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## Fuzzy evaluation-based university basketball public course teaching evaluation system research

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### ABSTRACT

The paper applies documents literature, questionnaire survey, experts interview to study on current universities basketball public course performance evaluation system, analyzes system existing shortcomings, and proposes that university basketball public course evaluation system should target at solving students and teachers attitudes towards basketball public course and improving teachers teaching and students passions, so that improves students basketball quality, physical quality and basketball public course healthy development. And meanwhile, according to basketball public course evaluation indicators possessed multi-level and their relations fuzzy features, the paper applies fuzzy comprehensive evaluation method to establish models on selected basketball public course teaching system, utilizes experts interview and frequency statistics method to define selected indicators weights, finally defines each basketball public course teaching evaluation indicator weight in established model and established fuzzy evaluation model.

### KEYWORDS

Basketball public course; Fuzzy evaluation; Teaching evaluation; Healthy development; Mathematical model.



## INTRODUCTION

For years, university basketball course teaching always reflects that teachers are dominators of teaching, their teaching methods, organizational forms are too unified and normalized, they tend to only focus on students technical learning, adopted methods in basketball course teaching are also to technical tests and others, their teaching tend to hard to effective improve basketball quality and physical quality of students that basic skills and physical conditions are poor.

Scientific and reasonable basketball public course teaching evaluation can effective propel to basketball public course education development in universities, enhance students basketball quality and physical quality, and propel to lifelong sports and other thoughts transmission among students. By far, Chinese universities basketball public course implementation just targets at test contents, evaluation recognition has deviation, evaluation contents are not comprehensive and evaluation lacks of scientificity. For current Chinese basketball public course teaching issues, many scholars have already studied on them, from which Sheng Feng and others (2008) applied self-organizing competitive network and methods to study on Chinese institutions of higher learning sports major basketball teaching evaluation system, and put forward suggestions that neural network teaching evaluation system was key direction of future sports teaching reformation and others<sup>[1]</sup>; Jiang Bo (2011) applied documents literature, mathematical statistics and other methods, by carrying out public basketball course teaching evaluation on Zhe Jiang University public basketball course teaching objective and others, he researched on its teaching contents and teaching evaluation system, and optimized current teaching evaluation system<sup>[2]</sup>; Tang Xiaoyong and others (2009) made analytical investigation on current Chinese universities public basketball course teaching evaluation system features and existing problems, put forward suggestions on students basketball basic motions learning and others<sup>[3]</sup>; Luo Yong (2013) made analytical investigation on current universities basketball public course reformation and teaching existing problems, scientific constructed basketball public course evaluation system, and further propelled to its teaching model reformation further deepening<sup>[4]</sup>; Chen Xin (2011) applied documents literature, investigation and other methods to analyze Hunan province sports major education basketball course teaching evaluation status, explored sports major basketball teaching evaluation methods of evaluation, and put forward corresponding opinions<sup>[5]</sup>.

For present universities basketball public course evaluation system establishment, the paper based on formers analytic investigation, applies document literature, mathematical statistics and other methods to make analytic investigation on them, and applies fuzzy evaluation method to establish corresponding evaluation model, in the hope of solving present universities basketball public course evaluation system existing problems, and provides references for universities basketball public course development and their students basketball quality improvements.

## BASKETBALL PUBLIC COURSE AND MODEL ANALYSIS

In order to analyze and study on basketball public course organization status in universities and school evaluation system about students performance, the paper selects Shandong province fifteen undergraduate universities, fifteen academies, carries on questionnaire survey on them, and implements experts consultation with partial basketball public course teachers, and makes mathematical statistics of questionnaire results and consultation. Finally, the paper carries on principal components analysis of statistical results, and establishes corresponding evaluation models on universities basketball public course.

### **Basketball public course research methods**

The paper firstly adopts questionnaire survey and experts interview, makes questionnaire survey on universities 40 basketball teachers, from which there are 50 universities basketball public course teachers, and meanwhile releases 200 pieces of questionnaires on the 40 schools. In order to verify questionnaires effective rate, the paper carries on second time questionnaire on students received

questionnaires, finally it defines effective questionnaires are 177 pieces. At last, the paper makes mathematical statistics, logic analysis and principal component analysis of experts interview and students questionnaire contents, on the basis of analyzing present universities public course evaluation system existing problems, it establishes universities basketball public course teaching evaluation model.

### **Basketball public course present existing problems**

In order to carry out effective reformation and modeling on universities basketball public course teaching evaluation system, the paper studies on present universities basketball public course teaching and teaching evaluation relative problems by experts interviewing and questionnaire survey statistics.

Presently, universities basketball public course teaching contents mainly are based on most basic simple sports techniques, no elastic adjustment on teaching contents; it cannot effective let students to improve their basketball quality and physical quality, and even cannot let students to understand lifelong sports significance during learning proves. And meanwhile, in basketball learning, students recognition of basketball integrality, team attribute are not enough, students solitary and cooperation spirits are deficient, teachers also cannot effective cultivate students striving spirits of self-confidence and self-improvement, they cannot propel to their sound psychological adjustment as well as cultivate their good quality by basketball teaching.

Universities basketball public course teaching should put students' subjective function and independence playing into the first place in guiding thought. But evaluation system also has many problems that lack of scientificity. In reality teaching, students tend to learn basketball for earn credits and graduation, teachers also teach as teaching requests, basketball public course hasn't yet aroused students learning and teachers teaching positivity. Teachers tend to focus on students sports learning performances while ignore students each kind of basic quality. According to documents literature, for 50 basketball teachers questionnaires, the paper divides teachers teaching model into subject style teaching, sheep herding style teaching, traditional style teaching and actual combat style teaching four teaching models<sup>[6]</sup>. By investigation, universities basketball public course teachers teaching model status is as TABLE 1 shows.

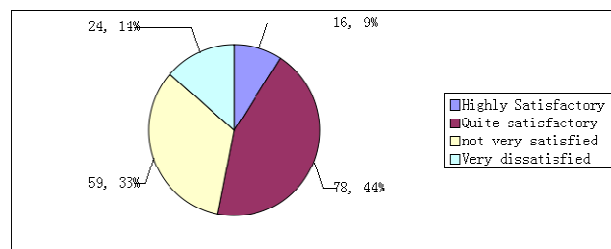
**TABLE 1 : Universities teaching model investigation table**

<b>Teaching model</b>	<b>Subject style teaching</b>	<b>Sheep herding style teaching</b>	<b>Traditional style teaching</b>	<b>Actual combat style teaching</b>
Number of teachers	7	15	20	8
Percentage	14%	30%	40%	16%

Different teaching models correspond to different evaluation system, education is root in students development, subject style teaching gives students subject function into full play, let students to get fully development in activities. In questionnaires, only 7 teachers carry out subject style teaching that occupy 14% of total number of informant teachers. Teachers with sheep herding style teaching even randomly score on students' performance rather than carrying out effective evaluation on their courses, there are 15 teachers take sheep herding style teaching that occupy 30% of total number of informant teachers. Traditional style teaching mainly is based on passing on and evaluating students most basic techniques, it is hard to let students basketball quality, physical quality and else to be realistic improved, there are 20 teachers take traditional style teaching that occupy 40% of total number of informant teachers. There are eight teachers carry out actual combat teaching that occupy 16% of total number of informant teachers. By above statistics, it is clear that present universities basketball public course teaching models are not ideal, which also causes basketball public course evaluation system to be imperfect and not standardized, its teaching model and teaching performance evaluation model need to be reformed.

By questionnaire survey, the paper investigates students' current attitudes contents towards basketball public course teaching. For students' attitudes problems on basketball teaching, in

questionnaires, the paper sets four options that are highly satisfactory, quite satisfactory, not very satisfied and very dissatisfied. In the investigated 177 pieces of students effective questionnaires, university students attitudes toward current basketball public course teaching contents, its statistic data is as Figure 1 shows.



**Figure 1 : Students attitudes toward basketball teaching contents**

By Figure 1 statistical data, it is clear that among basketball teaching evaluation system effective questionnaires 177 informants, students that are highly satisfactory with teaching contents are only 16 people that only occupy 9.04% of sum totals, people that are quite satisfactory with teaching contents are 78 that occupy 44.07% of sum totals, students that are not very satisfied with teaching contents are 59 people that occupy 33.33% of sum totals, and students are very dissatisfied with teaching contents are 24 people that occupy 13.56% of sum totals. Among them, only 94 people are highly satisfactory and quite satisfactory with basketball teaching contents that occupy 53.11% of sum totals, the proportion is just slightly higher than students proportions that are not very satisfied and very dissatisfied with basketball teaching contents.

By above analysis, it is clear that present basketball public course teaching is not ideal, teachers' teaching models are not ideal, students satisfaction on them are poor, students interests in basketball public course and teachers teaching passions cannot be effectively aroused. So establishment of universities basketball public course performance evaluation system model should take solving students and teachers attitudes on basketball public course, promoting teachers and students passions as targets, so that enhance students' basketball quality, physical quality and basketball public course healthy development.

### **Basketball public course evaluation indicators**

According to above analysis of presently universities basketball public course teaching and teaching evaluation system existing problems, the paper reforms and models its evaluation system, applies documents literature and experts interview methods, and establishes basketball public course evaluation indicators. New established evaluation indicators should solve previous teaching evaluation problems like put more emphasis on techniques, technologies and ignores students team cooperation, team awareness, and also solve problems of students basketball quality, physical quality improvements as well as learning interests cultivation in teaching, which means the paper planned basketball public course evaluation indicators should take solving students and teachers attitudes toward basketball public course, promoting teachers and students passions as targets, so that enhance students basketball quality, physical quality and basketball public course healthy development.

In order to comprehensive evaluate students basketball quality that attend in basketball public course, and make evaluation on students basketball course performances, the paper applies documents literature to select evaluation indicators on students, selected evaluation indicators have two layers, the first layer has five indicators that are respectively sports technology, sports awareness, physical health, social adaptability and psychological health. Among them, under indicator of sports technology, there are five sub indicators that are respectively sports techniques understanding, sports techniques application, sports technologies self-learning capacity, sports technologies appreciation, sports technologies indicators and imparting capacity<sup>[1]</sup>. Under sports awareness, there are four sub indicators that are respectively sports participation awareness, lifelong exercises awareness, innovation awareness

and basketball culture accumulation awareness. Under physical health, there are three sub indicators that are respectively qualified physical quality, physical adaptability and physical quality enhance capacity, social adaptability has five sub indicators that are respectively competition awareness and ability, cooperation awareness and ability, social role definition, social role exchange and social role transformation. Under psychological health there are three sub indicators that are respectively emotional experience, sports recognition and learning attitude.

Above selected basketball public course test contents and indicators investigate students' basketball technology, basketball course learning status from each aspect. These statistical indicators investigate students' basketball learning mainly from sports technology, social adaptability, psychological health, sports awareness, and physical health five directions. Among them, it has technical indicators targeted at students' learning technical understanding, technical applications and so on, indicators for students' social adaptability's competition awareness, competition ability and so on, and also indicators for psychological health's emotional experience, sports recognition and learning attitude, which means evaluation indicators should comprehensive, objective evaluate students basketball technology learning and basketball quality improvements.

## **BASKETBALL PUBLIC COURSE TEACHING EVALUATION SYSTEM EVALUATION MODEL ESTABLISHMENT**

In order to analyze whether above established universities basketball public course evaluation system is fit for universities students' basketball public course evaluation or not, the paper carries on fuzzy evaluation on selected indicators. According to above analysis as well as basketball public course teaching evaluation indicators establishment, it is clear that basketball public course teaching evaluation indicators has hierarchies, with respect to this, the paper adopts multiple layer fuzzy comprehensive evaluation method to make analytic studies on the problem. Finally, by establishing basketball public course teaching evaluation model, the paper provides references for universities basketball public course development and their students basketball quality improvements.

### **Fuzzy evaluation system brief introduction**

1) Fuzzy comprehensive evaluation method is a kind of systematical analysis method that is fuzzy deduction-oriented, applies fuzzy mathematical principles to make comprehensive evaluation on things that suffer multiple factors impact and are difficult to be effectively quantitative analyzed. The paper selected basketball public course evaluation indicators wholly belong to qualitative indicators, the paper applies fuzzy comprehensive evaluation method, carries out quantitative analysis of selected qualitative indicators. Fuzzy comprehensive evaluation specific steps are as following:

Evaluation elements system indicators setting. By analyzing problems, set evaluation elements system indicators factors domain of discourse for comprehensive evaluation objects factors, evaluation elements set is:

$$U = \{u_1, u_2, \dots, u_n\}$$

Among them,  $u_1$  is the first layer evaluation element in evaluation domain of discourse. For relative complex evaluation coefficient, its evaluation elements may be in multiple layers, the paper is two layer evaluation system, set the second layer evaluation element set is :

$$u_1 = \{u_{11}, u_{12}, \dots, u_{1m}\}, u_2 = \{u_{21}, u_{22}, \dots, u_{2m}\}, \dots, u_n = \{u_{n1}, u_{n2}, \dots, u_{nm}\}$$

2) Remark set definition. Fuzzy comprehensive evaluation needs to transform fuzzy, qualitative indicator information into quantitative indicator information, so that carry out fuzzy comprehensive evaluation analysis on them. Here, it needs to define remark grade domain of discourse  $V$ , from which:

$$V = \{v_1, v_2, \dots, v_n\}$$

General used remarks are  $V = \{\text{Very good, good, general, } \dots, \text{not good, bad, very bad}\}$ .

3) Carry out single factor evaluation. Carry out single factor weight defining on defined indicators layers, it needs to establish fuzzy relation matrix R:

$$R = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{m1} & r_{m2} & \dots & r_{mn} \end{bmatrix}$$

Among them,  $r_{ij}$  is each evaluation element  $u_i$  membership relation with  $v_j$  in remark grade domain of discourse  $V$ , and  $0 \leq r_{ij} \leq 1$ .

4) Define each evaluation element membership relations with evaluated things that is to allocate weight on each element. Set evaluation factor weight vector  $A = \{a_1, a_2, \dots, a_m\}$ , from which  $A$  each element membership relations with evaluated things. Define evaluation factors weight vector  $A$  weight  $a_k$  methods are mainly frequency statistical method, fuzzy analytic hierarchy process and so on.

5) Select proper fuzzy calculation operators, do fuzzy computation on evaluation factor weight vector  $A$  and fuzzy relation matrix  $R$ , finally proceed with form handling with fuzzy comprehensive evaluation results, and get required forms.

**Fuzzy evaluation system establishment**

**Fuzzy evaluation system weight defining**

Basketball public course evaluation indicators have hierarchies, the paper adopts fuzzy analytic hierarchy process method, applies experts knowledge, information to solve each element distribution weight problems. When analytic hierarchy process defines each factor weight, it adopts paired comparison method, establish comparison judgment matrix, so as to convert experts information into mathematical problems. In comparison judgment matrix, each element value defining can refer to TABLE 2.

**TABLE 2 : Saaty (1-9 Ratio scale table)**

Scale scores	Definition
1	Indicates two factors have equal importance by comparing
3	Indicates the former is slightly more important than the later by comparing two factors
5	Indicates the former is obviously more important than the later by comparing two factors
7	Indicates the former is intensely more important than the later by comparing two factors
9	Indicates the former is extremely more important than the later by comparing two factors
2, 4, 6, 8	Indicates middle value of corresponding judgment that former factor to later factor
Reciprocal of above numerical values	It indicates the later factor importance to former factor by comparing two factors

By paired comparison method, establish first layer basketball public course evaluation indicator paired comparison matrix, and do consistency test on it. The first layer basketball public course evaluation indicators are sports technology, sports awareness, physical health, social adaptability and psychological health five indicators, established paired comparison matrix each element value is as TABLE 3 shows.

**TABLE 3 : Basketball public course first layer indicators each factor comparison judgment matrix**

	Sports technology	Sports awareness	Physical health	Social adaptability	Psychological health
Sports technology	1	1/5	3	1/5	1/5
Sports awareness	5	1	5	3	3
Physical health	1/3	1/5	1	1/5	1/5
Social adaptability	5	1/3	5	1	3
Psychological health	5	1/3	5	1/3	1

Carry out feature value and feature vector solution on TABLE 3 data composed matrix, it gets maximum feature value as 5.4089, and its corresponding feature vector is:

$$w = [-0.1260 \quad -0.7847 \quad -0.0812 \quad -0.5056 \quad -0.3258]^T$$

Judgment matrix is five orders matrix that  $n=5$ , and then its corresponding  $RI$  value is 1.12, and meanwhile by above, it is clear that matrix feature vector,  $\lambda = 5.4089$ . Finally, by consistency indicators formula  $CR = \frac{CI}{RI}$  and  $CI = \frac{\lambda - n}{n - 1}$ , it can solve consistency indicator is 0.0912 that consistency indicator is less than 0.10, judgment matrix consistency can be accepted. Make normalization handling with feature vector  $w$ , it solves basketball public course evaluation indicator system first grade indicator weight is :

$$A = (0.0691 \quad 0.4304 \quad 0.0445 \quad 0.2773 \quad 0.1787)$$

Similarly, apply above stated methods, it defines basketball public course second layer evaluation indicators weights, totally corresponding establish five paired comparison matrix, it can solve weight as following shows:

$$A_1 = (0.1736 \quad 0.3272 \quad 0.0899 \quad 0.3615 \quad 0.0476)$$

$$A_2 = (0.5083 \quad 0.2653 \quad 0.0752 \quad 0.1512)$$

$$A_3 = (0.2583 \quad 0.1047 \quad 0.6370)$$

$$A_4 = (0.2448 \quad 0.4896 \quad 0.0848 \quad 0.1336 \quad 0.0472)$$

$$A_5 = (0.3333 \quad 0.3333 \quad 0.3333)$$

### Fuzzy evaluation system membership matrix defining

By above analysis, it is clear that the paper first layer evaluation element domain of discourse  $U$  each element is above selected sports technology, sports awareness, physical health, social adaptability and psychological health five indicators, in the second layer evaluation element domain of discourse is first layer five indicators respective corresponding sub indicators. The paper takes one student performance evaluation as an example, and meanwhile, the paper set remark grade as five grades that domain of discourse

$$V = \{\text{Very good, good, general, not good, very bad}\}$$

Based on above domain of discourse, define basketball public course performance evaluation model fuzzy membership matrix. There are more methods to define fuzzy membership matrix, the paper applies frequency statistical methods. In designed system, in teachers teaching process, evaluate ten

times on each kind of indicators, membership of indicators to domain of discourse each element is the ratio between selecting element times and total times 10, so that it can get students term end basketball performance information, and can also fully evaluate on students performance change information in learning.

In order to define exact scores on students' performance, it can calculate five grades memberships. The paper multiplies very good, good and general three grades membership sum by 100, its obtained result is used for established fuzzy evaluation coefficient scores.

**Fuzzy evaluation system application**

The paper takes one university basketball student basketball performance as an example, carry out fuzzy evaluation on his performance. Make fuzzy comprehensive evaluation on the student, it needs to establish fuzzy membership matrix on the second layer indicators that totally establish five fuzzy membership matrix that are respectively  $R_1, R_2, R_3, R_4, R_5$ , by soliciting students and teachers opinions, the paper handles with student basketball public course each item statistical data, and solves five fuzzy membership matrix are respectively :

$$R_1 = \begin{bmatrix} 0.2 & 0.4 & 0.4 & 0 & 0 \\ 0.3 & 0.4 & 0.3 & 0 & 0 \\ 0 & 0.1 & 0.5 & 0.4 & 0 \\ 0 & 0.2 & 0.7 & 0.1 & 0 \\ 0 & 0.3 & 0.4 & 0.2 & 0.1 \end{bmatrix}, R_2 = \begin{bmatrix} 0 & 0.4 & 0.4 & 0.1 & 0 \\ 0.2 & 0.4 & 0.4 & 0 & 0 \\ 0 & 0.2 & 0.4 & 0.3 & 0.1 \\ 0.1 & 0.7 & 0.2 & 0 & 0 \end{bmatrix}$$

$$R_3 = \begin{bmatrix} 0 & 0.1 & 0.2 & 0.5 & 0.2 \\ 0 & 0 & 0.2 & 0.3 & 0.5 \\ 0 & 0 & 0.2 & 0.6 & 0.2 \end{bmatrix}, R_4 = \begin{bmatrix} 0.1 & 0.2 & 0.5 & 0.2 & 0 \\ 0.1 & 0.3 & 0.4 & 0.2 & 0 \\ 0 & 0 & 0.1 & 0.4 & 0.5 \\ 0 & 0.3 & 0.4 & 0.3 & 0 \\ 0 & 0 & 0 & 0.3 & 0.7 \end{bmatrix}, R_5 = \begin{bmatrix} 0 & 0.1 & 0.3 & 0.3 & 0.3 \\ 0.1 & 0.3 & 0.5 & 0.1 & 0 \\ 0.4 & 0.5 & 0.1 & 0 & 0 \end{bmatrix}$$

Carry out membership vector calculation on basketball public course second grade evaluation indicators, its computational formula is:

$$B_i = A_i \times R_i$$

Among them,  $i=1,2,3,4,5$ . It can solve second grade evaluation indicator membership vectors as following:

$$B_1 = (0.1329 \quad 0.2959 \quad 0.4846 \quad 0.0816 \quad 0.0048)$$

$$B_2 = (0.0682 \quad 0.4303 \quad 0.3698 \quad 0.0734 \quad 0.0075)$$

$$B_3 = (0 \quad 0.0258 \quad 0.2000 \quad 0.5428 \quad 0.2314)$$

$$B_4 = (0.0734 \quad 0.2359 \quad 0.3802 \quad 0.2350 \quad 0.0754)$$

$$B_5 = (0.1666 \quad 0.3000 \quad 0.3000 \quad 0.1333 \quad 0.1000)$$

Similarly, by formula  $B = A \times R$ , it can also solve first grade evaluation indicators membership vectors, from which  $R$  is fuzzy membership vectors transposed matrix that is composed of line vector  $B_i$ . Then it can solve first grade evaluation indicators membership vector after normalization is:

$$B = (0.1816 \quad 0.2281 \quad 0.2119 \quad 0.2022 \quad 0.2088)$$



### Fuzzy evaluation result analysis

By above, it is clear that the paper divides students evaluation into five grades that fuzzy evaluation domain of discourse elements are very good, good, general, not good, very bad. By above computed result, it is clear that the paper selected student performance to five grades memberships are respectively 0.1816, 0.2281, 0.2119, 0.2022 and 0.2088. That student performance membership to very good, good and general three grades is 0.6216, and membership to not good and very good two grades is 0.3784. By the paper established evaluation system, evaluated student performance is 62.12 points.

### CONCLUSION

The paper applies fuzzy mathematical knowledge, establishes universities basketball evaluation system. Established evaluation system comprehensive investigates students' basketball technology and learning attitudes from each aspect, it can comprehensive evaluate on students basketball public course learning. Due to selected basketball indicators relations are relative complex and fuzzy. When evaluate each student performance, defining of its each indicator corresponding numerical value is relative fuzzy, and selected indicators have hierarchies, so it chooses fuzzy comprehensive evaluation method, it can effective apply teachers experiences and others. Basketball public course fuzzy comprehensive evaluation system establishment will effective solve current universities basketball public course performance evaluation system existing problems, and provides references for universities basketball development.

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