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Application of Fuzzy Mathematics Calculation in Quantitative Evaluation of Students' Performance of Basketball Jump Shot

Lianzhu Qu^{1†}, Iyad Katib², Marwan Aouad³¹Physical Education Teaching and Research Department of Northeast Petroleum University, Heilongjiang, 163311, China²Computer Science Department, Faculty of Computing and Information Technology, King Abdulaziz University, Jeddah, Saudi Arabia³Applied Science University, Al Eker, Kingdom of Bahrain

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Abstract

Objective: To explore the application of fuzzy mathematics calculation in quantitative evaluation of students' basketball jump shot performance.**Methods:** Using the basic theory of fuzzy mathematics and the calculation method of fuzzy correlation, the correlation degree between the training means and the free throw hit rate was obtained, and further, the best training means to improve the free throw hit rate of basketball players were selected. As a result, when the ball reaches the highest point or falls after reaching the highest point, it is pushed out towards the 45° Angle, making the basketball fly to the basket in an arc. The jump shot is designed to avoid being blocked by a defender and is very effective against players of similar size or when no one is guarding.**Conclusion:** The method proposed in this paper is suitable for the evaluation of college basketball teaching and ball skill training, and provides theoretical basis and quantitative data for training.**Keywords:** Fuzzy mathematical calculation; Jump shot performance; Training means.**AMS 2010 codes:** 03-00

1 Introduction

In sports teaching exam score, an action or a technology often need to use multiple indicators to characterise the nature and features, such as basketball that belongs to the field of combined mutation multivariate structure

[†]Corresponding author.Email address: qlz1982223@163.com

class antagonism, where skill evaluation is unfavourable, and use of simple fuzzy language to evaluate such as good or better [1] as a different degree of evaluation, the previous technical evaluation method basically one with five skills assessment by the teacher give points at a time, in the five Within the interval, many students of different grades are in the same score interval, which cannot accurately and objectively evaluate the students. Because there is no obvious and clear boundary between successive grades of skill evaluation, and there is fuzziness between good and better, it is unsuitable to evaluate basketball skills by traditional mathematical method based on set theory in sports skill evaluation, and the traditional skill evaluation method must be reformed. In order to accurately measure student's grades and in order to obtain the objective score of the basketball combination technique of the mutation of multiple structures, we choose the corresponding operator and mathematical model on the basis of the original qualitative research made by quantitative analysis of fuzzy mathematics comprehensive evaluation to make the technical evaluation results to accurately reflect students' actual level.

However, the factors that affect the free throw shooting rate are manifold and they are psychological factors, physical cable, technical level, muscle proprioception, coordination and so on. And the training methods are also vary such as return run free throw practice, Eye closed free throw practice, free hand imitation practice, and shooting match between two teams. Then, what are the effects of these training methods on improving the free throw shooting rate? What is the main role of the link, each link in the overall how much position; In essence what kinds of training content or the form of training is similar; among these trainings which method is the best; According to the characteristics of basketball, how to choose the training content reasonably and so on is a big task. These problems are difficult to explain and can be effectively explained only by people with their subjective consciousness and experience. How to choose the training means scientifically, solve the problems existing in the training, improve the efficiency of training and shorten the training cycle [2] are the urgent requirements of the majority of sports workers.

2 Research objects and methods

2.1 Subjects

With the rapid development of modern basketball, the skills and level that basketball players need to master are of high standard. Jump shot technology is the most important for a basketball player and good jump shot technology can make the player in the field of play to have a certain advantage. The jump shot first originated from the NBA in the United States. In the early days of the establishment of the NBA, players used to shoot from standing in a place. In the early 1950s, some players began to use the jump shot. Due to the obvious improvement in the efficiency of blocking the jump shot, it has gradually become popular in the whole NBA and even the international basketball world, and has become the main means of scoring in today's basketball games. In modern basketball, athletes basically master a variety of jump shots, such as the jump shot, the fadeaway jump shot, the step-back jump shot, and so on. Each jump shot has its own characteristics and skills. However, most basketball jump shot technical evaluation is only limited to subjective evaluation due to lack of certain quantitative verification [3] and the use of fuzzy mathematics method combined with basketball jump shot technical subjective evaluation can make up for its defects.

In this paper, 40 basketball students majoring in 2015 in the Physical Education Institute of a university were selected as the research objects. First, the application of fuzzy mathematics method in the field of sports and basketball was understood through literature review, and then the professional investigation of basketball teaching and training in the studied universities was conducted by questionnaire survey, so as to obtain part of the weight. Finally, the fuzzy mathematics method is used to quantitatively evaluate the basketball jump shot.

2.2 Basketball Rating

The work of basketball referee is an indispensable part of basketball competition, which plays an important role in promotion of the basketball game. With the development of the competitive level of modern basketball,

high requirements are needed for the referee's work. Basketball referees' on-the-spot work performance is the integrated embodiment of its theory and the practice ability, and accurate, comprehensive and scientific evaluation is highly beneficial to the competent authorities at all levels of basketball referees, and by evaluation one can find the problem, find out gaps or flaws and thus can improve the level of the referee. At present, the evaluation of basketball referees is mainly based on experience, which has limitations and also one-sidedness. The job of basketball referee on the spot is a complicated work with many factors, which is dynamic and fuzzy. In this paper, fuzzy mathematics method is used to evaluate the on-the-spot refereeing work of basketball referees, making the evaluation of the on-the-spot refereeing work more scientific, standardised and procedural [4].

2.3 Fuzzy mathematical evaluation method

In production practice, scientific experiments and daily life, people often encounter fuzzy concepts (or phenomena). For example, big and small, light and heavy, fast and slow, dynamic and static, deep and shallow, beautiful and ugly and so on all contain certain vague concepts. With the development of science and technology, practical problems related to these fuzzy concepts often need to be analysed quantitatively in various fields, which requires the use of the tool of fuzzy mathematics to solve.

The fuzzy comprehensive evaluation method belongs to the category of fuzzy mathematics. The membership degree [5] generally refers to A function. For example, for any element x in the field U , there is a number $A(x) \in [0,1]$ corresponding to it, then A is called the fuzzy set on U , $A(x)$ is called the membership of x to A . Based on the membership principle of fuzzy mathematics, the qualitative problem is transformed into a quantitative one, that is, the problem of overall evaluation of complex system is solved by using fuzzy mathematics.

2.4 Set relevant factors

Improving the free throw shooting rate is achieved through a variety of training means. To determine the degree of correlation between these training methods and free throw shooting rate, we denoted this correlation as the fuzzy correlation coefficient R ; At the same time, think of these drills as set X , such as: return free throw running drills, free throws with eyes closed, Freehand imitation exercises, two-team basketball games, imaginary shooting contests... And so on [6].

3 Research methods

3.1 Weighted average fuzzy mathematics comprehensive evaluation method is adopted to establish an evaluation model

Given two finite domains, let the domain $U = [U_1, U_2, \dots, U_a]$ be the set of evaluation indexes or evaluation factors, each of these factors is the 'focus point' of evaluation. Let $V = [V_1, V_2, \dots, V_m]$ be the collection of evaluation grades, let the evaluation of the i factor be $R_i = [r_{i1}, r_{i2}, \dots, r_{im}]$. It can be thought of as a Fuzzy subset on U , and r_{ik} represents the membership degree of the i th factor to grade K , thus, the evaluation matrix of n factors can be obtained. Each evaluated factor determines the fuzzy relation $\tilde{R}$ from U to V , which is a matrix:

$$\tilde{R} = r_{ij} n * m \begin{Bmatrix} r_{11} & r_{12} & \dots & r_{1m} \\ r_{21} & r_{22} & \dots & r_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ r_{n1} & r_{n2} & \dots & r_{nm} \end{Bmatrix}$$

Where r_{ij} represents the following from factor V , this evaluation object can be rated as V_i membership $[i = 1, 2, \dots, n; j = 1, 2, \dots, m]$. The evaluation of objects is based on the factors in the index set U . This fuzzy relation matrix is not enough to evaluate things. A fuzzy subset $\tilde{A}$ on U is proposed to be introduced and it is called the weight or

weighting allocation set, $\tilde{A} = [a_1, a_2, \dots, a_n]$, among them $a_i > 0$, and $\sum_{i=1}^n a_i = 1$. Its reflection is a trade-off between

factors. At the same time, introduce a fuzzy subset $\tilde{B}$ on V , it's called the evaluation set, and its fuzzy evaluation, $\tilde{B}=[b_1, b_2, \dots, b_m]$. Find the solution of $\tilde{B}$ from $\tilde{R}$ and $\tilde{A}$, general $\tilde{R} = \tilde{A} \cdot \tilde{R} = [b_1, b_2, \dots, b_m]$, (“.” Is operator symbol) is called fuzzy transformation, $\tilde{A}$ is the input and $\tilde{B}$ is the output, $\tilde{R}$ is used as a fuzzy converter from U to V , for each set of weights $\tilde{A}$, the corresponding comprehensive evaluation result $\tilde{B}$ can be obtained.

3.2 Establish fuzzy correlation matrix table

Set U and X are both finite sets, and a fuzzy correlation matrix table [7] can be established. First, set U and five elements are filled into the horizontal species of the table, and then eight elements (training methods) of set X are filled into the vertical column of the table, as shown in Table 1. In order to objectively reflect the degree of correlation between things, we adopt a five-level method; that is, a complete correlation score is 1 point, a major correlation score is 0.75 points, a general correlation score is 0.50 points, a major correlation score is 0.25 points and a complete correlation score is 0 points. Similarly, the author invited 10 experts with rich experience in the basketball teaching and research department to make an evaluation, and finally took the average value for application, the coefficient of correlation with $X_1, U_1, U_2, U_3, U_4, U_5$: was determined as 0.225, 0.625, 0.875, 0.450, 0.225, 0.625, 0.875, 0.45. Then, the correlation coefficient between R_1 and R_2 is calculated (Table 1), the result of R_1 is the correlation value between the training means and the field. The result of R_2 is the degree of correlation between each element in U and the training method.

Table 1 Correlation matrix of various training methods and influencing factors of free throw shooting

Training means	Psychological factors	Physical factors	The technical level	Muscle proprioception	Coordination	A combined	R_2
X_1	0.225	1	0.625	0.875	0.450	3.175	0.635
X_2	0.125	0	0.625	0.95	0.450	2.2	0.44
X_3	0	0	0.925	0.95	0.450	2.525	0.505
X_4	1	0.125	0.825	0.425	0.35	2.725	0.565
X_5	0.225	0	0.85	0.875	0.825	2.775	0.565
X_6	0.475	0.975	0.65	0.775	0.525	3.4	0.555
X_7	0	0.575	0.825	0.90	0.775	3.075	0.615
X_8	1	0.275	0.575	0.325	0.225	2.4	0.48
A combined	3.05	2.95	5.95	6.08	4.25		
R_1	0.38	0.37	0.74	0.76	0.53		

From Table 1, we can find the correlation coefficient of various training means to various purposes and tasks. The correlation level between each training means and free throw shooting rate is shown through R_2 and through R_1 , indicating the extent to which the factors that affect the free throw percentage may be developed. X_1 and X_7 from R , have biggest effect in improving the free throw. But X_1 and X_7 are weak points to U_1 's development, if A and B can be combined to train together and learn from each other, better training effect will be obtained.

3.3 Method for determining weight A

After processing the data obtained from the interview survey according to Table 2, the measurement value of the relative importance of each representing factor of the technology assessment factors in the study was obtained.

$$\tilde{A} = [0.095, 0.092, 0.083, 0.092, 0.089, 0.122, 0.141, 0.131, 0.15]$$

Table 2 Weight determination method

Expert U_j weight U_j	U_1	U_2	...	U_m	Σ
Experts 1	a_{11}	a_{12}	...	a_{1m}	1
Experts 2	a_{21}	a_{22}	...	a_{2m}	1
...	...	...	...	...	...
Experts m	a_{m1}	a_{m2}	...	a_{ma}	1
$\frac{1}{m} \sum a_{ij} = a_j$	$\frac{1}{m} a_1$	$\frac{1}{m} a_2$	...	$\frac{1}{m} a_a$	1

3.4 The method of solving $B_{\sim}$

Weighted average operator model selection:

$$B_{\sim} = A_{\sim} \cdot [b_1, b_2, \dots, b_m] b_1 = \sum_{i=1}^m (a_i \cdot r_{1j}) = (a_1 \cdot r_{1j}) \oplus (a_2 \cdot r_{2j}) \oplus \dots \oplus (a_m r_{mj})$$

3.5 Determine the weight vector of evaluation elements [8]

Fuzzy evaluation evaluates the weight vector of the meta factor $W = \{W_1, W_2, \dots, W_n\}$ representing the set of weights corresponding to $(R|x_1)$, which indicates the relative importance of each element, for example, how important the former factor is to the latter. Its weight value can be obtained by the analytic hierarchy process, or can be determined by combining with the data obtained from the questionnaire, thus determining the weight coefficient.

3.6 Calculate the fuzzy comprehensive evaluation result vector $B = RW$

$$\begin{pmatrix} r_{11} & r_{12} & \dots & r_{1m} \\ r_{21} & r_{22} & \dots & r_{2m} \\ \dots & \dots & \dots & \dots \\ r_{a1} & r_{a2} & \dots & r_{nm} \end{pmatrix} \begin{pmatrix} (W_1 W_2 \dots, W_a) = \\ (b_1 b_2 \dots, b_a) = B \end{pmatrix}$$

4 Results analysis and discussion

For the fuzzy evaluation results, use the appropriate method to analyse; The commonly used method is the analysis principle of the maximum membership degree, but sometimes the error is large. To make up for its shortcomings, it can be optimised by using the method of average weighting of membership grades.

4.1 Determine evaluation factors and comment sets

According to the fuzzy comprehensive evaluation method, this paper establishes the evaluation model of students' basketball jump skills, designs the concrete steps and constructs the factor set of the evaluation model of students' basketball jump skills according to the evaluation index system.

$Q = \{Q1, Q2, Q3, Q4, Q5\} = \{\text{excellent, good, fair, pass, fail}\}$

$E = \{E1, E2, E3, E4\} = \{\text{lift the ball position, the smoothness of lifting the ball, Cast dancing posture}\}$

Set up a review collection:

$$P = \{P1, P2, P3, P4, P5\} = \{\text{excellent, good, fair, pass, fail}\}$$

Assign the values for the above five levels as shown in Table 3.

Table 3 Score values of each grade

Level	Score	Comments
1	100~90	Excellent
2	89~80	Good
3	79~70	Fair
4	69~60	Pass
5	<60	Fail

4.2 Determine the weight of evaluation factors

The weight of the factor set obtained from the questionnaire data is:

$$W = \{W_1, W_2, W_3\} = (0.558, 0.320, 0.122)$$

4.3 Fuzzy evaluation analysis

This paper evaluates the basketball jump shot skills of the basketball major students in the grade of 2015 in a physical education college of a university, and takes the evaluation results of two of them, as shown in Tables 3, 4 and 5.

Student 1 Evaluation vector of basketball jump shot skills:

$$B_1 = W \cdot R_1 = (0.558, 0.320, 0.122) \begin{pmatrix} 0.25 & 0.27 & 0.22 & 0.26 & 0 \\ 0.17 & 0.21 & 0.31 & 0.31 & 0 \\ 0.21 & 0.34 & 0.22 & 0.23 & 0 \end{pmatrix} = (0.225, 0.283, 0.234, 0.258, 0)$$

Student 2 Assessment vector of basketball jump shot skills:

$$B_2 = W \cdot R_2 = (0.558, 0.320, 0.122) \begin{pmatrix} 0.28 & 0.21 & 0.24 & 0.27 & 0 \\ 0.22 & 0.24 & 0.27 & 0.27 & 0 \\ 0.27 & 0.31 & 0.19 & 0.27 & 0 \end{pmatrix} = (0.259, 0.231, 0.243, 0.270, 0)$$

Take the middle score value of each evaluation grade as the column vector:

$$P = \begin{pmatrix} 95 \\ 85 \\ 75 \\ 65 \\ 30 \end{pmatrix}$$

Then the evaluation results of student 1's basketball jump shot skills are as follows:

$$F_1 = B_1 \cdot P = (0.225, 0.283, 0.234, 0.258, 0) \begin{pmatrix} 95 \\ 85 \\ 75 \\ 65 \\ 30 \end{pmatrix} = 79.75$$

The evaluation results of student 2's basketball jump shot skills are as follows:

$$F_2 = B_2 \cdot P = (0.259, 0.231, 0.243, 0.270, 0) \begin{pmatrix} 95 \\ 85 \\ 75 \\ 65 \\ 30 \end{pmatrix} = 80.1$$

Combined with the above calculation results and the values in the assignment table, it can be seen that the basketball jump ball and jump shot skills of the evaluated students are generally at a 'good' level, indicating that the basketball teaching system of this college is relatively complete. Student 1 is at a 'good' level and Student 2 is at a 'good' level. Student 2 should focus on improving the skill level of basketball jump shot, further should strengthen the training in lifting the ball, and also ensure the training of the landing point of jump shot.

Table 4 Score of student 1 evaluated in the evaluation

Items/Comments	Excellent	Good	Fair	Pass	Fail
Lift the ball position	0.25	0.27	0.22	0.26	0
The smoothness of lifting the ball	0.17	0.21	0.31	0.31	0
Cast dancing posture	0.21	0.34	0.22	0.23	0

Table 5 Score of student 2 evaluated in the evaluation

Items/Comments	Excellent	Good	Fair	Pass	Fail
Lift the ball position	0.28	0.21	0.24	0.27	0
The smoothness of lifting the ball	0.22	0.24	0.27	0.27	0
Cast dancing posture	0.27	0.31	0.19	0.27	0

4.4 Analysis

From this article, you can see, the method of fuzzy evaluation analysis can be effectively used for basketball jumper grade evaluation needed for selection, evaluation index including presence and decision effect, psychological control ability, the pre-match preparations and on-the-spot control competition ability from four aspects, and to lift the ball position, smooth lift degrees, jumper position from three aspects to throw and get scores. The method of fuzzy mathematics evaluation can accurately and quantitatively evaluate the level of basketball players, which has high feasibility and can provide objective basis for the evaluation and management of referees.

4.5 Influence of spectators on basketball players

You've all heard the term home court advantage, or home court effect. In one statistic, teams have a significantly higher winning percentage at home than on the road in most competitive games. In this variable, audience support is an important aspect, but it is not the only one, nor is it the most important one. The most important one is players' habit or familiarity. The cheering of the audience is more positive for the team, especially when the team is facing adversity, the encouragement of the fans is a very good heart booster. Listening to others call your name when you are playing games is a very powerful motivating factor and also a kind of encouragement [9].

After the target and key point of the league marketing work are clear, the countermeasures corresponding to the influence factor are extracted from the 'countermeasure database' and sent to the basketball association and basketball club in the form of 'countermeasure report on increasing the number of spectators in the basketball match scene.' In addition, due to the concerted efforts of all aspects, as well as the comprehensive use of multi-level, all-around countermeasures, finally the prosperity is achieved as the number of spectators in basketball matches has increased greatly and jumped from 12,500 to 28,000 spectators, and note that some matches have never seen the full audience in many years [10].

5 Conclusion

First, the evaluation model is established by the weighted average fuzzy mathematics comprehensive evaluation method, then the development status of basketball jump shot technology is summarised and the jump shot technology is introduced. This paper takes the basketball major students of 2015 from a college of physical education as the research objects, evaluates the basketball jump shot skills of students through constructing mathematical methods, and finally calculates the total score of students' evaluation to obtain the evaluation results of students' basketball jump shot skills quantitatively. To improve the accuracy of the evaluation method, a variety of grading evaluation indexes are divided according to the actual situation, but at the same time, it will increase the amount of calculation. This paper selects the evaluation results of two students' basketball jump-shooting skills, and finds that the basketball jump-shooting skills of the evaluated students are generally at a 'good' level, and they should increase training efforts in lifting the ball and the landing point of the jump-shooting. In addition, this fuzzy evaluation method is also suitable for evaluating other students, as long as the data required for the above evaluation process is obtained.

The method proposed in this paper is suitable for the evaluation of basketball teaching and skill training in colleges and universities, and has a certain guiding significance for improving basketball skills of players. In the training of free throw, it is very difficult to make quantitative division in the actual training, even for the experienced experts to know how much effort can be exerted on the improvement of free throw shooting rate by various training means. But by using the basic theory and method of fuzzy mathematics, we can calculate the degree of correlation between them, so that the valuable experience of experts can be quantified, and effective methods and means are provided to improve the training effect and shorten the training period, so that the training can be more scientific. This exploration makes the basketball skill evaluation to change from qualitative to quantitative, and the evaluation results are in agreement with the actual level of students. The reasonable combination of skill evaluation and standard can better reflect the technology, and in turn promote the improvement and standardisation of the technology to improve the achievement of the standards needed. The software of basketball skill evaluation makes the work more scientific, accurate, simple and practical. It can be used for the evaluation of high level sports teams, and also for the evaluation of basic basketball skills in teaching and training of all ages.

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