The influence of X fuzzy mathematical method on basketball tactics scoring

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Abstract

In the selection of basketball players, the determination of the selection index system and the weight of each index is an important prerequisite for whether the selection is scientific or not. Only when the index system is determined and the importance of each index is sorted reasonably can it be guaranteed that the basketball tactics scoring work went smoothly. This research introduces a method of X fuzzy mathematics, called analytic hierarchy process, or AHP for short. The AHP method can be used in regional planning, resource allocation, program selection, policy analysis, conflict analysis, forecast estimation, decision research, etc. The AHP method schematises the thinking process of the human brain analysis program, which can simply, comprehensively, effectively and clearly deal with complex problems restricted by many factors; it is also a quantitative tool that can be used for the measurement of the sports evaluation system.

Keywords: X fuzzy mathematical method, basketball, tactical scoring, analytic hierarchy process

AMS 2010 codes: 90C70

1 Introduction

From a big point of view, modern training mainly includes the scientific selection of athletes, the long-term systematic scientific training of athletes and the assessment of the best performance in the competition, as well as scientific management. The scoring of basketball tactics is the most important part. If the selected athlete is a seedling with no future for training, no matter how much manpower, material and financial resources are invested, it will be futile. Therefore, the selection of talents has attracted more and more attention. The initial training age of contemporary sports events has been advanced. The selection of some sports events even started

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before the age of 7, which greatly increased the difficulty of accurately predicting athletes’ future athletic ability in the early stage of selection, thus making people pay more attention to the scientific research of basketball tactics score. Scientific practice has proved that from the beginning of the development of competitive sports to the present, scientific selection, scientific management and scientific training have become three major factors restricting the improvement of competitive sports. As German Wuermo said ‘To cultivate contemporary world champions, three conditions must be met: high-level scientific training, optimized training environment and superior talent conditions for athletes.’ Therefore, with the rapid development of modern technology, information with the rapid development of communication methods and the rapid advancement of transmission speed, the development of sports intelligence technology has also been different from the past. The confidentiality of some techniques, tactics and training methods is also self-defeating, and the level of differences in training conditions, methods and methods is gradually shrinking. The level of sports is getting closer, the so-called ‘limits’ of human beings have been broken one by one, and the excavation of human ‘primitive instincts’ has reached an infinite degree. The world sports arena has evolved from ‘one strong dominating’ and ‘several countries contending for hegemony’ to ‘A hundred schools of thought contend. In contrast, the importance of athletes’ personal talents in improving athletic performance is even more prominent. Relevant experts believe that ‘the cultivation of contemporary world champions must have three conditions, namely, high-level scientific training, optimised training environment and superior personal talent conditions for athletes’. Today’s accomplished coaches believe that ‘success in selection means half success.’ It can be seen that scientific selection of talents is a requirement for the development of contemporary competitive sports, and it is a very important part of scientific training. Therefore, ‘the success of the selection means half of the success of the training’ is not an exaggeration, and it has become the general consensus of the people in the sports industry.

Nowadays, basketball tactics scores have high practical and social values. Scientific selection of materials is more economical and effective than traditional empirical selection. The traditional selection of materials adopts the methods of ‘natural elimination’ and ‘layered selection’, which not only has a high elimination rate but also has a greater impact on sports talents and invested human and material resources. Financial resources also cause great waste. Scientific selection of talents can improve the efficiency and accuracy of the selection of talents. Coupled with scientific training, it can further increase the rate of success and obtain the greatest benefits at the least cost. For the above reasons, countries are paying more and more attention to the scientific selection of athletes. People pay more and more attention to the importance of research and selection [1].

This research introduces a mathematical model called analytic hierarchy process (AHP), which was proposed by the American operations researcher and professor Saaty at the University of Pittsburgh in the mid-1970s. AHP is developed from decision analysis. It is a combination of the qualitative and quantitative X fuzzy mathematics method for analysing multi-objective, multi-factor and complex large-scale systems. For decision-makers, it can make the thinking process of decision-making and evaluation organised, hierarchical, mathematical and modelized, which not only simplifies the systematic analysis and calculation of problems but also helps decision-makers maintain the consistency of their thinking processes. Therefore, the AHP conforms to the overall, comprehensive, optimal and simple system thinking. The method has both quantitative analysis and qualitative description.

2 Objects and methods

2.1 Research objects

Take our school’s high-level male basketball players as the research object: aged between 18 years and 22 years, and two athletes have national-level certificates (including), and the number of players is 15.
2.2 Research methods

2.2.1 Expert interview method

According to the purpose and task of the research, in the form of interviews, we visited Shandong Normal University, Ludong University, our school, Yantai University and other well-known experts, professors, coaches and scholars to assess the basketball tactics scoring and evaluation system at various levels. We will conduct interviews on issues such as screening and determination and solicit relevant opinions and suggestions and strive to obtain a comprehensive and objective understanding, which provides a basis for in-depth analysis of the paper [2].

Expert definition: associate professor and above, specialising in competitive sports and teaching workers and related department staff and above.

2.2.2 Questionnaire survey method

The design of the questionnaire is based on the basic requirements for the formulation of the questionnaire. There are 23 questions in total. The questionnaire is distributed on the spot and collected on the spot to ensure the authenticity and reliability of the survey content to the greatest extent. The returned questionnaires are tested and eliminated. As shown in Table 1, the recovery rate and effective rate of the questionnaires are 100%, which meets the requirements of this research.

| Number of issues | Number of recycling | Recovery rate | Effective number | Efficient |
|------------------|---------------------|---------------|------------------|-----------|
| 12               | 12                  | 100%          | 12               | 100%      |

In order to ensure the validity of the questionnaire, we specially designed an expert validity test questionnaire evaluation form, consulted relevant experts who have conducted in-depth research on this subject and comprehensively reviewed and assessed the questionnaire. After logical analysis, the questionnaire was ‘very suitable’, ‘appropriate’ and ‘basically suitable’. There were five levels of qualitative evaluation of ‘inappropriate’ and ‘very inappropriate’. After consulting experts, the questionnaire was revised, and then, a 12-person questionnaire survey was conducted. It can be seen that the questionnaire has a high degree of validity (see Appendix 2) through the recovered expert validity test questionnaire evaluation form. The composition of experts and evaluation results are as follows in Tables 2–5:

| Job title                  | Professor | Associate professor | Total |
|----------------------------|-----------|---------------------|-------|
| Number of people           | 4         | 8                   | 12    |

| Content validity | Very reasonable | More reasonable | General | Not reasonable | Unreasonable |
|------------------|-----------------|-----------------|---------|----------------|--------------|
| Frequency        | 4               | 7               | 1       | 0              | 0            |
| Percentage       | 33.30%          | 58.40%          | 8.30%   | 0              | 0            |

| Content validity | Very reasonable | More reasonable | General | Not reasonable | Unreasonable |
|------------------|-----------------|-----------------|---------|----------------|--------------|
| Frequency        | 4               | 6               | 2       | 0              | 0            |
| Percentage       | 33.30%          | 50.00%          | 16.70%  | 0              | 0            |
The ‘expert method’ was used for reliability testing. For the first time, 12 experts were selected to fill in the questionnaire. After 15 days, the second round of questionnaires was issued to the same population, which was filled out by the original survey respondents, and the correlation coefficients were calculated as items by each person. The overall correlation coefficient $R = 0.861 (P < 0.01)$, the reliability of the questionnaire meets statistical requirements and the reliability of the questionnaire is high.

### 2.2.3 AHP

Use the AHP to reasonably establish the comparison judgement matrix of each indicator in the evaluation indicator system, calculate the weight of each indicator and then pass the consistency test to calculate the weight of the relative importance of all indicators at the same level to the overall indicator and arrange the order to achieve the purpose of quantitative description.

### 2.2.4 Experimental method

The research results were applied to the candidates of our school’s high-level basketball team to participate in the 2010 CUBA Shandong competition area, and the selection and evaluation were carried out, and the degree of consistency between the research results and the actual situation was observed, which further proved that the AHP is used in the scoring of basketball tactics. The scientific, objectivity and practicality of.

### 3 Research results and discussion

#### 3.1 Use tomographic analysis to establish a mathematical model

##### 3.1.1 Establish a hierarchical structure model of basketball skills

This article refers to the first edition of the ‘Advanced Basketball Course’ published by the People’s Sports Publishing House issued by the National Sports School Textbook Committee in October 2000. At the same time, based on expert interviews, the main technical indicators of basketball technology are summarised into two major categories. With regard to the nine factors, in order to enable the evaluation criteria and the corresponding index system to faithfully reflect these characteristics and at the same time to correspond to the AHP theory, we have established a hierarchical structure as shown in Figure 1, where C layer factors can be transformed into specific indicators [3].

**Passing and receiving C1:** Passing is a purposeful method of transferring the ball between offensive players in a basketball game. It is the link between offensive players on the court and the organisation of offense. It is a specific means to achieve tactical coordination. The quality of the passing technique directly affects the quality of the tactics and the outcome of the game. Accurate and clever passing can not only disrupt the opponent’s deployment but also create more and better shooting opportunities. Receiving the ball is one of the main techniques in basketball. It is the action of getting the ball and is the basis for rebounding and stealing the ball. In a fierce competition, whether the correct action can be used to receive the ball firmly has a very important role in reducing pass errors, making up for insufficient passes and intercepting the opponent’s pass.

**Shooting C2:** Shooting is a specialised action for players to throw the ball into the hoop. The main offensive technique of basketballs is the only means of scoring in a basketball game. It is the ultimate goal of all offensive and defensive contradictions [4].

**Dribbling C3:** Dribbling is a type of action method in which a team member is in place or on the move, using
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Fig. 1 Basketball tactics scoring and evaluation hierarchy analysis model.

one hand to continuously tap the ball bounced from the ground. It is an important technique for personal offense in basketball games. It is an offensive method for individuals to not only get rid of, attract and break through defines but also is an important bridge for launching and organising tactical coordination.

**Offensive rebounds C4:** Offensive rebounds are the main means to obtain the second offense. Actively grabbing offensive rebounds is an important offensive action and an important method to continue to control the ball. It not only increases the number of offenses and make-up opportunities for the team but also boosts morale and confidence. It has a certain ‘lethal’ to the defensive team and has very important tactical significance.

**Breaking with the ball C5:** Breaking with the ball refers to a highly offensive technique in which team players use footwork and dribbling skills to quickly surpass their opponents. The ball-holding breakthrough action is mainly composed of several links, such as stepping across, shouldering sideways, pushing and releasing the ball and accelerating. It is an offensive means of offense and a prelude to scoring [5].

**Steal the ball C6:** Steal the ball from the hands of the offensive player. When using it, you should seize the opportunity of the team player to be distracted, turn around, catch the ball from the air and stop the dribble. Hold the ball accurately and quickly and use sudden force. Stealing is a method of capturing the pass while the ball is flying. Whether it is intercepting the ball from the side or back of the opponent receiving the ball or blocking the pass of the passing team member, there must be an active movement step to coordinate, accurately determine the moment when the opponent takes the pass and keep the body after intercepting the ball. Balance, moving quickly to the next action, turn defines into offense.

**Defensive rebound C7:** Defensive rebound is an important part of defines and an important way to regain possession of the ball. It is the starting point from defensive to offensive. If you can successfully control the defensive rebound every time you miss a shot, then you must be able to better control the entire game. Regardless of which method or action is used to grab a defensive rebound, the body is required to stretch and the direction of the air to be as close as possible to the point of the ball. At the same time, pay attention to maintaining body balance in the fierce confrontation.

**Defensive opponent C8:** Defensive opponents have both personal defines and team defines. Personal defines requires athletes to be brave, witty, decisive and have the momentum to overwhelm the opponent on the court and
use a combination of defines and offensive actions to control them, that is, the opponent’s offense. Therefore, higher requirements are put forward for athletes in terms of mind, body and technique. The quality of individual defensive skills reflects the player’s defensive ability, and personal defensive ability is the basis of the team’s defines. Only by successfully completing the task of one defines can we better cooperate with the defines and complete the overall defines of the team [6].

**Playing C9:** Playing is knocking out the ball in the hands of the offensive player. According to the height and trend of the part holding the ball, the direction and speed of the rebound in the dribble, the process of shooting and lifting the ball to the front of the shot, etc., quickly slap the ball with the power of the fingers and wrist from the bottom to the top, from the top to the bottom or from the side. To master the timing, move quickly and shortly [7].

### 3.1.2 Mathematical model and its solution

Establish a comprehensive evaluation model:

$$y = \sum_{i=1}^{n} W_i x_i$$  

### 3.1.3 The basis for establishing a judgement matrix

Choose any two forms, compare their contribution to y and assign the importance degree according to the following 9-level scale. Establish an n-order matrix: the importance ratio scale relative to the criterion of the previous layer. In the formula, n is the number of sub-goals of the tested level. Then, the judgement matrix A has the following properties:

$$a_{ij} > 0, \quad a_{ji} = \frac{1}{a_{ij}}, \quad a_{ii} = 1$$

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**Fig. 2** Principle of AHP. AHP, analytic hierarchy process.
For example, suppose the lower element associated with the upper element $A$ is the first $N$ element, first determine the relative importance of the element relative to the element. If is considered to be equally important than, then; if is considered slightly more important than Important; if is considered to be significantly more important than, then; if is considered to be more important than; if is considered to be extremely important than; can also be selected as 2, 4, 6 and 8 is equivalent and corresponds to or other more appropriate values. Figure 2 shows the schematic diagram of the AHP [8].

3.1.4 Establish the judgement matrix and calculate the weight coefficient according to the scale of each layer

Integrating 12 experts according to Professor Saaty’s 1–9 scale method to compare the scores of the items in each layer one by one, the index importance judgement matrix as shown in Table 6 is obtained:

| Pass and catch | Shot | Dribble | Offensive rebound | Break with the ball |
|----------------|------|---------|-------------------|--------------------|
| Pass and catch | 1    | 1/2     | 5                 | 6                  |
| Shot           | 2    | 1       | 6                 | 5                  |
| Dribble        | 1/5  | 1/6     | 1                 | 1/5                |
| Offensive rebound | 1/6  | 1/5     | 5                 | 1                  |
| Break with the ball | 1/6  | 1/7     | 1/3               | 1/4                |
| Steal the ball | 1/7  | 1/8     | 1/5               | 1/3                |
| Defensive rebound | 1/4  | 1/4     | 5                 | 2                  |
| Defensive opponent | 1/2  | 1/3     | 6                 | 5                  |
| Play ball      | 1/8  | 1/9     | 1/6               | 1/7                |

The consistency check formula of the matrix is given as follows:

$$CR = CI/RI$$ (3)

$\lambda_{\text{max}}$ is the largest characteristic root. The value of and can be calculated by software MATLAB7.7. The value of RI varies with the matrix order $n$ as shown in Table 7.

| Matrix order $n$ | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|------------------|---|---|---|---|---|---|---|----|----|----|
| RI value         | 0.52 | 0.89 | 1.12 | 1.26 | 1.36 | 1.41 | 1.46 | 1.49 | 1.52 | 1.54 |

| Aims             | Weights WI |
|------------------|------------|
| Pass and catch   | 0.198037   |
| Shot             | 0.225612   |
| Dribble          | 0.079883   |
| Offensive rebound| 0.10562    |
| Break with the ball | 0.046674  |
| Steal the ball   | 0.034089   |
| Defensive rebound| 0.1291     |
| Defensive opponent | 0.169627 |
| Play ball        | 0.011348   |
The consistency test of matrix $A$ is $CR = CIRI = 0.01930.52 = 0.037 < 0.10$. There is no logical error in the judgement of the weight of each sub-objective at this level. For calculation of the weight coefficient, the steps for calculating with the sum method are as follows:

First sum up each column of the judgement matrix to get $\sum_{i=1}^{n} b_{ij} = a_{ij} / \sum_{i=1}^{n} a_{ij}$ and calculate

$$ W_i = \frac{\sum_{j=1}^{n} b_{ij}}{n} \quad (4) $$

The weights are calculated from matrix $A$ and normalised, and the results are shown in Table 8.

### 3.2 Calculate the comprehensive score and conduct a comprehensive evaluation

The actual value of each indicator and the product of its weight coefficient are calculated to calculate the weighted average, which is the player’s comprehensive score. The results are shown in Table 9.

| Indicator name          | Weight coefficient | Zhang Chao | Wang Wei | Clever | Dai Peng | Sun Xiaojie |
|-------------------------|--------------------|------------|----------|--------|----------|-------------|
| Pass and catch          | 0.198037           | 70         | 70       | 60     | 70       | 60          |
| Shot                    | 0.225612           | 70         | 90       | 60     | 75       | 60          |
| Dribble                 | 0.079883           | 85         | 60       | 60     | 75       | 60          |
| Offensive rebound       | 0.10562            | 60         | 70       | 85     | 70       | 60          |
| Break with the ball     | 0.046674           | 90         | 75       | 60     | 85       | 60          |
| Steal the ball          | 0.034089           | 70         | 85       | 80     | 85       | 60          |
| Defensive rebound       | 0.1291             | 80         | 80       | 85     | 80       | 60          |
| Defensive opponent      | 0.169627           | 80         | 75       | 90     | 90       | 60          |
| Play ball               | 0.011348           | 50         | 60       | 60     | 70       | 60          |
| overall ratings         | 73.92              | 76.57      | 71.72    | 77.51  | 60.06    |             |
| Rank                    | 9                  | 5          | 13       | 4      | 15       |             |

It has been verified that the results of the AHP and the subjective selection of coaches are compared, and the conclusions of the two methods are consistent. Therefore, in practical application, AHP can be used as a good reference basis and supplement for subjective coach selection [9].

### 4 Discussion

4.1 Construct a quantitative system for selecting materials that combines subjective and objective characteristics

This paper constructs a system of basketball tactics scoring and evaluation indicators and uses AHP to scientifically and rationally solve the weight distribution of various indicators in the basketball tactics scoring and evaluation system and to quantitatively describe the empirical evaluation results more accurately. So, the ranking results can objectively and truly reflect the actual situation so that many material selection issues enter the stage of quantitative research [10].
4.2 The establishment of material selection standards is a prerequisite and necessary condition for the quantitative system

In the AHP, the stratification of various factors is more critical. It is necessary to extensively listen to opinions and conduct expert consultation and surveys to make the stratification standards relatively appropriate. This can avoid the one-sided abuse of personal subjective consciousness and make the evaluation results more realistic. It reflects the athlete’s actual level and potential and has certain reference value for training, decision-making and determining the athlete’s development goal.

4.3 The system provides a scientific theoretical basis for the selection and training of athletes

In basketball tactics scoring and basketball training, you can scientifically arrange the training content and select the best training plan with reference to the weight value of the above mentioned selection indicators and assign quantitative indicators for training control so that the training arrangement is based, focussed and clear for the purpose of making its quantitative standards provide a scientific theoretical basis for basketball training [11].

4.4 Strong operability and easy control

The AHP method is flexible, clear in thinking and distinct in levels. It organises, hierarchises and quantifies the decision-making process of the complex problem of basketball tactics scoring and evaluation; so, it has extremely high practicality. At the same time, it is suitable for solving decision-making problems that are difficult to analyse with quantitative methods. It is a powerful tool for complex social systems to realise scientific decision-making.

5 Conclusion

This article adopts the AHP to determine the weight of the index system. After empirical analysis, it is found that it is feasible and scientific in the scoring and evaluation of basketball tactics. However, the AHP itself has inherent defects, such as the inability to reflect the mutual influence relationship between indicators. Future research can consider the use of the analytic network method (ANP) or fuzzy comprehensive evaluation method to increase the effectiveness and scientific decision-making of the evaluation model.

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