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Construction of Basketball Professional Quality Training Evaluation System Based on Automatic Information Technology

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Keywords: Evaluation System, Basketball Quality Training, Dynamic Monitoring, Automated Information Technology

Abstract: An excellent basketball player is bound to have high basketball professional quality. As an important base for transporting basketball talents, relevant colleges and universities must do better in the training of basketball professional quality. At present, although many colleges and universities have strengthened their work in this area, the phenomenon of uneven basketball quality still exists, which urgently needs an evaluation system based on basketball professional quality training. Traditional evaluation systems usually have problems such as cumbersome evaluation process, different evaluation standards, and low evaluation accuracy. In order to change this situation, this paper studied the basketball professional quality training evaluation system under the background of the information age. Combined with automatic information technology, this paper built an intelligent evaluation system for basketball professional quality training, and used the fuzzy evaluation method to optimize and upgrade the system. The practical results showed that the evaluation system can dynamically monitor the training process of basketball professional quality, and then accurately evaluate the technical ability of basketball students. The evaluation accuracy of the system was 4.87% higher, while compared with the traditional evaluation system.

1. Introduction

In recent years, with the rapid progress of basketball competition level, all circles have put forward higher requirements for the quality and ability of basketball players. In various colleges and universities, many coaches pay more and more attention to the training and training of basketball students' competitive ability. Usually, the coaches test and evaluate the basketball ability level of

the players through the competitive ability evaluation index. Therefore, it is particularly critical to build a scientific basketball professional quality training evaluation system. The emergence of automated information technology has provided technical support to various fields. It is an attempt and a change to apply this technology to the basketball professional quality training evaluation system.

With the continuous progress of society, the requirements for the evaluation system in various fields are getting higher and higher, and it is imminent to establish an intelligent and comprehensive evaluation system. Livio J A developed a comprehensive evaluation system based on the enterprise information system model, which can accurately evaluate the performance level and utilization of enterprise information systems [1]. Zhang G combined AHP and factor analysis to propose a reasonable evaluation index system, and finally verified the feasibility of the evaluation system by taking community satisfaction as an example [2]. Hu Y proposed an evaluation system for water inrush risk in karst tunnels. The test results showed that the system can accurately evaluate the water inrush risk value [3]. Sun Q introduced a Web-based automatic evaluation system for students' performance, and finally found that the system has high accuracy in evaluating students' performance [4]. Busch L established a power grid structure evaluation system by using AHP and Delphi method. The practice showed that the system can be well applied to the evaluation of urban power grid structure [5]. Cai X proposed an innovation evaluation system based on the Complex Product System (CoPS), and selected some telecom companies as samples to verify the effectiveness of the evaluation system [6]. Tseng T Y proposed a fuzzy neural expert evaluation system based on set-valued statistics, and finally proved the feasibility and effectiveness of the system through experiments [7]. These studies on the evaluation system are relatively specific, but they do not involve the evaluation of basketball professional quality training, nor do they use automated information technology.

The emergence of automated information technology has seen development opportunities in many fields, and many scholars have also joined the ranks of researching automated information technology. Kim J used automated information technology to build an educational support platform, which solved a series of problems such as uneven distribution of resources in the teaching system and curriculum solidification [8]. It aimed at the problems existing in agricultural informatization, Stelmach P built an agricultural information service platform by using automated information technology, and realized the effective use of regional agricultural information resources [9]. Mann M applied automated information technology to the soybean production risk early warning system, which not only monitored the soybean production process dynamically, but also analyzed the soybean market price [10]. Iqbal M M developed a new digital laboratory management model by using automated information technology, which laid the foundation for building a first-class inspection technology institution [11]. Okhtilev M Y combined automated information technology to construct an intelligent online teaching model, which improved students' classroom participation rate [12]. Varma Pamba R analyzed the important role of automated information technology in internal auditing, and proposed an application framework for internal auditing in colleges and universities based on automated information technology, which laid the foundation for the informatization construction of internal auditing in colleges and universities [13]. Kharytonova O applied automated information technology to modern logistics systems. The practice has shown that automated information technology can improve the efficiency of logistics systems [14]. The above researches on the application of automatic information technology are relatively detailed, but the automatic information technology has not been applied to the basketball professional quality training evaluation system.

The advent of the information age has ushered in great changes in many fields, including basketball. With the continuous improvement of basketball level, the traditional management

system can no longer meet the needs of players and coaches. The importance of an evaluation system as a benchmark for training and developing players cannot be overstated. This paper introduced automatic information technology into the basketball professional quality training evaluation system, which aimed to optimize the evaluation process, innovate the evaluation mode, and improve the work efficiency of the evaluation system. The final test results showed that the new evaluation system proposed in this paper has certain reference value.

2. Automated Information Technology

Automation refers to the process of automatically operating equipment according to predetermined procedures or instructions without human intervention. Information technology is mainly the application of computer science and communication technology to design and develop information systems and application software. A basic automation system includes at least three parts: information acquisition, information processing and information application, while an automation system using a computer network or communication network includes all of information acquisition, transmission processing and application. That is, automation technology involves all aspects of information technology. In general, automated information technology is based on a collection of computer data and hardware and software, which uses input from various resources to automate operations and information management, as shown in Figure 1.

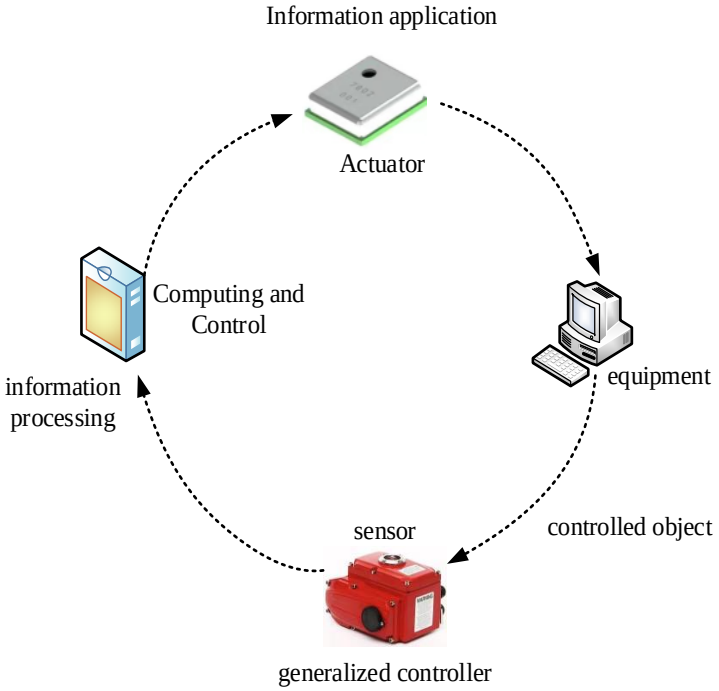


Figure 1. The process of automated information technology operation

The operation process of automated information technology is shown in Figure 1. The hardware part mainly includes actuators and sensors for the application of automation programs, while the software part is computer software for information acquisition, processing and analysis. Several parts are closely related and inseparable from each other, and some parts work almost simultaneously. The application of automated information technology to the evaluation system can ensure the smooth development of the monitoring process, and can also improve the system's ability to process relevant data, thereby promoting the smooth progress of the evaluation work.

3. Intelligent Evaluation System for Basketball Quality Training Combined with Automated Information Technology

3.1. Basic Basketball Quality Training Requirements

As a highly confrontational sport, basketball has very high requirements on the quality of players. As shown in Figure 2, the training of basketball quality can be divided into three aspects: psychological quality, physical quality and technical ability. Physical fitness is the foundation. Whether it is basketball or other sports, having a strong physique is a must for athletes. The overall evaluation of players by coaches or outside scouts also takes physical fitness as the primary basis. The second is technical ability, which shows the basic ability of basketball, including shooting, dribbling, running and so on. Having a strong mentality is the key to an athlete's success, and basketball is no different. If a player is not confident in himself or is afraid of opponents when he is on the court, his competitive state will be greatly reduced, so it is also necessary to cultivate and evaluate the psychological quality of players.

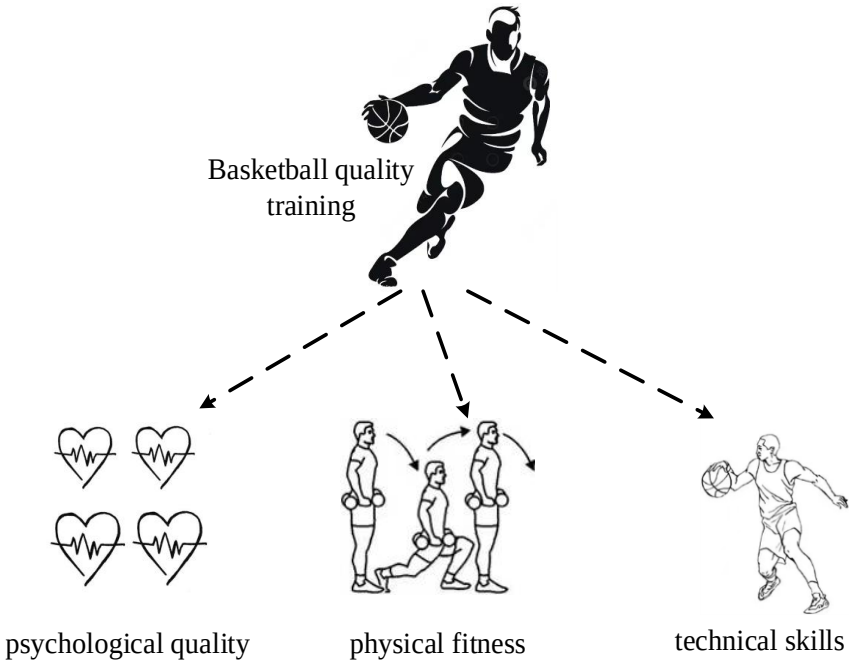


Figure 2. Basic requirements for basketball quality

3.2. Overall Architecture of Rating System

Combined with automatic information technology, this paper built an intelligent system for basketball quality training and evaluation. The specific implementation process is shown in Figure 3. First of all, a comprehensive and dynamic monitoring of the basketball quality training process is carried out using a smart camera. The camera combined with the new era technology can realize automatic adjustment of monitoring in all directions. Several sensors are placed next to the camera, and the sensors send all the monitoring data to the computer. After the information is entered, information technology is used to evaluate the quality indicators of the players, and the final evaluation results will be fed back to the players or coaches.

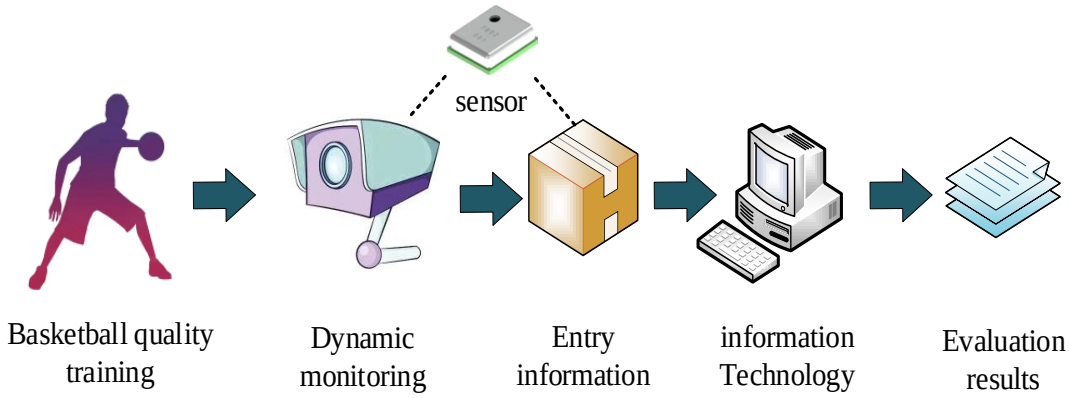


Figure 3. Overall architecture of the rating system

3.3. Specific Evaluation Indicators in the Evaluation System

Body shape index: body shape refers to the general characteristics of the body, including the shape and structure of organs, size, physical characteristics and posture, etc., which roughly reflects the development of the athlete's body and the degree of transformation of the body by training. Basketball is a skill-based confrontation sport, which determines that athletes must have basic physical characteristics such as tall and strong, broad arms and chest, and long Achilles tendon [15]. When evaluating a player, 12 indexes such as height, weight, upper limb length, hand length, finger-to-gap height, shoulder width, body fat composition, bust circumference, and Achilles tendon length are usually used as body shape evaluation indicators.

Body function index: body function refers to the life activities expressed by the overall organ system of a person. Physical function is the basis of a player's competitive ability, and the level of function directly determines the training load that a player must bear when performing skills. On the other hand, the training state and physical condition of the players can be objectively evaluated according to the physical function index.

Athletic quality indicators: athletic quality is the ability of the central nervous system to exhibit different abilities in the body during physical movement, usually including strength, speed, sensitivity, endurance, and flexibility [16].Because basketball emphasizes confrontation, the training of athletic qualities puts forward higher requirements for explosive power, specific endurance and maximum strength. As shown in Figure 4, specific indicators include push-ups, reentry runs, bounces, and squats.

Psychological quality index: with the continuous improvement of basketball level, the cultivation of psychological quality plays a pivotal role in improving the overall quality of players. Good psychological quality can enable players to adapt to changes in the face of complex situations, so that players can maintain a stable mood in the difficult situation of the game, and then show the competitive state they should have. When evaluating the psychological quality of players, it is usually carried out from the aspects of sports will, sports emotion, sports perception, personality psychological characteristics, game experience, referee factors and so on.

Sports intelligence indicators: the intelligence factors of basketball players include observation and judgment ability, thinking ability, distribution ability, etc.; non-intellectual factors include will, emotion, temperament, interest, motivation, and personality. Therefore, sports intelligence indicators mainly involve several aspects such as ball quotient, cultural level, special theoretical knowledge, sports imagination, sports observation and sports thinking.

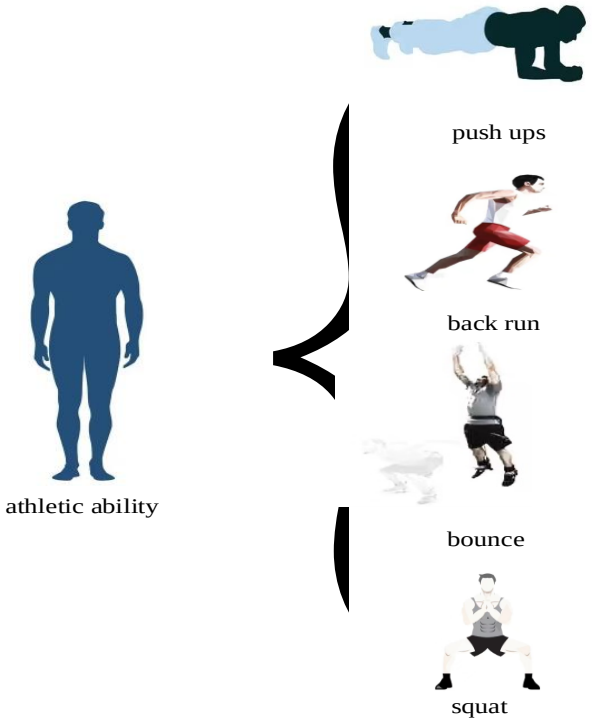


Figure 4. Basketball sports quality indicators

3.4. Application Demonstration of Evaluation System in Basketball Professional Quality Training

In order to more clearly show the application process of the evaluation system in basketball quality training, this paper drew Figure 5 based on the content of the article. Figure 5 is a large basketball training ground, which is also the main base for players' basketball quality training. It can be seen that the quality training on the court includes shooting, dribbling, running, and defense. Smart cameras are placed on the two opposite corners of the stadium, and the cameras are connected to the computer (evaluation system) at the end.

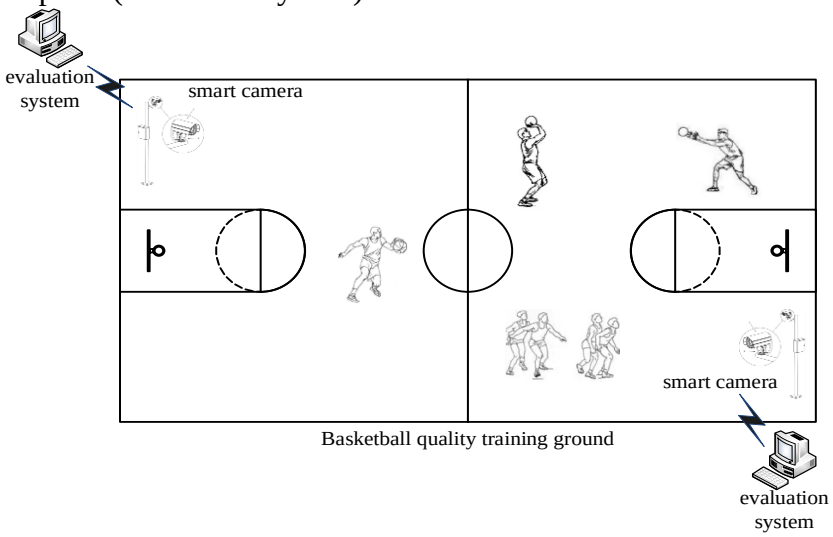


Figure 5. Application display of evaluation system in basketball professional quality training

The two cameras monitor the player's entire training process and quality development process in real time and dynamically, and the monitoring data will also be transmitted to the evaluation system in time. The blessing of automated information technology allows the evaluation system to organize and analyze player data according to relevant basketball evaluation indicators, and finally give accurate evaluation results.

4. Application of Fuzzy Evaluation Method in Evaluation System

In order to further optimize the evaluation process and improve the efficiency and accuracy of the basketball professional quality training evaluation system, this paper applied the fuzzy evaluation method to the evaluation system.

Triangular fuzzy number is a branch of fuzzy evaluation method, its role is to use triangular fuzzy set to deal with ambiguity, that is, to use language evaluation to evaluate the influence relationship between attributes [17]. Given a fuzzy set of x belonging to O, and a number $o(x)$ belonging to $[0,1]$ corresponding to it, $o(x)$ is the membership degree of x to o, and o is the membership function. The definition of triangular fuzzy numbers is as:

If M is a triangular fuzzy number, its membership function can be expressed as:

$$\alpha_A(x)=\begin{cases}(x-1)/(m-1), 1\le x\le m\\ (o-x)/(o-m), m\le x\le 0\\ 0, \quad \text{otherwise}\end{cases} \tag{1}$$

In the Formula (1), $1\le m\le o$ is a convex fuzzy set and belongs to a continuous function.

Assuming two triangular fuzzy numbers $x=[x^L,x^M,x^O]$ and $y=[y^L,y^M,y^O]$, the operation of triangular fuzzy numbers is as:

$$x\oplus y=(x^L,x^M,x^O)\oplus(y^L,y^M,y^O)=(x^L+y^L,x^M+y^M,x^O+y^O) \tag{2}$$

$$x\times y=(x^L,x^M,x^O)\times(y^L,y^M,y^O)=(x^Ly^L,x^My^M,x^Oy^O) \tag{3}$$

$$\frac{1}{x}=\left(\frac{1}{x^L},\frac{1}{x^M},\frac{1}{x^O}\right) \tag{4}$$

$$\lambda x=(\lambda a^L,\lambda a^M,\lambda a^O),\lambda\ge 0 \tag{5}$$

In the evaluation system, in order to evaluate the data accurately, the distance between two fuzzy numbers must be measured [18]. Given two fuzzy numbers $x=[x^L,x^M,x^O]$, $y=[y^L,y^M,y^O]$, the distance between them is:

$$d(x,y)=\left|x^{def}-y^{def}\right| \tag{6}$$

In the Formula (6), x^{def} and y^{def} are respectively the fuzzy points of two triangular fuzzy numbers. According to the definition of fuzzy set, the calculation method of fuzzy points can be written as:

$$fuzzy\ point = \begin{cases} o - \sqrt{(o-1)(o-m)/2}, o-m > m-1 \\ \sqrt{(o-1)(o-m)/2 - l}, o-m < m-1 \\ m, \qquad\qquad\qquad \text{otherwise} \end{cases} \tag{7}$$

It is easy to conclude that the similarity measure based on distance has the following properties: $d(x,x)=0$, $d(x,y)=d(y,x)$, $d(x,y)<d(x,f)$, then the distance between y and x is smaller than the distance between f and x.

Based on the distance between the fuzzy points, the similarity is calculated using the distance-based similarity measurement method [19]. The calculation process is as:

$$SM(x,y)=e^{-\beta d(x,y)} \tag{8}$$

Among them, SM is the similarity measure of the two fuzzy numbers and β is the steepness measure.

Based on the established triangular fuzzy numbers, this paper obtained the influence relationship between each attribute through a questionnaire survey, thereby establishing a direct influence matrix, which is specifically expressed as:

$$Q^{(k)} = \begin{bmatrix} 0 & Q_{12}^{(k)} & \Lambda & Q_{1n}^{k} \\ Q_{21}^{(k)} & 0 & \Lambda & Q_{2n}^{k} \\ \mathrm{M} & \mathrm{M} & \mathrm{O} & \mathrm{M} \\ Q_{n1}^{k} & Q_{n2}^{k} & \Lambda & 0 \end{bmatrix}, k = 1,2,..., p \tag{9}$$

Among them, $Q_{ij} = (Q_{ij,1}, Q_{ij,m}, Q_{ij,o})$, using the linear scale conversion method to convert the standard scale into a comparable form:

$$H^{(k)} = \begin{bmatrix} H_{11}^{k} & H_{12}^{(k)} & \Lambda & H_{1n}^{k} \\ H_{21}^{(k)} & H_{22}^{k} & \Lambda & H_{2n}^{k} \\ \mathrm{M} & \mathrm{M} & \mathrm{O} & \mathrm{M} \\ H_{n1}^{k} & H_{n2}^{k} & \Lambda & H_{nn}^{k} \end{bmatrix}, k = 1,2,..., p \tag{10}$$

Among them,

$$H_{ij}^{k} = \frac{Q_{ij}^{k}}{G^{k}} = \left(\frac{Q_{ij}^{k},1}{g_1^{k}}, \frac{Q_{ij}^{k},m}{g_m^{k}}, \frac{Q_{ij}^{k},o}{g_o^{k}} \right) \tag{11}$$

$$G^{k} = (g_1^{k}, g_m^{k}, g_o^{k}), k = 1,..., p \tag{12}$$

$$r_s^{(k)} = \max\left(\sum_{1 \le i \le n,\, j=1}^{n} Q_{ij}^{(k)}, s \right) \forall s = 1, m, o. \tag{13}$$

The average value of the evaluation of all evaluation systems can be expressed as:

$$H = \frac{H^{(1)} \oplus H^{(2)} \oplus ... \oplus H^{(p)}}{p} \tag{14}$$

$$H = \begin{bmatrix} H_{11} & H_{12} & \Lambda & H_{1n} \\ H_{21} & H_{22} & \Lambda & H_{2n} \\ \mathrm{M} & \mathrm{M} & \mathrm{O} & \mathrm{M} \\ H_{n1} & H_{n2} & \Lambda & H_{nn} \end{bmatrix} \tag{15}$$

Among them, $H_{ij} = \left(H_{ij,1}, H_{ij,m}, H_{ij,o}\right)$, the calculation method of each fuzzy number in H is:

$$H_{ij} = \frac{\sum_{k=1}^{p} H_{ij}^{k}}{p} \tag{16}$$

After getting the initialized fuzzy matrix, the total influence relationship matrix T can be calculated by $T = x(1-x)^{-1}$:

$$T = \begin{bmatrix} t_{11} & t_{12} & \Lambda & t_{1n} \\ t_{21} & t_{22} & \Lambda & t_{2n} \\ \mathrm{M} & \mathrm{M} & \mathrm{O} & \mathrm{M} \\ t_{n1} & t_{n2} & \Lambda & t_{nn} \end{bmatrix} \tag{17}$$

In the Formula (17), $t_{ij} = \left(t_{ij,1}, t_{ij,m}, t_{ij,o}\right)$ represents the evaluation of the influence of attribute i on attribute j, which is called the comprehensive influence rate. The sum of row i and column j in fuzzy matrix T is expressed as:

$$D_i = \sum_{j=1}^{n} t_{ij} \quad (i = 1,2,...,n) \tag{18}$$

$$G_i = \sum_{i=1}^{n} t_{ij} \quad (j = 1,2,...,n) \tag{19}$$

The weight of the attribute can be obtained as:

$$\sigma_i = \left\{ \left(D_i^{def} - G_i^{def}\right)^2 + \left(D_i^{def} + G_i^{def}\right)^2 \right\}^2 \tag{20}$$

After normalization the attribute weights can be expressed as [20]:

$$E_i = \frac{E_i}{\max_{1 \le i \le n}(E_i)} \forall i = 1,2,...,n \tag{21}$$

E_i is the obtained weight that is finally applied to the system. So far, the weight E_i of each fuzzy attribute can be obtained, and then the weight vector of the entire evaluation set can be obtained.

5. Test Results of the Evaluation System

It is an attempt and a change to apply automatic information technology to the basketball professional quality training evaluation system. In order to understand the degree of recognition of the evaluation system in the basketball field, the satisfaction degree of the coaches, players and scouts in a sports academy with the system was investigated. The total number of people is 800, and the survey results are shown in Table 1.

Table 1. Satisfaction level of coaches, players and scouts with the system

Satisfaction level	Coach		Player		Scout	
	Number of people	Proportion	Number of people	Proportion	Number of people	Proportion
Dissatisfied	2	0.25%	4	0.5%	7	0.88%
Not so satisfied	9	1.13%	13	1.63%	18	2.25%
Generally	23	2.88%	31	3.87%	35	4.38%
Satisfy	89	11.13%	83	10.38%	79	9.87%
Very satisfied	134	16.76%	147	18.37%	126	15.75%

From Table 1, it can be clearly seen the number and proportion of coaches, players, and scouts at each level of satisfaction. Overall, satisfied and very satisfied were the majority. At most, 147 players were very satisfied, accounted for 18.37% of the total. On the other hand, there were only a few people who are dissatisfied and dissatisfied, which also proved that the application of automated information technology in the basketball professional quality training evaluation system is relatively successful.

In order to more intuitively show the satisfaction of basketball-related personnel with the evaluation system, this paper analyzed the changed in the satisfaction of coaches, players, and scouts to the system within eight weeks, and drew a related line chart, as shown in Figure 6 Show.

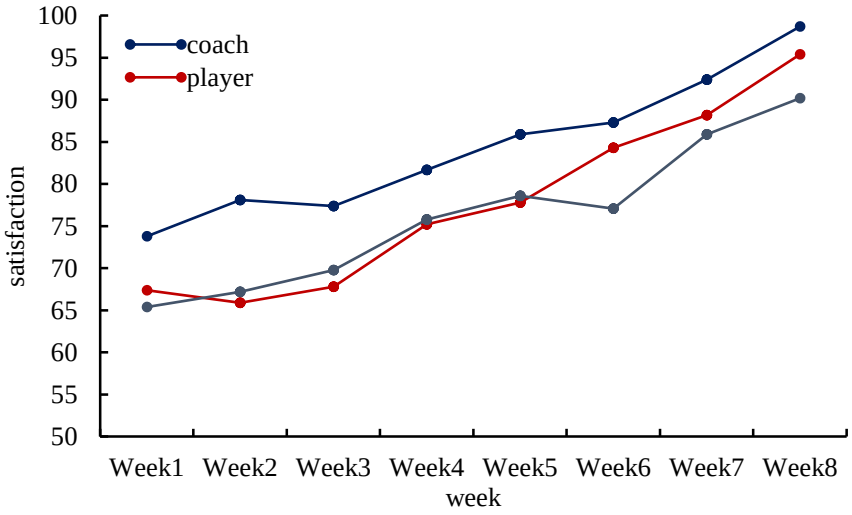


Figure 6. Changes in system satisfaction for coaches, players, and scouts over eight weeks

As can be seen from the line chart in Figure 6, the satisfaction of the three types of personnel with the evaluation system has generally maintained an upward trend over time. Although there has been a slight downward trend in the past few weeks, the impact is not large and is acceptable. After all, the new evaluation system requires an adaptation process. In Week 6, scouts' satisfaction with the rating system dropped slightly, due to some discrepancies between the player data provided by

the rating system and the data the scouts collected themselves. This small gap is likely to affect their choice of players, thus reducing satisfaction.

Players are the main body of the basketball professional quality training evaluation system, and the quality of an evaluation system is closely related to the players' opinions. When training basketball quality, a player's effort, progress and technical ability can be obtained from the evaluation system. If the system can accurately reflect these data, it proves that the evaluation system is successful and effective. To verify the success of the evaluation system, this paper surveys 500 basketball students. The specific investigation content is whether the basketball professional quality training evaluation system based on automatic information technology can accurately reflect one's own effort, progress and technical ability. The results of the investigation are shown in Figure 7.

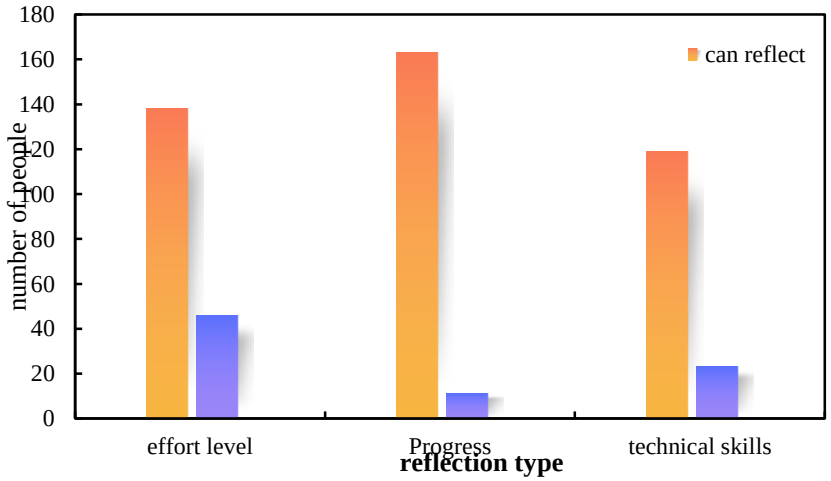
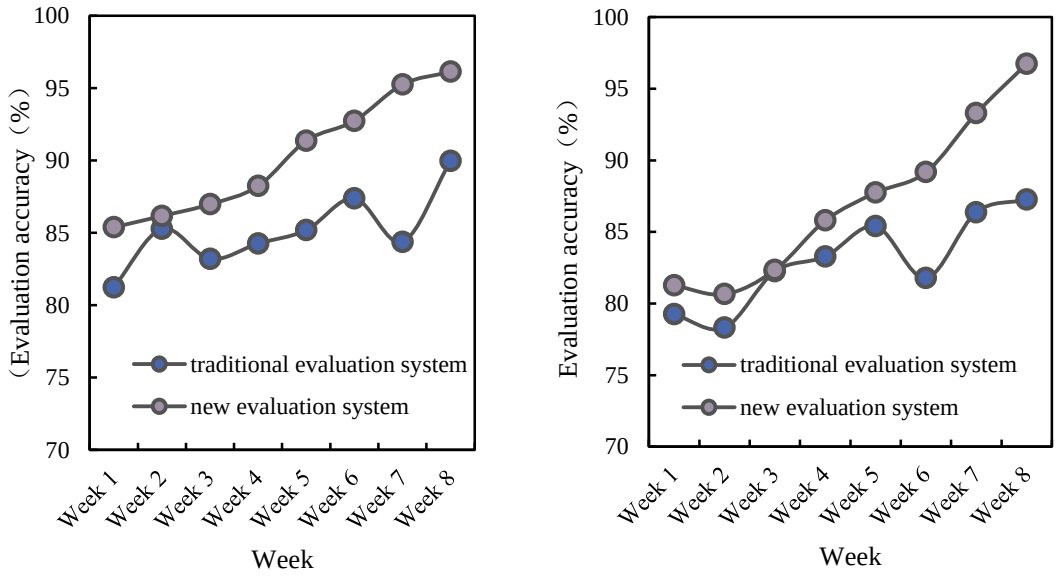


Figure 7. The evaluation system reflects the player's effort, progress and technical ability

From the bar chart in Figure 7, it can be seen that the majority of people think that the evaluation system can reflect their efforts, progress and technical ability, and more than 160 people can reflect the progress. And there were only a handful of people who think they can't respond, which proved that the construction of the evaluation system is successful and effective.

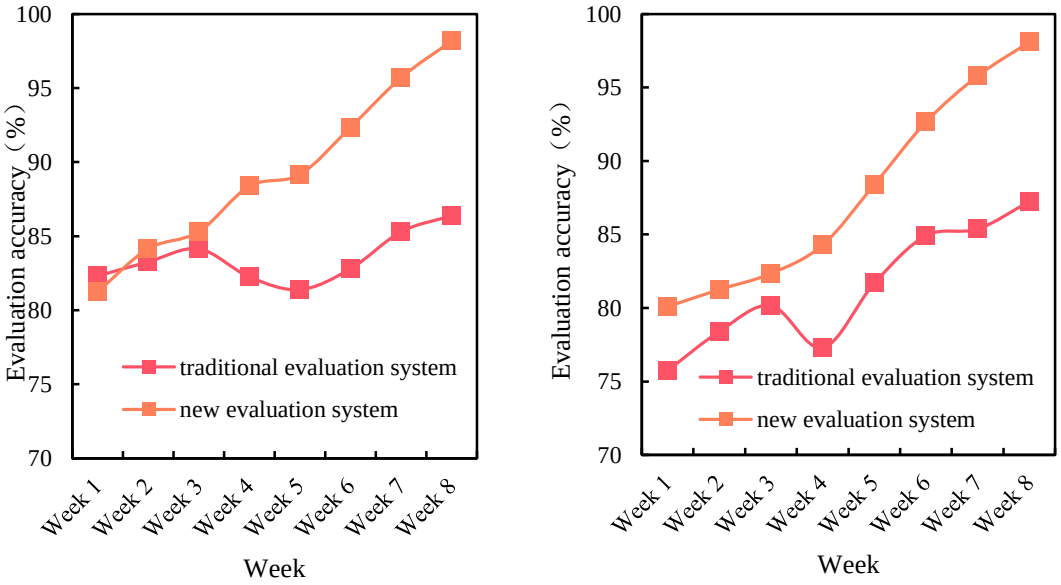
The accuracy of the evaluation system affects the training status of players, the training plan of coaches, and even changes the selection goals of scouts. In order to test the accuracy of the evaluation system, this paper analyzed the changes in the evaluation accuracy of the system in eight weeks from the four aspects of players' physical quality, psychological quality, technical ability and competitive state, and compared it with the traditional evaluation system. As shown in Figure 8 and Figure 9.

Figure 8 shows the changes in the accuracy of the evaluation system in terms of player physical and psychological quality. It can be seen from the line chart that the accuracy rate of players' evaluation of physical fitness in the traditional evaluation system had been maintained between 80% and 90%. This accuracy rate was not low, but judging from the overall trend within eight weeks, the fluctuations in the accuracy rate were too large, which is not conducive to long-term evaluation of player quality. Observing the broken line of the new evaluation system, it can be seen that the accuracy rate of its evaluation of players' physical fitness had remained above 85%, and it had shown a rising trend within eight weeks. Similarly, when evaluating the psychological quality of players, the changes in the evaluation accuracy of the two systems were similar to the former. Overall, the new evaluation system had shown a high evaluation accuracy rate in terms of physical quality and psychological quality, which also provided a guarantee for subsequent evaluation work.



a. Physical fitness *b. Psychological quality*

Figure 8. Changes in the evaluation accuracy of the evaluation system in terms of players' physical and psychological quality



c. Technical skills *d. Competitive status*

Figure 9. Changes in the evaluation accuracy of the evaluation system in terms of technical ability and competitive status

Technical ability and competitive status are the two most important aspects of basketball professional quality training. Figure 9 shows the changes in the evaluation accuracy of the evaluation system in these two aspects. It can be seen that in the first three weeks, when the traditional evaluation system evaluates the players' technical ability and competitive state, the evaluation accuracy rate was in a state of increase. But it started to drop from the fourth week, and

then continued to rise, and the final accuracy rate froze at around 87%. In contrast to the new evaluation system, the accuracy rate remained at around 80% from the first week, and then soared over time, reaching a peak of around 98%. Although the traditional evaluation system has a high evaluation accuracy in terms of players' technical ability and competitive status, it is still slightly inferior to the new evaluation system.

The cultivation of basketball professional quality takes time to accumulate, half a year, a year, or even longer, which requires the evaluation system to maintain an accurate state at all times. In order to further verify the accuracy of the new evaluation system proposed in this paper, the evaluation accuracy of the system over the past year was analyzed, and compared with the traditional evaluation system. The comparison results are shown in Figure 10.

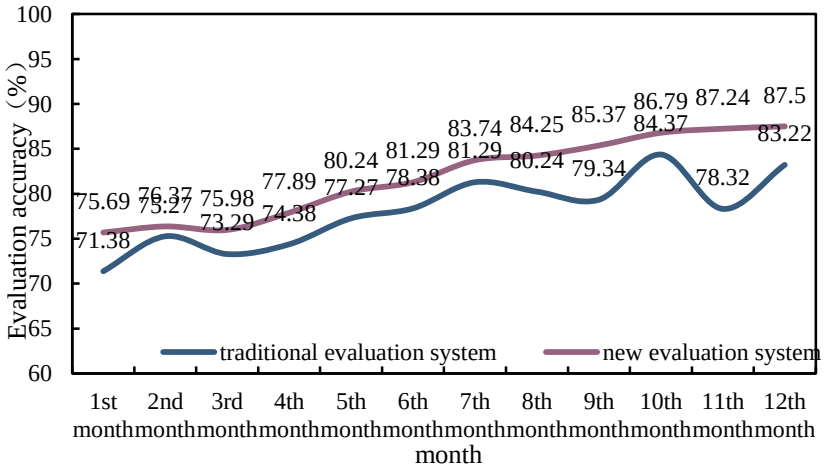


Figure 10. The evaluation accuracy rate of the new evaluation system and the traditional evaluation system within one year

It can be seen from the graph in Figure 10 that during the year, with the passage of time, the evaluation accuracy rates of the two systems have changed, and on the whole, they have shown an upward trend. Observing the accuracy rate curve of the traditional evaluation system, it can be seen that its accuracy rate fluctuated greatly within a year, especially in the next four months. Although the accuracy rate has increased, the gap is obvious. The accuracy of the new evaluation system had been relatively high since the first month, and there was almost no fluctuation, which had always been an upward trend. It can be seen that the accuracy rate of the traditional evaluation system was concentrated between 70% and 85% within one year, while the new evaluation system was concentrated between 75% and 90%. Compared with the accuracy values in Figure 10, it can be concluded that the evaluation accuracy of the new evaluation system was 4.87% higher than that of the traditional evaluation system.

6. Conclusion

The evaluation system has always played an important role in the basketball field. It can not only monitor the professional quality development of players, but also provide a large amount of data for players and coaches. With the progress of the times and the development of science and technology, basketball has also ushered in great changes. Now, both basketball training and quality training have achieved intelligence and informatization, which also makes the evaluation system have to make changes. Automation information technology has developed rapidly in recent years, and its application in the field of sports is also increasing. The application of automated information technology to the basketball professional quality training evaluation system is conducive to

optimizing the evaluation process and improving the evaluation accuracy.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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