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Students' sports performance comprehensive evaluation model research and application based on fuzzy theory

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ABSTRACT

Normal universities have higher requests on both students' specialized course education and comprehensive quality education the two aspects, from which physical quality is the most basic education content, it includes speed quality, endurance quality, sensitivity quality, flexibility quality and so on, in order to better distinguish everyone physical quality merits, we apply fuzzy mathematical method to carry out comprehensive evaluation on university students' sports performance. By utilizing maximum membership(remarks)and fuzzy linear transformation principle, it constructs fuzzy comprehensive evaluation basic thought, and considers evaluated things relative multiple factors influences, so that realize some purposes to make relative reasonable comprehensive evaluation on another thing.

KEYWORDS

Fuzzy comprehensive evaluation;
Physical quality;
Sports performance;
Evaluation model.

INTRODUCTION

Students' physical quality is the important composition of national physique, relative fields all around the world take it seriously, and world health organization has mentioned physical quality definition referred to human each organ system function comprehensive reflection in muscle working that was basic ability of human muscle activity in charter long time ago. Physical quality generally includes flexibility, speed, sensitivity, strength, endurance and so on [1-3]. In order to strengthen students' physical quality comprehensive evaluation researching, many people have established scientific, representative, practical, and operable indicator system, and provided easy operation, reliable comprehensive evaluation method for them, which has very importance practical significance to scientific evaluate students' physical health status and propel to university students' carry out scientific effective sports training and form good sports training habits as well as propel to school sports teaching reform[4-7].

For physical quality research, lots of people have made efforts and gained results; it provides beneficial conditions for each social circle scholar making researches on it and provides impetus for human health development. Such as: '$Scholar Larry.D. Hansri thought that physical quality should include test and evaluation the two aspects, the greater purpose was to evaluate physical quality development or improvement degree, thereupon authors designed relative reasonable teaching training evaluation plan, reasonable sports prescription, as well as provided necessary basis for physique testing and classification. Therefore, developed countries have already gradually established relative in-

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tact physical quality comprehensive evaluation system[1]. a$Lin Jing, Wang Jian-Xiong the two wrote Japanese physical quality researches, the article mentioned Japan also put emphasis on physique researches and required to form a relative reasonable research system, the article's physique research was carried out mainly from mental state, morphological development and function evaluation the three aspects. In morphological development aspect, it focused on regular human body measurement, as well as testing on body composition, bodily form, skeletal development, it had already formed national relative systematical and standard system in these aspects; in function evaluation aspect, it put emphasis on lung function[2]; b$Hui Ping, Zhu Hong-Wei made research on American physical quality, in the article, it tested dozens of body shape indicators. Taken "Sports test standards" as evaluating physique unified request, and general implemented in whole nation. Besides, the article mentioned the country utilized physical quality researches to guide people strengthen physique and scientific body building. A few days ago, general used health physique testing method was popular in America, one company selected indicators all related to human body health that could be divided into body composition, body flexibility, lung function and so on[3,8].

The paper on the basis of previous research results, it analyzes students' physical quality influence factors, discusses fuzzy teaching algorithm, and provides theoretical basis for them, meanwhile by concrete applying the model, and it further verifies the model rationality and effectiveness.

STUDENTS' PHYSICAL QUALITY COMPREHENSIVE EVALUATION MODEL APPLICATION BASED ON FUZZY MATHEMATICS

Students' physical quality is affected by many kinds of factors, but these factors are fuzzy and uncertain, it is difficult to make evaluation with previous methods; to more reasonable establish students' physical quality comprehensive evaluation system, we put forward fuzzy mathematical comprehensive evaluation model. The basic though of constructing fuzzy comprehensive evaluation by utilizing maximum membership (remarks) and fuzzy linear transformation principle is the model correlation theory, we considered and evaluated things relative multiple factors influences conditions are considering under extreme fuzzy conditions, so that realize one purpose to make relative reasonable comprehensive evaluation method on another thing. So we utilize fuzzy mathematical to carry out comprehensive evaluation method and steps are as following[4,9]:

At first, it should define evaluation objective, it affects variables by n pieces of factors, and its factor sets is u, defines it as : $u = (u_{1,} u_2, u_3, \cdots, u_n)$, and stipulates: $u_i (i = 1,2,3, \cdots, n)$, due to each variable weight is different, so influence degrees are different to defined evaluation level, we assume its weights allocation is a_i, and: $a_i = (a_{1,} a_2, a_3, \cdots a_n)$ Among them, $a_i (i = 1,2,3, \cdots, n)$, the weight value in formula (2), according to common sense, we know that $a_i \geq 0$ and $\sum_{i=1}^{n} a_i = 1$. If every factor a_i includes m pieces of factors, its factor sets is $u_i = (u_{i,1,} u_{i,2}, u_{i,3}, \cdots, u_{i,m})$, and then corresponding weight value is $a_i = (a_{i,1,} a_{i,2}, a_{i,3}, \cdots a_{i,m})$, to $u_{i,j}$ weight value a_i, according to common sense, it is known that $a_{i,j} \geq 0$ and $\sum_{j=1}^{m} a_{i,j} = 1$. Establish a evaluation indicator set $v = (v_{1,} v_2, {}_3, \cdots, v_s)$, corresponding evaluation objectives can be divided into s pieces of different levels, here, we let $v_{1,} v_2, {}_3, \cdots, v_s$ to be each merits evaluation degree from high to low, such as excellent, good, qualified, and unqualified so on.

After defining every factor $u_{i,j}$ evaluation indicator evaluation degree, it makes evaluation on factor u_i fuzzy comprehensive evaluation model, we let $u_{i,j} (j = 1,2,3, \cdots, m)$ to be $r_i = (a_{i,1,} a_{i,2}, a_{i,3}, \cdots a_{i,m}) * (r_{i,1})^T, i = 1,2,3, \cdots n$ fuzzy comprehensive evaluation set of evaluation indicators v hypothesis.

It gets required comprehensive evaluation result by

fuzzy matrix compound calculation, which is $b = a * r = (a_{1,} a_2, a_3, \cdots a_n) * (r_1, r_2, r_3, \cdots, r_n)^T$

$= (b_1, b_2, b_3, \cdots, b_n)$

From fuzzy set b, we can make use of maximum evaluation degree method to get a definite evaluation level. Because $B_k = \{B_I\}$, then B_K final evaluation result level is k.

Students' physical ability implementing comprehensive evaluation—Single item scores

Model establishment

Known $u = (u_1, u_{2,} \cdots, u_n)$, u_1 is u_i corresponding weight value, u can be defined by investigation, experience statistic and other methods. Take one student to carry out comprehensive evaluation, for example given student learning attitude u_1 —— good, and then $u_4 = [0,0,0.25,0.5,0.25]$. After that, combine each kind of factor so that compose of comprehensive evaluation transformation matrix r_1.

Comprehensive evaluation $a_1 : a_{11} = u * r_{11}$, $a_{12} = u * r_{12}$, $\cdots, a_{1n} = u_{1n} * r_{1n}$, after that we can combine a_{11} into matrix r_{11}

Comprehensive evaluation $a_2 : a_2 = u * r_2$.

Take intersection from above two comprehensive evaluation, comprehensive evaluation scores: $b = a * r^T$, from which, r^T is r transformation matrix, and r is TABLE 1 scores' matrix form.

TABLE 1: Parameters allocation

	Parameter	20	40	80	100
1	Well (first grade, excellent)	0	0	0.25	0.75
2	Good (better than average, good)	0	0	0.50	0.25
3	Normal (middle, qualified)	0	0.25	0.25	0
4	Worse (middle, low grade)	0.25	0..5	0	0
5	Bad (lower grade, unqualified)	0.75	0.25	0	0

Model calculation and resolution: Define evaluation content, as Figure 1.

Weight value layout:

Comprehensive evaluation(u)-body function and shape 20%(0.2); extracurricular physical training 20%(0.2); sports course 60%(0.6)

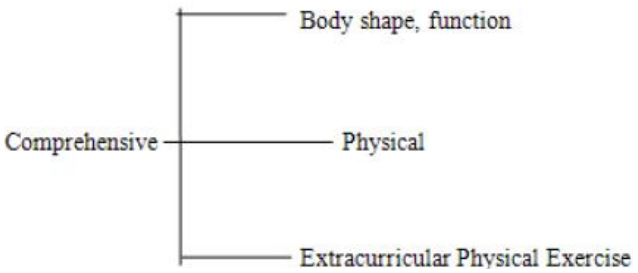

Figure 1 : A comprehensive evaluation of the design

Function, shape-function 50%(0.5), shape 50%(0.5)

Extracurricular physical training(u_2)-qualified 60%(0.6); Extracurricular activity 20%(0.2); Morning exercise (class-break setting-up exercise)20%(0.2)

Sports course(u_1- learning attitude, ideology and morality 10%(0.1);physical quality 25%(0.25); technology, skill 50%(0.5);Sports knowledge 15%(0.15).

We select one school one group of students to carry out single factor evaluation; its evaluation remark No. is :4, 5, 5, 4, 3, 4, 5, 4, 4. In the following we will divide students' comprehensive evaluation into two parts as following:

Comprehensive evaluation one to the group of students is:

Body function, shape: $a_{11} = u * r = [0.5 \quad 0.5]$

Extracurricular physical training:

$$a_{12} = u_2 * r_{12} = [0.20 \quad 0.20 \quad 0.60] * \begin{bmatrix} 0 & 0.25 & 0.50 & 0.25 & 0 \\ 0 & 0 & 0.25 & 0.50 & 0.25 \\ 0 & 0 & 0 & 0.25 & 0.75 \end{bmatrix}$$

$=[0 \quad 0.05 \quad 0.15 \quad 0.3 \quad 0.5]$

Sports course:

$$a_{13} = u_3 * r_{13} = [0.15 \quad 0.50 \quad 0.25 \quad 0.10] * \begin{pmatrix} 0 & 0 & 0.25 & 0.50 & 0.25 \\ 0 & 0 & 0 & 0.25 & 0.75 \\ 0 & 0 & 0 & 0.25 & 0.75 \\ 0 & 0 & 0.25 & 0.50 & 0.25 \end{pmatrix}$$

$=[0 \quad 0 \quad 0.0625 \quad 0.3125 \quad 0.625]$

Comprehensive evaluation two to the group of students is:

$$a_2 = u * r_2 = [0.6 \quad 0.20 \quad 0.20] * \begin{pmatrix} 0 & 0 & 0.0625 & 0.3125 & 0.625 \\ 0 & 0.05 & 0.15 & 0.3 & 0.5 \\ 0 & 0 & 0.25 & 0.5 & 0.25 \end{pmatrix}$$

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$=[0 \quad 0.01 \quad 0.1175 \quad 0.3475 \quad 0.525]$

The group of student's comprehensive evaluation score is:

$$b = a_2 * r^T = [0 \quad 0.01 \quad 0.1175 \quad 0.3475 \quad 0.525] * \begin{bmatrix} 20 \\ 40 \\ 60 \\ 80 \\ 100 \end{bmatrix} = 87.8$$

From previous research, it is know the group of students' sports performance is the good type.

Student's sports performance carrying out comprehensive evaluation-multiple item scores

Model establishment: At first, according to students features, it needs to establish a evaluation objective related factor set : $u = (u_1, u_2, u_3, \cdots, u_n)$, the next, according to sports performance establishing learning attitude, team work ability, basic knowledge, physical ability development, emotional expressions and others total 6 item, the corresponding factors use $u_1, u_2, u_3, \cdots, u_6$ to express: $u = (u_1, u_2, u_3, \cdots, u_6)$, after that, divide students' sports performance in successive into well, good, qualified, worse the four levels to evaluate, so corresponding set is $v = \{well, good, qualified, worse\} = \{v_1, v_2, v_3, v_4\}$, we let r_{ij} to be the j factor the i remark possible degree[10,11].

Model solution: This paper carries out evaluation on three students(s)from six aspects, from evaluation results, it can get : s_1 Physical ability evaluation result is 20%(0.2)*excellent*,23%*good*,47%*middlegrad*e,10%*qualified*and0%*worse*, and gives values on them are respectively: 5, 4, 3, 2, 1, and then corresponding each level weight can be got after calculating:

Excellent: $5/(1+2+3+4+5) = 0.33$

Good: $4/(1+2+3+4+5) = 0.27$

Middle level: $3/(1+2+3+4+5) = 0.2$

Qualified: $2/(1+2+3+4+5) = 0.13$

Bad: $1/(1+2+3+4+5) = 0.07$

From above, it is clear that corresponding weight written as vector form is:

$a = (a_1, a_2, \cdots, a_6) = (0.33, 0.27, 0.2, 0.13, 0.07)$

Then six evaluation vectors for 30 people on student s_1 are:

u_1 vector evaluation is (0.21 0.45, 0.24, 0.1, 0.00)

u_2 vector evaluation is (0.06 0.11, 0.36, 0.31, 0.17)

u_3 vector evaluation is (0.20 0.36, 0.18, 0.17, 0.00)

u_4 vector evaluation is (0.20 0.46, 0.24, 0.10, 0.10)

u_5 vector evaluation is (0.36 0.00, 0.43, 0.13, 0.07)

u_6 vector evaluation is (0.03 0.00, 0.23, 0.16, 0.13)

By corresponding handling, we get student s_1, s_2, s_3 sports performance evaluation matrix as:

$$r_1 = \begin{pmatrix} 0.21 & 0.06 & 0.20 & 0.20 & 0.36 & 0.03 \\ 0.45 & 0.11 & 0.36 & 0.46 & 0.00 & 0.00 \\ 0.24 & 0.36 & 018 & 0.24 & 0.43 & 0.23 \\ 0.10 & 0.31 & 0.17 & 0.10 & 0.13 & 0.16 \\ 0.00 & 0.17 & 0.00 & 0.10 & 0.07 & 0.13 \end{pmatrix}$$

$$r_2 = \begin{pmatrix} 0.03 & 0.51 & 0.20 & 0.30 & 0.40 & 0.07 \\ 0.10 & 0.27 & 0.36 & 0.40 & 0.37 & 0.37 \\ 0.47 & 0.13 & 018 & 0.17 & 0.00 & 0.40 \\ 0.20 & 0.11 & 0.17 & 0.07 & 0.17 & 0.07 \\ 0.20 & 0.00 & 0.00 & 0.07 & 0.07 & 0.10 \end{pmatrix},$$

$$r_3 = \begin{pmatrix} 0.00 & 0.03 & 0.00 & 0.30 & 0.10 & 0.07 \\ 0.07 & 0.20 & 0.20 & 0.30 & 0.17 & 0.07 \\ 0.23 & 0.17 & 0.63 & 0.27 & 0.67 & 0.20 \\ 0.17 & 0.57 & 0.13 & 0.07 & 0.03 & 0.57 \\ 0.53 & 0.03 & 0.03 & 0.07 & 0.03 & 0.10 \end{pmatrix}$$

Then by fuzzy mathematical evaluation matrix, through corresponding linear transformation, respectively transform three students s_1, s_2, s_3 evaluation matrix:

Student s_1 linear transformation is:

$$b_1 = (0.33 \quad 0.27 \quad 0.20 \quad 0.13 \quad 0.07) * \begin{pmatrix} 0.21 & 0.06 & 0.20 & 0.20 & 0.36 & 0.03 \\ 0.45 & 0.11 & 0.36 & 0.46 & 0.00 & 0.00 \\ 0.24 & 0.36 & 018 & 0.24 & 0.43 & 0.23 \\ 0.10 & 0.31 & 0.17 & 0.10 & 0.13 & 0.16 \\ 0.00 & 0.17 & 0.00 & 0.10 & 0.07 & 0.13 \end{pmatrix}$$

$$= (0.24 \quad 0.17 \quad 0.23 \quad 0.27 \quad 0.24 \quad 0.15)$$

Student s_2 linear transformation is

$$b_2 = (0.33 \quad 0.27 \quad 0.20 \quad 0.13 \quad 0.07) * \begin{pmatrix} 0.03 & 0.51 & 0.20 & 0.30 & 0.40 & 0.07 \\ 0.10 & 0.27 & 0.36 & 0.40 & 0.37 & 0.37 \\ 0.47 & 0.13 & 018 & 0.17 & 0.00 & 0.40 \\ 0.20 & 0.11 & 0.17 & 0.07 & 0.17 & 0.07 \\ 0.20 & 0.00 & 0.00 & 0.07 & 0.07 & 0.10 \end{pmatrix}$$

$=(0.17 \quad 0.28 \quad 0.29 \quad 0.25 \quad 0.26 \quad 0.22)$

Student s_3 linear transformation is

$$b_3=(0.33 \quad 0.27 \quad 0.20 \quad 0.13 \quad 0.07)*\begin{pmatrix}0.00 & 0.03 & 0.00 & 0.30 & 0.10 & 0.07\\ 0.07 & 0.20 & 0.20 & 0.30 & 0.17 & 0.07\\ 0.23 & 0.17 & 0.63 & 0.27 & 0.67 & 0.20\\ 0.17 & 0.57 & 0.13 & 0.07 & 0.03 & 0.57\\ 0.53 & 0.03 & 0.03 & 0.07 & 0.03 & 0.10\end{pmatrix}$$

$=(0.12 \quad 0.18 \quad 0.20 \quad 0.25 \quad 0.22 \quad 0.16)$

We get corresponding set from three students' linear transformation as: $b=\begin{pmatrix}0.24 & 0.17 & 0.12\\ 0.17 & 0.28 & 0.18\\ 0.23 & 0.29 & 0.20\\ 0.27 & 0.25 & 0.25\\ 0.24 & 0.26 & 0.22\\ 0.15 & 0.22 & 0.16\end{pmatrix}$

For students' sports performance, we reference Xing Ji-Qin and others researched university students' sports performance weight table from university students' sports performance research based on comprehensive evaluation, as TABLE 2.

$$A=(a_{11},a_{22},a_{33})*b=(0.20 \quad 0.10 \quad 0.10 \quad 0.25 \quad 0.15 \quad 0.20)*\begin{pmatrix}0.24 & 0.17 & 0.12\\ 0.17 & 0.28 & 0.18\\ 0.23 & 0.29 & 0.20\\ 0.27 & 0.25 & 0.25\\ 0.24 & 0.26 & 0.22\\ 0.15 & 0.22 & 0.16\end{pmatrix}=(0.22 \quad 0.24 \quad 0.18)$$

From above, it is known that three students' comprehensive evaluation score vectors $A_1=0.22, A_2=0.24, A_3=0.18$, then corresponding sequence is: A_2 is larger than A_1 is larger than A_3 .Therefore we can get three students' sports performance each indicator, and is single item segmental result as TABLE 3.

From above TABLE 3, we can know though s_2 is lower than s_1 in physical ability development aspect, it is not lower in learning ability, team work ability and other five aspects, some even goes beyond student s_1, so student s_2 is superior to s_1 in total sports performance, while student s_3 is lower than s_1 in all item performance, so the three students' total sports performance sequence is : $s_2 \succ s_1 \succ s_3$.

TABLE 2 : Students' sports performance whole weight table

Factor u_i	Learning attitude u_1	Team work ability u_2	Sports basic knowledge u_3	Physical ability development u_4	Emotional expression u_5	Basic technology mastering u_6	$\sum$
Weight a_{ij}	0.20	0.10	0.10	0.25	0.15	0.20	1.00

TABLE 3 : Three students' sports performance each indicator single item scores

Factor u_i	Learning attitude u_1	Team work ability u_2	Sports basic knowledge u_3	Physical ability development u_4	Emotional expression u_5	Basic technology mastering u_6	$\sum$
Weight a_{ij}	0.20	0.10	0.10	0.25	0.15	0.20	1.00
Student s_1	0.05	0.03	0.02	0.06	0.02	0.05	0.22
Student s_2	0.05	0.03	0.03	0.04	0.03	0.06	0.24
Student s_3	0.04	0.02	0.02	0.03	0.02	0.04	0.18

CONCLUSIONS

Through students' physical quality comprehensive evaluation, it better verified fuzzy mathematical adaptation and effectiveness, and utilized performance quantization method; it could clearly show each student's sports performance. The model verifying process, by establishing six indicators, displayed the model advantages more by comparing with previous model. From

research, we knew that we should bring into better life habits from the perspective of ourselves, and keep a positive optimistic mental state; the next, from education perspective, it should strengthen sports attraction to let students participate physical exercise so as to improve students' overall physical quality.

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