Research Article

Interactive Teaching System of Basketball Action in College Sports Based on Online to Offline Mixed Teaching Mode

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The mixed teaching mode can be used to improve students’ academic performance. In this study, an interactive teaching system of basketball action in college sports based on online to offline mixed teaching mode is developed. The system is mainly comprised of teacher function module, student function module, and system analysis module. In the teacher function module, online to offline mixed teaching mode is introduced to realize the interactive teaching of basketball action in college sports in the form of organic combination of microclass, massive open online course, and traditional classroom teaching. The student function module is mainly used to manage the information related to students learning basketball actions. The system analysis module uses the data mining model based on multi-ant colony clustering combination algorithm to obtain the learners’ behavior data and then designs a targeted interactive teaching course for basketball action. After testing, it was concluded that the designed system can improve the students’ mastery of basketball movement in sports and can be applied to improve student’s academic performance.

1. Introduction

In the tide of higher education reform, a series of reforms and innovations have been carried out in ideology, theory, teaching materials, and practice system of physical education. The traditional teaching methods cannot meet the needs of teaching development. With the in-depth reform of physical education, the implementation of the new curriculum system, and the scientific management of work, the management content of physical education has greatly increased [1]. This requires physical education administrators to constantly improve their management level. This includes the ability to understand sports management activities, seriously understand and master the scientific teaching methods and management content, and actively explore new ways of physical education management.

The teaching management system of basketball action in college sports is composed of the main body, object, and means of sports teaching management and has some similarities and differences compared with the teaching management of other courses [2]. Therefore, in addition to the general rules of teaching management, the management of basketball action in college sports teaching should also follow the rules of human body function adaptability, action formation, and changes of human physiological function. Only by following these scientific rules of human activities to manage physical education, can the management task of basketball action teaching in college be completed more smoothly [3]. From the perspective of work arrangement, the teaching management of basketball action in college sports is composed of several different and interrelated stages, such as midterm management and final management. Its characteristics are that there are few managers and more management contents. It needs to work in an orderly way in multiple stages, with a large amount of work and complicated management tasks. In addition, the teaching management of basketball action in colleges and universities has the characteristics of repetition, circulation, and indirect coordination. It includes term circulation, academic year circulation, and irregular circulation. The management personnel should not only do their own job of organizing and managing physical education, but also carry out
teaching work to the leaders of higher authorities and teaching management organizations at the same level. It has a wide range of work contacts, including both vertical contact and horizontal coordination. It can coordinate and deal with the relationship at all levels and solve all kinds of problems in the teaching process in time; basketball action teaching management in college sports needs to be in line with the overall teaching order, subject to the school's teaching decision-making. But because it is a relatively independent teaching mode, it has its own management object and scope. Therefore, basketball actions in college sports teaching management and school teaching management have both subordination and relative independence. Managers of basketball action teaching in college sports keep close contact with students and teachers in the process of specific management, coordination, and organization of teaching activities. This is accomplished to ensure a good teaching environment and teaching order through this teaching management mode, to create necessary preconditions for serving the students and teachers [4].

The rapid development of modern education technology and Internet communication technology has affected many aspects of life. The emergence of Taobao online store has curbed the monopoly of physical stores in the industry. Didi taxi has broken the situation of no competition in the taxi industry, prompting taxi drivers to improve their service quality. Compared with the conservativeness and closeness of traditional physical education, openness and cooperation are the most significant characteristics of the "Internet +" era. The application of new classroom teaching modes, methods, and resources with stronger interactivity and visibility, such as microclass and massive open online course (MOOC), has developed rapidly in China's Curriculum Teaching Reform [5]. As the medium of transforming theory into practice, the innovation of the teaching mode of physical education plays an important role in teaching. At present, the demand for interdisciplinary talents is increasing with the development of society, and the goal of school education is no longer limited to the cultivation and investigation of students' single professional courses and professional ability. The development of teaching content and teaching form has enriched a lot [6, 7]. Therefore, blended teaching mode is more and more popular among educators and students, and O2O teaching mode is one of them [8].

O2O mode was initially used in commercial marketing, which is expressed as online to offline (O2O) in English. It refers to a marketing mode that drives offline operation and consumption through online marketing purchase or reservation. It is also called offline business mode. It is applied in the field of education and teaching, which is called the O2O teaching mode. At this time, great changes have taken place in the meaning of O2O mode, which mainly refers to the sharing of teaching and learning resources through network information technology, the change of traditional learning methods and teaching methods, and the creation of an open, interactive, personalized, efficient, and comfortable teaching environment [9–11]. Through a certain teaching design, the teaching mode flexibly combines network with traditional classroom education and effectively makes up for the defects of single online learning and traditional classroom learning. It is not only the mixture of autonomous learning, collaborative learning, acceptance learning, and discovery learning but also the mixture of real classroom environment and virtual network environment or the mixture of offline communication and online communication between teachers and students [12].

The main contribution of this work is as follows:

This paper designs an interactive teaching system of basketball action in college sports based on O2O mixed teaching mode.

The system provides an interactive teaching system and can meet the design requirements.

2. The Interactive Teaching System of Basketball Action in College Sports Based on O2O Mixed Teaching Mode

2.1. Design of System Architecture. Based on the O2O mixed teaching mode, all the functions of the interactive teaching system for basketball action in college sports are realized according to the user's browser and the interaction of basketball action's interactive teaching server. The database server of the system can organize store and maintain all the data related to the system. The Internet is used to connect the interactive teaching server of basketball action. Students, teachers, and administrators section of the system send their access requests to the server through the browser. The interactive teaching server of basketball action is applied to the interactive teaching course of basketball action on the database server. Figure 1 represents the architecture of basketball action in college sports interactive teaching system based on O2O mixed teaching mode.

This system is comprised of three parts: teacher function module, student function module, and system analysis module. The overall functional structure of the interactive teaching system of basketball action in college sports based on O2O mixed teaching mode is shown in Figure 2.

2.1.1. Physical Education (PE) Teaching Management. The PE teaching management part of the teacher management module consists of curriculum management, performance management, teaching resources, teaching analysis, question answering and discussion, class hour statistics, and system management. In the course management, O2O mixed teaching mode is mainly used to realize the interactive teaching of basketball action. The architecture of the O2O mixed teaching mode is shown in Figure 3.

Microclass, MOOC, and traditional classroom complement each other. The emergence of microclass makes the teaching method of physical education more flexible, and the construction of MOOC broadens the coverage of traditional knowledge dissemination [13]. Making accurate microclass and massive MOOCS can provide indispensable online resources for basketball action classroom teaching, thus organically integrating with traditional classroom teaching and fundamentally subverting the existing teaching mode.
Combined with the successful experience of microclass and MOOC in classroom teaching, this paper constructs a three-dimensional O2O sports teaching mode based on microclass-MOOC-traditional classroom.

Basketball technology in sports is different from the teaching of other disciplines. The introduction of microclass and MOOC cannot completely replace the traditional classroom teaching. The integration of microclass and MOOC into traditional sports classroom teaching is not simple addition. It should combine the characteristics and needs of basketball teaching course to study the three-dimensional teaching mode of the organic combination of microclass, MOOC, and traditional classroom teaching. The microclass embedded in the interactive teaching of basketball actions can shorten the time spent by teachers in explaining the essentials of basketball technical actions. MOOCs and microclasses are not limited by time and space.

Before classroom teaching, students can complete the preview of new courses and review of learned courses. After class, no matter when and where students can watch the video of microclass, they can learn and imitate basketball actions repeatedly to deepen their understanding and mastery, so as to realize the organic combination of sports basketball inside and outside class and save a lot of time for basketball teaching in classroom of teachers' to make differentiated instruction.

The O2O basketball action teaching mode of "microclass-MOOC-traditional classroom" includes four parts: interactive teaching course construction, classroom teaching, after class learning, and evaluation feedback. The construction of interactive teaching course is to create valuable microclass resources in a moody class platform. Firstly, it should conduct detailed research on basketball action, decompose the contents of basketball action, extract...
the essence of basketball action, prepare for the shooting of microclass, open the MOOC platform, provide high-quality online course resources, and provide corresponding text teaching materials, self-test summary, learning tasks, and so on. Through the MOOC platform, students can have targeted and repeated learning difficulties knowledge points and can also consolidate and master basketball action knowledge points through online Q and A, so as to build an independent learning support system for students. Before classroom teaching, students can preview the course through the MOOC platform. The preview task is designed to be interesting, so as to stimulate learning interest and solve the knowledge learning beyond the key and difficult points of teaching. The key and difficult points of teaching are the important problems to be solved in basketball action classroom teaching. Classroom teaching focuses on solving students’ problems and improving vulnerable learning groups. It also gives corresponding measures for students’ feedback and evaluation of online testing exercises. After class learning, students can flexibly control the time and place of autonomous learning, skip what they have mastered, and focus on consolidating their own unskilled knowledge points. Feedback evaluation is not only a link between online and offline but also a booster to promote the continuous development of teaching. Feedback evaluation includes two aspects: basketball performance evaluation and students’ periodic evaluation feedback on MOOC platform and microclass video. Performance evaluation includes evaluation of old teachers, mutual evaluation of students, and evaluation of offline activities. Through the analysis and combined with the results of students’ feedback, teachers can optimize and adjust the course content. Each link of this mode influences and promotes each other, which is a kind of teaching mode of learning initiative, integration diversification, teaching diversification, and three-dimensional support [14, 15].

2.1.2. Teacher Information. The teacher information section of the teacher management module consists of the following modules: personal home page, teacher information, and contact information.

(a) Personal home page: teachers’ personal home page used to publish some teachers’ personalized information
(b) Teacher information: the age, professional title, curriculum vitae, and other pieces of basic information of the teacher
(c) Contact information: the contact information of teachers

2.1.3. Student Learning Management. The student learning management part of the student management module is mainly composed of the following modules: curriculum management, sports technology learning, score query, learning resources, question answering and discussion, and class hour statistics.

(a) Course management: students can conduct interactive teaching of basketball actions, course query, course selection, and other operations
(b) Sports technology learning: after students choose the interactive teaching course of basketball action, they can learn the project
(c) Score query: after the teacher publishes the scores, students can query their basketball test scores online through the login system
(d) Learning resources: some necessary learning resources, such as courseware and software
(e) Q&A and discussion: in the process of learning, students can communicate with teachers or classmates online when they encounter difficult problems
(f) Credit statistics: make statistics on the credits of courses taken by students

2.2. Data Mining Model Based on Multiant Colony Clustering Algorithm. One of the difficulties in network teaching is how to monitor the learning process of students, so as to realize the effective combination of teaching and learning based on network teaching platform. In this paper, data mining technology is applied to establish the corresponding data mining model and to mine the association between learner behavior data. According to the mining data, different teaching objectives and teaching content organization strategies are used for different student groups to realize the hierarchical teaching of students’ network [17, 18].

2.2.1. Model Structure. Figure 4 shows the structure of the data mining model based on multiant colony clustering combination algorithm. Ant colony algorithm is inspired by the foraging behavior of ants. At the core of this behavior is the indirect communication between the ants with the help of chemical pheromone trails, which enables them to find short paths between their nest and food sources.

The first layer of the proposed model is composed of three ant colony modules with different speed types, and the middle layer is composed of clustering module, which combines the preliminary clustering results into a hypergraph. The last layer is the graph partition module, which uses the graph partition algorithm based on ant colony algorithm to divide the hypergraph twice to get the final clustering results of learner behavior data.

2.2.2. Clustering Combination. The clustering results of a known group of learners’ behavior data are expressed as a hypergraph. Assuming that \(O = \{o_1, o_2, \ldots, o_n\}\) represents a set of learners’ behavior data, the \(n\) learners’ behavior data are divided into \(k\) classes, which can be expressed as a label vector \(\lambda \in I^k\). In the \(r\) cluster results, the known \(q\)-th learner behavior data \(\lambda^{(q)}\) is divided into \(k^{(q)}\) categories, and then it can get a binary member matrix \(H^{(q)} \in I\). In this matrix, each cluster is represented as a superedge (corresponding to the column of the matrix). By combining these member matrices, an adjacency matrix of a hypergraph with \(n\) vertices and \(\sum_{q=1}^{r} k^{(q)}\) hyperedges is obtained.

\[
H = \{H^{(1)}, \ldots, H^{(r)}\}. \tag{1}
\]

Each row of the matrix \(H\) represents a vertex (learner behavior data), and each column represents a superedge. The value of the vertex belonging to the same superedge is 1; otherwise, it is 0. So far, the clustering results of a group of learner behavior data have been mapped into the critical matrix of hypergraph.

Here is a simple example to illustrate the above concept. Table 1 shows three cluster marker vectors with seven learner behavior data \(o_i (i = 1, 2, \ldots, 7)\), among which clusters 1 and 2 are logically consistent, while cluster 3 has some disputes on the classification of objects 3 and 5. The adjacency matrix \(H\) of the hypergraph is shown in Table 2, where seven vertices \(v_1, (1, 2, \ldots, 7)\) of hypergraph correspond to seven objects. Each cluster is represented as a hyperedge, and there are nine hyperedges.

Next, the adjacency matrix \(H\) of a hypergraph with \(n\) vertices and \(\sum_{q=1}^{r} k^{(q)}\) hyperedges can be determined by the following formula:

\[
S = HH^T. \tag{2}
\]

It is transformed into a symmetric adjacency matrix \(S\) of \(n \times n\), where \(H^T\) is the transpose matrix of \(H\). Each row and column of \(S\) correspond to a vertex in the hypergraph, and the value on the nondiagonal line reflects the weighted value of the hyperedge. If two vertices belong to the same superedge more times, the weight of the superedge is larger.
2.3. Graph Partition Algorithm Based on Ant Colony Algorithm. The main idea of the second partition of hypergraph is that the operation of the learner behavior data object $o_1$ is changed to the operation of the vertex $v_i$, and the distance $d(o_1,o_2)$ between the learner behavior data is changed to the distance $d(v_i,v_j)$ between the vertices. Therefore, the graph partition algorithm based on ant colony algorithm is a dynamic clustering algorithm by moving vertices on the plane [19,20].

Suppose $G(V,E)$ is a graph, $V = \{v_i, i = 1, 2, 3, \ldots, n\}$ is the set of vertices, and $E$ is the set of edges. The adjacency matrix of graph $A = [a_{ij}]$. Where $a_{ij} \neq 0$ if and only if $(v_i,v_j) \in E$; $a_{ij} \neq 0$ if and only if $(v_i,v_j) \notin E$, the distance $d(v_i,v_j)$ between any two vertices is defined as

$$d(v_i,v_j) = \frac{\|D(\rho(v_i),\rho(v_j))\|}{\|\rho(v_i)\| + \|\rho(v_j)\|},$$

where $\rho(v_i)$ is the set of all vertices adjacent to vertex $v_i$, including $v_i$ itself; $\rho(v_j)$ is the set of all vertices adjacent to vertex $v_j$, including $v_j$ itself; $D$ is the symmetry difference between the two sets.

If two vertices $v_i$ and $v_j$ have a large number of common adjacent nodes, that is, $\rho(v_i) \cup \rho(v_j) - \rho(v_i) \cap \rho(v_j)$ is a small set, then $d(v_i,v_j)$ is smaller, that is, $v_i$ and $v_j$ will eventually come together and fall into one category. On the contrary, if there are only a few or no adjacent edges between the two vertices $v_i$ and $v_j$, that is, $\rho(v_i) \cup \rho(v_j) - \rho(v_i) \cap \rho(v_j)$ is a large set, then $d(v_i,v_j)$ is larger. In other words, $v_i$ and $v_j$ will eventually be far apart and belong to different classes.

### 3. Results

In order to test the application effect of the system, the experimental environment is designed to ensure the normal operation of the system. Table 3 shows the details.

#### 3.1. The Rationality Test of the System

The rationality of the system in this paper is tested. Taking the support and confidence as the test index, the rationality of the basketball action course taught by the system to students is analyzed. The details of the interactive teaching course of basketball action are shown in Table 4. The rationality test results of the system are shown in Figures 5 and 6.

Through the analysis of the above table, we can know that, in the interactive teaching of five kinds of basketball actions, such as passing and catching the ball + dribbling, holding the ball breakthrough, personal defense, grabbing the ball, grabbing the basket, and pitching, the support degree and confidence degree of the basketball action course displayed by the system for students are as high as 0.99, so the rationality of the basketball action course displayed by this system for students is very high, and it matches the students’ learning progress very well. The reason is that the data mining model based on multi-agent colon clustering algorithm is used in this system to mine the learning behavior data of student groups. According to the mining model, different teaching objectives and teaching content organization strategies are used for different student groups to realize the hierarchical teaching of student network.

#### 3.2. The Application Satisfaction Test of the System

Through the form of a questionnaire survey, this paper analyzes the application satisfaction of users after using the system, and the test content is shown in Table 5.

The test results are shown in Figure 7.

From the above table, it can be seen that, after the application of the system in this paper, the user’s satisfaction with this system is higher than 98%. Therefore, this system is deeply loved by users, and the application feedback is good.

#### 3.3. The Teaching Effect Test of the System

In order to test the teaching effect of the system in this paper, this paper tests the students’ mastery of basketball action before and after using this system and after interactive teaching of basketball action in college sports, as well as the examination results of basketball action in college sports. The types of basketball action in college sports are moving, passing and catching, dribbling, shooting, holding breakthrough, personal defense, grabbing, breaking, and grabbing. The test results are shown in Table 6. Among them, the full score is 10. More than 6 points are qualified, and less than 6 points are unqualified.
According to the data in Table 6, when the types of basketball action in college sports are moving, passing and catching, dribbling, shooting, breakthrough with the ball, personal defense, grabbing the ball, and pitching before using the system in this paper, the students’ mastery of basketball action in college sports is poor, and the test score of sports basketball action is less than 6 points, with an average of 5 points. After using this system, the students have a good grasp of basketball action in college sports, and the test score of basketball action is more than 6 points, with an average of 9 points. In contrast, this system can effectively improve the students’ mastery of basketball action and improve their sports performance.

### 3.4. The Data Mining Effect of Students’ Group Learning Behavior of the System

The data mining effect of the system in this paper is tested on five students’ learning behavior, and the interactive teaching course of two kinds of basketball actions is taken, namely, holding the ball breakthrough and personal defense, as an example to test the mining effect of this system. The mining effect is mainly reflected by precision $P$ and recall $R$. The test results are shown in Figures 8 and 9.

$$P = \frac{N_{ij}}{N_i}$$
$$R = \frac{N_{ij}}{N_j}$$

where $N_{ij}$ is the number of classification $i$ in cluster $j$; $N_i$ is the number of all objects in cluster $j$; $N_j$ is the number of all objects in cluster $i$.

As shown in Figures 8 and 9, this system has a good effect on the data mining of five students’ learning behavior. In the interactive teaching course of holding the ball breakthrough and personal defense, after the data mining of five students’ learning behavior, the maximum precision rate is 0.98, and the maximum precision rate is 0.98. The mining performance is significant, which has a positive impact on the setting of interactive teaching course of basketball action.

### 3.5. The Concurrency Test of the System

At present, in the application performance test of all the systems, it needs to pay attention to its concurrency resistance. The concurrency resistance reflects whether the system can carry concurrent user access. The number of concurrent users of this system is set to 10, 20, 30, and 40 in turn. Taking the interactive teaching course of three kinds of basketball actions, such as grabbing the ball, breaking the ball, grabbing the basket, and pitching, as an example, under the condition of a different number of users, the system in this paper is running smoothly. Whether the screen gets stuck in the interactive teaching of basketball action is mainly reflected by the utilization rate of CPU. The test results are shown in Figure 10.

As shown in Figure 10, when the number of concurrent users of this system is 10, 20, 30, and 40, under the condition of a different number of users, although the CPU utilization rate of this system is gradually increasing, the maximum value is less than 40%, the CPU utilization rate is low, and there is no significant interference to the interactive teaching screen of this system. Therefore, the concurrency of this system is low. The test is passed, and the performance remains the same under different concurrent users.
Table 5: The content of the system application satisfaction test.

| Evaluation item code | Evaluation content                                                                 | Option               |
|----------------------|------------------------------------------------------------------------------------|----------------------|
| A                    | Views on the interactive teaching course of basketball action setup in this paper | Approve/disapprove   |
| B                    | Is the teaching of this system reasonable                                         | Reasonable/unreasonable |
| C                    | This paper discusses the effect of the system on students’ practical ability      | Positive/negative    |

Figure 7: Test results of application satisfaction of this system.

Table 6: Teaching effect test of this system.

| Action type                  | Score before use | Score after use |
|------------------------------|------------------|-----------------|
| Move                         | 5                | 9               |
| Pass and catch               | 5                | 8               |
| Dribble                      | 5                | 9               |
| Shoot                        | 5                | 9               |
| Breakthrough with the ball   | 5                | 9               |
| Individual defense           | 4                | 9               |
| Grab the ball                | 4                | 8               |
| Break the ball               | 4                | 8               |
| Blue bowling                 | 5                | 9               |
| Average                      | 5                | 9               |

Figure 8: Precision test results. (a) Breakthrough with the ball. (b) Individual defense.
4. Conclusions

With the information technology, distance education system based on network has made great progress. Moreover, at this stage, multimedia technology has been fully integrated with network communication technology, and teaching work is more carried out in the network environment, so that the teaching mode has been completely changed. The networked teaching system has the characteristics of autonomy and interaction, which makes the communication between students and students and teachers more convenient. This paper designs an interactive teaching system of basketball action in college sports based on O2O mixed teaching mode and verifies its availability in the experiment. PE is one of the compulsory courses, which can enhance the system and health of students. Networked teaching solves the time and space constraints of PE, meets the requirements of interaction between students and teachers in the process of PE, and promotes the development of PE. Therefore, the application of networked technology in PE has a great role in promoting PE. However, due to the practicality of PE teaching activities, it cannot be separated from the traditional way of PE. Therefore, for networked PE teaching, it is a beneficial supplement to the traditional PE teaching and cannot replace the traditional PE teaching.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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