final score of each student's 11 sports indicators. Set A for 100 points, B for 90 points, C for 80 points, and D for 70 points, and find α for 91.6 points, find β for 91 points.

V. CONCLUSION

Based on fuzzy pattern recognition and analytic hierarchy process, we give an algorithm for comprehensive evaluation of college students' physical quality. we also present an examples to show the efficiency of given algorithm.

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REFERENCES

[1] J. M. Wang, Y. F. Sun, "The Application of Multi-Level Fuzzy Comprehensive Evaluation Method in Technical and Economic Evaluation of Distribution Network," International Conference on Management and Service Science, IEEE, pp.1-4, June 2010.

[2] M. Z. Naghadehi, R. Mikaeil, M. Ataei, "The application of fuzzy analytic hierarchy process (FAHP) approach to selection of optimum underground mining method for Jajarm Bauxite Mine," Iran, Expert Systems with Applications, 36(4), pp.8218-8226, May 2009.

[3] X. D. Keating, J. Guan, J. C. Piñero, et al, "A meta-analysis of college students' physical activity behaviors," Journal of American College Health, 54(2), pp. 116-126, August 2005.

[4] Y. Tian, K. University, "Connotation and Influencing Factors of Physical Education Quality——Start from Strengthening Physical Education," Guide of Science & Education, 6, pp. 87-88, June 2015.

[5] Y. Jiang, Y. Wang, "Evaluation of Teaching Quality of Public Physical Education in Colleges Based on the Fuzzy Evaluation Theory," Journal of Computational & Theoretical Nanoscience, 13(12), pp. 9848-9851, December 2016.

[6] Q. Yang, H. Zhang, "Construction and Application of "Four Phase Evaluation Theory" Technique and Tactics for Table Tennis," Journal of Tianjin University of Sport, 5, pp. 439-442, September 2014.

[7] D.W. Gong, S.F. Xu, "Diagnosis system of process loss of control in coal preparation plant based on fuzzy pattern recognition," System engineering theory and practice, 11, pp. 135-138, November 2000.

[8] Y. Zhang, Fuzzy mathematical methods and their application, Coal industry press, April 1992.

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