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A Performance Analysis Model of Sports talent training Pattern of Colleges and Universities based on Fuzzy Membership Function

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Sports talent training is diversified and in multiple levels. Indicators that influence sports talent training are distinct. In this paper, strategies, methods and approaches for sports talent training of colleges are studied and discussed and training performance is evaluated. A performance analysis model of sports talent training in colleges is proposed based on fuzzy membership function. In this model, multi-attribute performance of sports talent training is evaluated and performance influence indicators are analysed according to fuzzy membership function. Study results are expected to provide instructions on sports talent training in colleges and universities. Last but not the least, the efficacy of the model is verified through case study.

1. Introduction

In order to select and nurture sports talents, sports talent training has been given much attention. In particular, in modern days, the mass has developed higher expectation on competitive ability of athletes. Nurturing excellent athletes is a key concern of sports colleges and relevant institutions. This explains why sports talent training becomes a hot issue [Kong (2014) et al and Ma et al (2010) reported]. Many sports experts, scholars and researchers have studied the performance of sports talent training from different views with fruitful results [GAO Et Al (2011), Hang et al (2013), Huang et al (2014) and Sun et al (2010) reported]. College is an important place to produce sports talents. At the present time, a few scholars have conducted the study of sports talent training in colleges [Li (2012), Liang (2012),Xie et al (2010)and Zhang (2012) reported].
However, there falls short of research on effective strategies, methods and approaches of sports talent training in colleges. Thus, this paper draws merits on previous ones, analyses relevant methods and strategies worthy of practicing and proposes a performance analysis model of sports talent training in colleges based on fuzzy system theory[Chee (2015), Harish (2014), Maisa et al (2014)and Radko et al (2015) reported]. It intends to provide support for sports talent training of the nation.

2. Analysis of strategies of sports talent training in colleges

After a careful study of previous research and according to real situations of sports talent training in colleges and universities, strategies of sports talent training are provided and described as followings:
(1) Update hardware facilities of sports in colleges and universities to enhance basic ability: basic ability, which is key to sports talent training, includes hardware facilities like teaching places, teaching equipment, proper class scale, clear focus, teachers' salary and welfare.
(2) Increase investment on sports major in colleges and universities and enhance teachers' teaching ability: the sports talent training is a combination of sports and education. The key lies in how to play the best of teachers' teaching ability and allocate rationally supporting equipment. Consequently, it is important to invest in sports major to facilitate course design, class performance, teaching attitude, teaching quality, teaching content and teaching method.
(3) Pay attention to club building and activities and tab the potential of personalized development: sports club and activities are attractive to students, conductive to developing individual skills and promote skill

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communication among people. Consequently, it is significant to set up sports club of various kinds and hold more activities.

(4) Focus on all-round development and encourage the integration of higher education, sports institutions and enterprises: single-mode sports talent training is limited. Multiple modes of training can draw merits from each other. In modern times, many enterprises with huge wealth are engaged in the sports industry. Their economic strength can bring benefits to sports talent training. So, the integration of higher education, sports institutions and enterprises should be encouraged.

(5) Enhance basic qualities of sports talent and lay a solid foundation for their further development: basic qualities of a person include: body shape, educational level, Artistic expression, physical fitness, to name just a few. These qualities should be given a priority in the sports talent training.

(6) Pay attention to professional qualities and ensure that talents are at a high level: professional qualities of a sports talent include: skill, knowledge, creativity, psychological quality and research ability. These qualities are also important for an athlete to be professional.

(7) Pay attention to diversified development of people, follow global trend and meet the demand of the market: diversified sports trainings can equip athletes with the ability to follow the trend and not to be left behind. Diversified sports trainings also allow them to make anticipation about the market.

3. Performance analysis model of sports talent training in colleges

3.1 Selection of performance analysis indicator

According to strategies of sports talents training in colleges and universities introduced in Section 2, it is seen that the effect of training can be directly reflected on athlete qualities. Consequently, after consulting with sports experts, performance analysis indicators from six dimensions, namely basic condition c_1 ,skill c_2,motor function c_3 , physical fitness c_4 , strength c_5 and performance result c_6 are selected to form an indicator set c :

$$C = \{c_1, c_2, c_3, c_4, c_5, c_6\} \tag{1}$$

3.2 Construction of fuzzy category of the performance analysis

In this paper, there are four fuzzy categories of the performance analysis, namely excellent (A), good (B), qualified (C) and unqualified (D). Table 1 shows the possible fuzzy categories of performance analysis indicator r_j and their fuzzy value interval.

Table 1: Table title (Style: CET-table-title)

Fuzzy category	Definition	Fuzzy value interval
A	Excellent	$v_{r_j}^C - v_{r_j}^D$
B	Good	$v_{r_j}^B - v_{r_j}^C$
C	Qualified	$v_{r_j}^A - v_{r_j}^B$
D	Unqualified	$0 - v_{r_j}^A$

3.3 Construction of fuzzy membership function of performance analysis indicators

Traditional analysis of fuzzy value interval of indicators usually fails to set up fuzzy membership function. Its accuracy and objectivity are not reliable. In this paper, an improved method is adopted to construct fuzzy membership function. Fuzzy membership function corresponding to the fuzzy category of indicator r_j is shown in Fig.1.

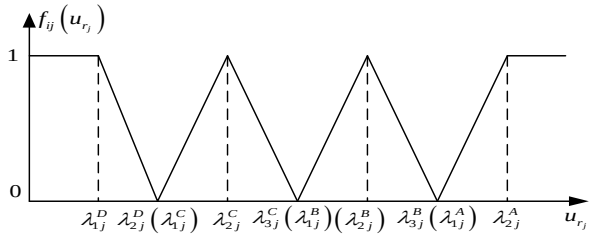

Figure 1: Fuzzy membership function

According to Table 1 and Fig.1, fuzzy membership functions of different fuzzy categories can be established.

The fuzzy membership function $f_{Dj}\left(u_{r_j}\right)$ of fuzzy category D is:

$$f_{Dj}\left(u_{r_j}\right)=\left[-,-,\lambda_{1j}^{D},\lambda_{2j}^{D}\right] \tag{2}$$

$$\lambda_{1j}^{D}=v_{r_j}^{A}/K \tag{3}$$

$$\lambda_{2j}^{D}=\left(v_{r_j}^{A}+v_{r_j}^{B}\right)/T \tag{4}$$

Where: K and T are proportion coefficient.

The fuzzy membership function $f_{Cj}\left(u_{r_j}\right)$ of fuzzy category C is:

$$f_{Cj}\left(u_{r_j}\right)=\left[\lambda_{1j}^{C},\lambda_{2j}^{C},-,\lambda_{3j}^{C}\right] \tag{5}$$

$$\lambda_{1j}^{C}=\lambda_{1j}^{D}=v_{r_j}^{A}/K \tag{6}$$

$$\lambda_{2j}^{C}=\lambda_{2j}^{D}=\left(v_{r_j}^{A}+v_{r_j}^{B}\right)/T \tag{7}$$

$$\lambda_{3j}^{C}=\left(v_{r_j}^{B}+v_{r_j}^{C}\right)/T \tag{8}$$

The fuzzy membership function $f_{Bj}\left(u_{r_j}\right)$ of fuzzy category B is:

$$f_{Bj}\left(u_{r_j}\right)=\left[\lambda_{1j}^{B},\lambda_{2j}^{B},-,\lambda_{3j}^{B}\right] \tag{9}$$

$$\lambda_{1j}^{B}=\lambda_{2j}^{C}=\left(v_{r_j}^{A}+v_{r_j}^{B}\right)/T \tag{10}$$

$$\lambda_{2j}^{B}=\lambda_{3j}^{C}=\left(v_{r_j}^{B}+v_{r_j}^{C}\right)/T \tag{11}$$

$$\lambda_{3j}^{B}=v_{r_j}^{D} \tag{12}$$

The fuzzy membership function of fuzzy category is:

$$f_{Aj}\left(u_{r_j}\right)=\left[\lambda_{1j}^{A},\lambda_{2j}^{A},-,-\right] \tag{13}$$

$$\lambda_{1j}^{A}=\lambda_{2j}^{B}=\left(v_{r_j}^{B}+v_{r_j}^{C}\right)/T \tag{14}$$

$$\lambda_{2j}^{A}=\lambda_{3j}^{B}=v_{r_j}^{D} \tag{15}$$

3.4 Realizing performance analysis model of sports talent training in colleges based on fuzzy membership function

Assume the value of object P about indicator r_j of sports talent training in colleges is u_{r_j}. The fuzzy membership degree between object P about indicator r_j and fuzzy category i is $f_{ij}^{P}\left(u_{r_j}\right)$. So the comprehensive fuzzy membership degree $\rho_i^{P}\left(u_{r_j}\right)$ between object P about indicator r_j and fuzzy category i is:

$$\rho_i^{P}\left(u_{r_j}\right)=\frac{1}{n}\sum_{j=1}^{n} f_{ij}^{P}\left(u_{r_j}\right) \tag{16}$$

If indicators don't have equal weight, and the same of indicator r_j is w_j, then the weighed fuzzy membership degree $\rho_i^{\Delta P}\left(u_{r_j}\right)$ between object P about indicator r_j and fuzzy category i is:

$$\rho_i^{\Delta P}\left(u_{r_j}\right)=\sum_{j=1}^{n}\left(w_j * f_{ij}^{P}\left(u_{r_j}\right)\right) \tag{17}$$

According to the weighed fuzzy membership degree $\rho_i^{\Delta P}\left(u_{r_j}\right)$, the fuzzy category k of object P can be determined:

$$\rho_k^{\Delta P}\left(u_{r_j}\right)=\max_{i=A,B,C,D}\left(\rho_i^{\Delta P}\left(u_{r_j}\right)\right),\quad k=A,B,C,D \tag{18}$$

4. Case studies

Sports talent training performance of the rhythmic gymnastics major is taken as an example to verify the proposed model. First, indicators are selected according to characteristics of this major. Performance analysis data are obtained according to athletes' performance in the latest three years, as shown in Table 2.

Table 2: Performance analysis indicators

Performance analysis indicator	Number of students trained	Number of qualified students	Index value (percentage of qualified students)
Body shape r_1	50	48	0.96
Motor function r_2	50	43	0.86
Psychological quality r_3	50	35	0.70
Physical fitness training r_4	50	32	0.64
Power training r_5	50	45	0.90
Special skills r_6	50	40	0.80
Artistic expression r_7	50	40	0.80
Coordination ability r_8	50	43	0.86

Fuzzy categories are divided by the proposed method and fuzzy intervals of different fuzzy categories are obtained (See Table 3) as well as fuzzy membership function (See Table 4).

Table 3: Fuzzy interval of performance analysis indicators

Performance analysis indicator	Fuzzy interval			
	A	B	C	D
Body shape r_1	0-0.6	0.6-0.8	0.8-0.9	0.9-1.0
Motor function r_2	0-0.6	0.6-0.8	0.8-0.9	0.9-1.0
Psychological quality r_3	0-0.6	0.6-0.8	0.8-0.9	0.9-1.0
Physical fitness training r_4	0-0.6	0.6-0.8	0.8-0.9	0.9-1.0
Power training r_5	0-0.6	0.6-0.8	0.8-0.9	0.9-1.0
Special skills r_6	0-0.6	0.6-0.8	0.8-0.9	0.9-1.0
Artistic expression r_7	0-0.6	0.6-0.8	0.8-0.9	0.9-1.0
Coordination ability r_8	0-0.6	0.6-0.8	0.8-0.9	0.9-1.0

The fuzzy membership degree is calculated from fuzzy categories and the fuzzy membership degree between the rhythmic gymnastics major and different fuzzy categories of indicators are obtained. After the weight is considered, the comprehensive fuzzy membership degrees between the rhythmic gymnastics major and different fuzzy categories of indicators are obtained, as shown in Table 5.

From the comprehensive weighted fuzzy membership degree in Table 5, it can be seen that the performance of rhythmic gymnastics major is in category B (good). There is still much to improve to get an A. Consequently, priority should be given to weaknesses of the sports talent training program in order to bring the sports teaching ability to a higher level.

Table 4: Fuzzy membership function of performance analysis indicators

Performance analysis indicator	Fuzzy membership function			
	A	B	C	D
Body shape r_1	-,-,0.3,0.7	0.3,0.7,-,0.9	0.7,0.9,-,1.0	0.9,1.0,-,-
Motor function r_2	-,-,0.3,0.7	0.3,0.7,-,0.9	0.7,0.9,-,1.0	0.9,1.0,-,-
Psychological quality r_3	-,-,0.3,0.7	0.3,0.7,-,0.9	0.7,0.9,-,1.0	0.9,1.0,-,-
Physical fitness training r_4	-,-,0.3,0.7	0.3,0.7,-,0.9	0.7,0.9,-,1.0	0.9,1.0,-,-
Power training r_5	-,-,0.3,0.7	0.3,0.7,-,0.9	0.7,0.9,-,1.0	0.9,1.0,-,-
Special skills r_6	-,-,0.3,0.7	0.3,0.7,-,0.9	0.7,0.9,-,1.0	0.9,1.0,-,-
Artistic expression r_7	-,-,0.3,0.7	0.3,0.7,-,0.9	0.7,0.9,-,1.0	0.9,1.0,-,-
Coordination ability r_8	-,-,0.3,0.7	0.3,0.7,-,0.9	0.7,0.9,-,1.0	0.9,1.0,-,-

Table 5: Comprehensive weighted fuzzy membership degree

Performance analysis indicator	Weight	Fuzzy category			
		A	B	C	D
Body shape r_1	0.135	0.600	0.400	0	0
Motor function r_2	0.135	0	0.800	0.200	0
Psychological quality r_3	0.075	0	0	1.000	0
Physical fitness training r_4	0.100	0	0	0.850	0.150
Power training r_5	0.120	0	1.000	0	0
Special skills r_6	0.150	0	0.500	0.500	0
Artistic expression r_7	0.150	0	0.500	0.500	0
Coordination ability r_8	0.135	0	0.800	0.200	0
Comprehensive weighted fuzzy membership degree		0.081	0.540	0.279	0.015

5. Conclusion

In this paper, sports talent training is studied and discussed. Strategies are given to improve sports talent training in colleges. In order to better evaluate the performance of sports talent training in colleges, a performance analysis model of sports talent training in colleges is proposed based on fuzzy membership function. By confirming different fuzzy membership functions of performance analysis indicators, fuzzy membership degree is obtained. According to the comprehensive weighed fuzzy membership degree, the performance of sports talent training in colleges is judged. This model is proved to be able to provide support for evaluating sports talent training in colleges.

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