# Design of personalized sports teaching resources recommendation system based on data mining

Fei Wu

Wuhan Huaxia Institute of Technology, College of Physical Education, Department of leisure sports, Wuhan Hubei 430223, China

CA Fei Wu email: 2015223055133@stu.scu.edu.cn

**Abstract：** Aiming at the problems of low resource utilization, low learning efficiency of learners and poor quality of physical education teaching in the teaching recommendation system, this paper aims to study the design of personalized sports teaching resource recommendation system based on data mining. First, we designed a personalized sports teaching resources recommendation system based on data mining, analyzed the system use cases, designed the overall architecture of the recommendation system and each functional module and database based on the system use cases, and introduced the recommendation ideas of sports teaching resources. Then, the personalized sports teaching resources recommendation method based on fuzzy clustering is adopted, and the traditional fuzzy clustering algorithm and fuzzy C-means clustering algorithm are adopted to improve the collaborative filtering recommendation algorithm, reduce the data sparsity of the teaching resources recommendation algorithm, thus completing the design of personalized sports teaching resources recommendation system based on data mining. And through experiments, it is proved that the system designed in this paper can recommend suitable learning resources for different learners, and has good performance. At the same time, the recommended method has higher recommendation accuracy, and can effectively improve the quality of physical education teaching.

**Keywords:** Data mining; Personalized teaching; Recommendation of teaching resources; Fuzzy clustering algorithm;

## 1. Introduction

With the wide application of the Internet, online education has also developed rapidly, and online teaching resources have also shown exponential growth. Network popularization provides learners with the ability to access teaching resources at any time. People also pay more attention to the sharing of digital teaching resources, and the demand for high-quality education resources is also increasing. In recent years, governments at all levels, in combination with universities, educational institutions, publishing houses and other relevant units, have invested a lot of resources in the construction of digital education resources and built a platform for teaching resources with large scale and rich content [1].

At present, the construction of digital teaching platform has gradually become the focus of education and practice. Modern information technology is integrated into the teaching platform, which also has the characteristics of digitalization, networking and intelligence. Digitalization can transform complex and changeable teaching

information into data that can be measured. Networking can realize the sharing of teaching resources, and teaching activities will not be limited by time and space, so that the teaching system can achieve humanized teaching. The use of digital teaching platform can not only break through the time and space limitations of traditional teaching methods, but also provide flexible learning methods, provide learners with rich and high-quality teaching resources, and create more learning opportunities and good learning environment. However, although information acquisition has certain convenience, it will also produce a series of problems. With the gradual increase of teaching resources, learners cannot find suitable and interesting content in a large amount of data information, which leads to low learning efficiency and poor learning level. Therefore, this paper designs a personalized sports teaching resource recommendation system based on data mining [2].

The innovations of this paper are as follows:(1) Design the personalized sports teaching resources recommendation system, analyze the system use cases, design the overall architecture of the recommendation system, each functional module and database based on the system use cases, and focus on the recommendation ideas of sports teaching resources. Then, the personalized recommendation method of physical education teaching resources based on fuzzy clustering is adopted, and the traditional fuzzy clustering algorithm and fuzzy C-means clustering algorithm are adopted to improve the collaborative filtering recommendation algorithm, so as to reduce the data sparsity of the recommendation algorithm of teaching resources. (2) Compared with other personalized sports teaching resource recommendation systems, the recommendation system designed in this paper has strong performance advantages. The accuracy rate of teaching resource recommendation is high, which can stimulate learners' interest in learning, thus improving learners' learning efficiency and sports teaching effect.

## 2. Related work

The application of personalized sports teaching recommendation system enables sports teachers and students to share and exchange resources through the personalized sports teaching recommendation system. Therefore, the system is studied in depth. With the rapid development of teaching informatization, Ming qiaoying has created a personalized recommendation system for teaching resources. Although teaching information sharing can bring convenience to users, at the same time, because of the gradual increase of teaching resources, information fog is formed, which causes users to spend a lot of time and energy to screen the resources they need from the massive teaching information. In view of this problem, the personalized teaching recommendation technology is applied to the sports teaching system to provide users with targeted and relevant sports teaching resources that meet the interests of users. The characteristics of physical education teaching, personalized learning theory and personalized recommendation technology are analyzed in detail, with emphasis on the application of collaborative filtering recommendation of recommendation technology in physical education teaching system. The overall architecture, data storage structure and recommendation process of personalized physical education teaching recommendation system are designed in detail to achieve personalized physical

education teaching resource recommendation from teaching resources to system users, However, this method has the problem of poor recommendation accuracy [3].Wang gensheng et al., in view of the large amount of information on current sports teaching resources and their poor utilization, how to recommend interested learning resources to sports learners according to user preferences is the key application of personalized sports teaching intelligence. The recommendation algorithm of collaborative filtering can not describe the characteristics of teaching resources, but recommend sports teaching resources in various forms. However, the traditional collaborative filtering recommendation algorithm has the problems of sparse scoring matrix and cold start. To solve these problems, a recommendation method of personalized sports teaching resources based on improved collaborative filtering is proposed. The system first designs each functional module of the recommendation system, and then converts the user's learning style of physical education teaching resources into the user's rating of teaching resources, which alleviates the sparse problem of the scoring matrix, introduces the user initiated tags, and improves the user's similarity calculation, thus solving the cold start problem of new users, Use the root mean square error to measure the accuracy of teaching resource recommendation algorithm. The simulation experiment results show that this algorithm can effectively improve the accuracy of personalized sports teaching resource recommendation, but this method has more complex problems [4].With the rapid development of Internet technology, intelligent teaching systems are widely used. However, most of the current intelligent teaching systems do not pay attention to the magnanimity of teaching resources, resulting in poor performance of teaching recommendation systems and low utilization of teaching resources. Therefore, a personalized sports teaching recommendation system based on data analysis is designed, and the overall structure and specific functional modules of the sports teaching recommendation system are designed. The performance of the recommendation system for physical education teaching is tested through experiments. The experimental results show that the physical education teaching recommendation system can better carry out statistical analysis of learners' behavior laws, and recommend suitable physical education learning resources for different learners according to the analysis results. The teaching quality evaluation module in the personalized system can better evaluate and feedback students' learning behavior and teachers' teaching quality. Although the system has certain practical value, the effect of improving teaching quality is not obvious [5].The analysis of Zhang Jian et al. and the improvement of sports teaching resources put forward higher requirements for the sports teaching resources management system. In order to better manage sports teaching resources, a personalized sports teaching recommendation management system based on cloud platform is designed. The physical education teaching recommendation management system mainly adopts the HDFS distributed structure. The system function layer mainly includes some processing functions such as transaction logic rules, which can effectively reflect the relatively independent target functions. It is specifically divided into user modules, system management modules and personalized teaching resource management modules. Among them, the user module can effectively realize some functions such as uploading, downloading

and evaluating sports teaching videos. The teaching resource management function is based on the recommendation idea of the limited Boltzmann machine, and uses the data set training process to upgrade the weights and user preferences, so as to obtain the evaluation of the learners for the recommendation of sports teaching resources, and carry out the recommendation of sports teaching resources according to the evaluation results. The experimental results show that the designed sports teaching resources recommendation system can effectively meet the needs of learners in all aspects, and the teaching resources occupation rate of the recommendation system is relatively low, but the system does not improve the utilization rate of sports teaching resources [6].

## 3. Personalized recommendation system of physical education teaching resources based on data mining

### 3.1 Case analysis of recommendation system of physical education teaching resources

The personalized sports teaching resources recommendation system based on data mining is built for sports learners. Sports learners can not only complete the learning of sports resources, but also complete the downloading of teaching resources by using the personalized teaching resource recommendation system. At the same time, they can manage the recommendation system, including the basic information of users, their permissions and logs. The uploader of sports teaching resources uploads sports teaching patterns in the recommendation system, including sports courseware and sports videos [7-8]. According to the above different roles, the overall use case diagram of the personalized sports teaching resource recommendation system is drawn, which is shown in Figure 1.

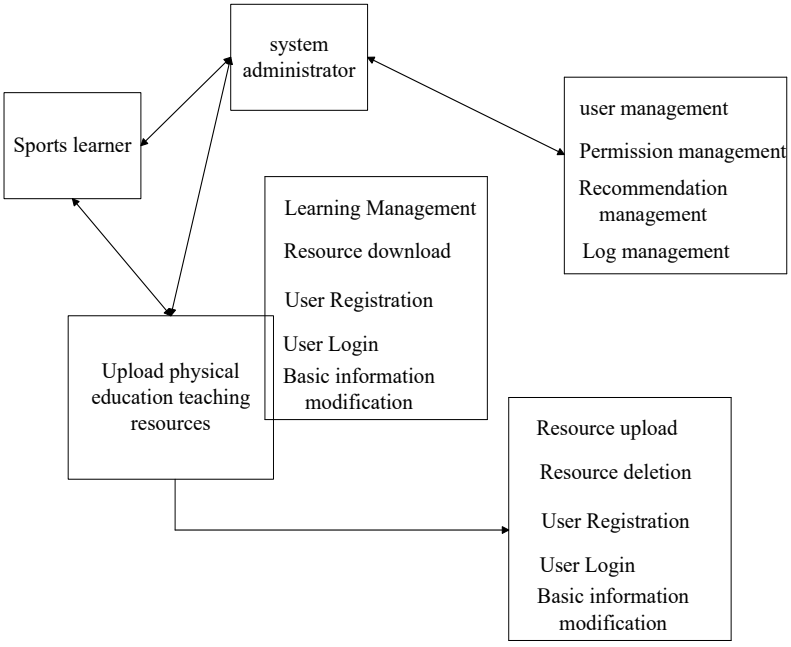



**Figure 1 Use case analysis of sports teaching resource recommendation system**

### 3.2 Overall architecture of personalized recommendation system

The overall architecture of the system adopts the B/S structure mode. The overall architecture of the system is divided into three layers, namely, the application layer, the logical layer and the data layer. The overall architecture of the personalized

recommendation system is shown in Figure 2.

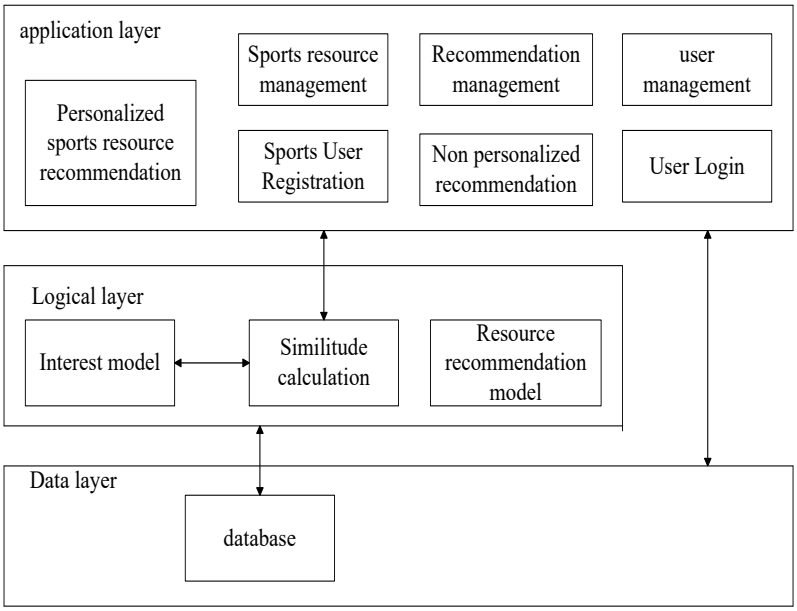



**Figure 2 Overall architecture of personalized recommendation system**

In Figure 2, (1) the application layer provides an interactive interface for users in the system and receives the user's operation request. In the application layer, it specifically includes personalized recommendation and non personalized recommendation. It is set for new registered users and old registered users in the system function interface. Install a browser in the client, and learners can log in to the personalized sports teaching system as long as they click the functions on the system page, thus completing the access to different functions. (2) The logical layer contains application servers and personalized resource recommendation models. The application service area can respond to the operation request sent by the user [9-10]. After receiving the request from the user in the client, the server in the database responds, sends the response result back to the client, and presents it to the user in the system. (3) The data layer contains the database management system and the database server. The database management system can effectively store the physical education teaching resources in the teaching resources recommendation system. The database server can respond to the request sent by the application server and return the query results to the application server in the recommendation system.

3.3 Functional module design

According to the use case analysis, the function of personalized sports resource recommendation system is designed into four modules, which are personal space management and resource management, system management and recommendation module. The detailed functional module design diagram is shown in Figure 3.

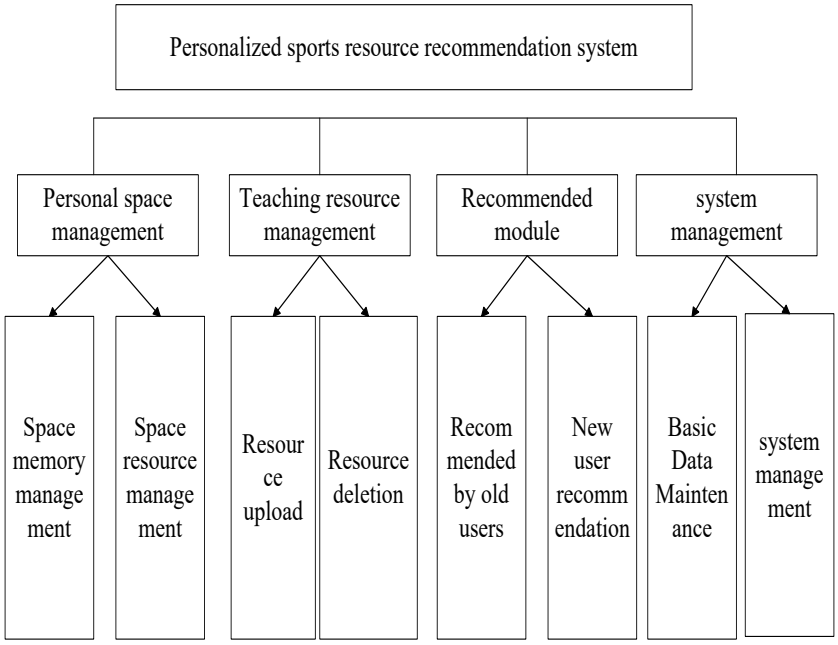



**Figure 3 Functional structure of personalized sports resource recommendation system**

In Figure 3, (1) Personal space management module includes sports teaching resources and space resource management, which can provide learning space for different sports learners, thus meeting the learning needs of different learners for different teaching resources. (2) The management of sports teaching resources is the uploader of sports resources, which includes the upload and deletion of sports teaching resources. Physical education teachers can upload teaching resources to the teaching resources recommendation system and share them with other learners. Physical education teachers can delete the teaching resources with a long time limit in the system and update the physical education teaching resources. (3) The recommendation of physical education teaching resources can be combined with the attribute characteristics of users, and can also be combined with users' browsing scores, thus completing the recommendation of teaching resources to learners [11-12]. In this module, new users and old users will adopt different recommendation models based on user characteristics to recommend teaching resources to learners. The specific personalized recommendation idea is shown in Figure 4. (4) System management is mainly used to manage users and maintain basic data. The users of system management are system administrators, who can scientifically divide the permissions of different roles and manage the logs in the system.

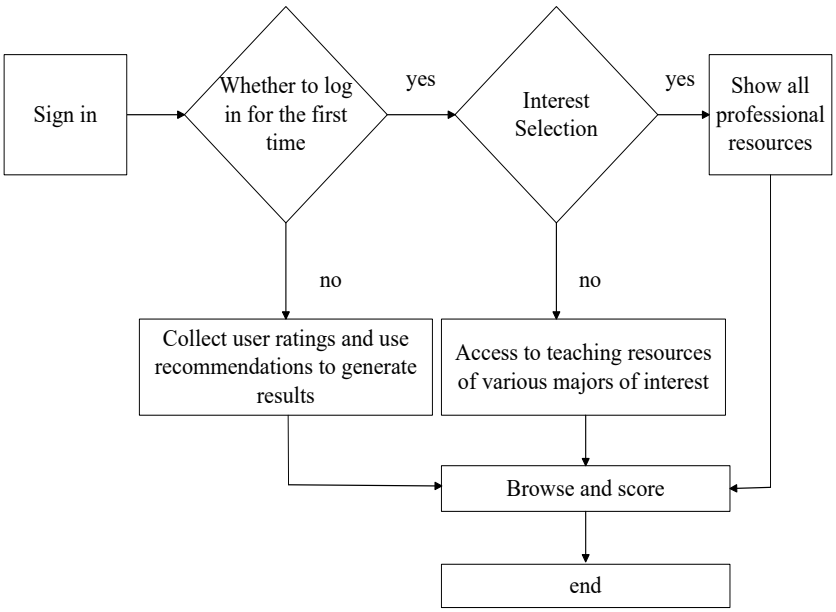



**Figure 4 Ideas of personalized recommendation**

3.4 Database design

The main table structure in the system database includes the basic information table of students, curriculum information table and teacher information table, which are represented by Table 1 - Table 3.

(1)Student information table is used to store students' personal information, such as student name and account password.

**Table 1 Student Information**

| field | type | explain |
|---|---|---|
| ID | Varchar（30） | Student ID |
| NAME | Varchar（80） | Student Name |
| PSW | Varchar（30） | Account password |
| SEX | Varchar（8） | Student gender |
| CLASS | Varchar（8） | Student class |
| AGE | Int（10） | Student age |
| RDATE | datetime | Student registration time |

(2)Course information represents the storage of all course information in the system, including course ID and course name [13-14].

**Table 2 Course Information**

| field | type | explain |
|---|---|---|
| ID | Varchar（30） | Course ID |
| NAME | Varchar（80） | Course name |
| TYPE | Varchar（30） | Course type |
| CONTENT | text | Course content |
| KEYWORD | Varchar（30） | Course keywords |
| RDATE | datetime | Course release time |
| TMAGE | Varchar（100） | Course image path |

(3) The teacher information table is used to store teacher related information in the system, including teacher ID, teacher name, etc.

**Table 3 Teacher Information**

| field | type | explain |
|---|---|---|
| ID | Varchar（30） | Teacher ID |
| NAME | Varchar（80） | Teacher Name |
| PSW | Varchar（30） | Account password |
| LESSON | Varchar（8） | Teaching courses |
| RDATE | datetime | Issue time |
| numb | int（100） | Number of courses added |

## 4. The recommendation method of personalized physical education teaching resources based on fuzzy clustering

### 4.1 Fuzzy C-means clustering algorithm

During the implementation of the fuzzy C-means clustering algorithm, it is assumed that the number of users of the recommendation system is $n$ and the number of items is $m$, $p_{ij}$ represents the $i$ learner's rating of the $j$ resource item.Let the $1 \le i \le n$, $1 \le j \le m$, evaluation matrix be expressed as:

$$P = \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1m} \\ p_{21} & p_{22} & \cdots & p_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ p_{n1} & p_{n2} & \cdots & p_{nm} \end{bmatrix} \quad (1)$$

Through the evaluation matrix, learners with high similarity can be divided into $c$ clusters, and the division results can be expressed by the membership matrix $X$ as:

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{c1} & x_{c2} & \cdots & x_{cn} \end{bmatrix} \quad (2)$$

Suppose $l$ represents the fuzzy index, and $d_{ij}$ represents the Euclidean distance between the $i$ sports learner and the $j$ cluster center.For $n$ sports learners and $c$ sports learners, the objective function of fuzzy C-means clustering can be calculated from the data in the membership matrix $X$, which is expressed as:

$$J_l(X,c) = \sum_{i=1}^{n} \sum_{j=1}^{c} x_{ij}^{l} d_{ij}^{2} \quad (3)$$

According to the relative operation rules, the realization conditions of the optimal value of the objective function are derived. For the center $c_j$ of the $j(1 \le j \le c)$ cluster, the conditions are as follows:

$$c_j = \frac{\sum_{i=1}^{n} x_{ji}^{l} p_{ij}}{\sum_{i=1}^{n} x_{ji}^{l}} \quad (4)$$

$$x_{ji} \frac{1}{\sum_{j=1}^{c} \left[ \frac{d_{ji}}{d_{ki}} \right]^{2/(l-1)}} \quad (5)$$

4.2 Specific process of algorithm

(1) Initialize. Let the number of user clusters $c$ and the index $l$ of clustering fuzziness. Under normal conditions, $l \succ 1$. Set the control parameter of iteration to $\varepsilon$.

(2) According to the principle of density, select the cluster center with the highest density [15-16].

(3) The distance between all sports learners and the center is calculated through the scoring matrix, and then the membership matrix is generated.

(4) If the results of iteration $t+1$ and iteration $t$ can meet:

$$\left| J_l^{t+1} - J_l^t \right| \prec \varepsilon \quad (6)$$

If the above conditions are met, the iteration can be stopped. At this time, the membership matrix and scoring matrix are the final solution of the problem, and you can turn to step (5), otherwise turn to step (2) to continue the iteration.

(5) Through the membership matrix and scoring matrix, the learners are grouped to build user clusters. Other users can be classified according to the current membership matrix and scoring results.

4.3 Selection of initial cluster center

In order to avoid errors in the selection of the initial cluster center, which makes it impossible to complete the classification of physical education teaching resources, the initial cluster center is selected according to the density. The detailed steps are as follows:

(1) Given $n$ learner scoring matrices $P$, calculate the density value of each learner [17-18]. Let $r_d$ represent the density radius of adjacent learners, then the density radius and the $i$ learner density are calculated as follows:

$$r_d = \frac{\sqrt{\frac{1}{n(n-1)} \sum_{j=1}^{n} \sum_{i=1}^{n} \left\| p_i - p_j \right\|^2}}{2} \quad (7)$$

$$V_i = \sum_{j=1}^{n} \frac{1}{1 + 4 / \left( r_d^2 \left\| p_i - p_j \right\|^2 \right)} \quad (8)$$

(2) Calculate the density value according to step (1), and select the initial cluster center of the maximum density $V^*$. Let $\delta_a$ represent the search range centered on

the $i$ user, and correct the density value of each learner through Formula (9):

$$V_i^* = V_i - V^* \exp\left(\frac{-\left\|p_i - p^*\right\|^2}{0.25\delta_a}\right) \quad (9)$$

(3) Conduct judgment in the modified initial clustering. If the initial clustering can meet the formula (10), the calculation process can be ended. On the contrary, turn to step (1) to continue the calculation.

$$V_i^* / V^* \prec \varepsilon \quad (10)$$

(4) Output the result of selecting the initial cluster center [19-20].

From the above process, the design of personalized sports teaching resources recommendation system based on data mining is completed.

## 5. Experimental result

In order to verify the effectiveness of the design of personalized sports teaching resources recommendation system based on data mining proposed in this paper, simulation experiments were carried out through relevant equipment, and the simulation platform is shown in Table 4.

**Table 4 Simulation Experiment Platform**

| parameter | numerical value |
|---|---|
| operating system | Microsoft Windows 7 |
| CPU | Intel Core i7-4700HQ |
| Running software | Matlab R2019b |
| Operating capacity | 2TB |
| Memory | RAM 8 GB |

### 5.1 Test steps

In the process of simulation experiment, the information of physical education teaching resources with different amounts of data is set, and the simulation experiment is carried out through the traditional personalized physical education teaching resources recommendation system as the contrast object of the simulation experiment. The curve of information simulation of different quantities of physical education teaching resources is shown in Figure 5.

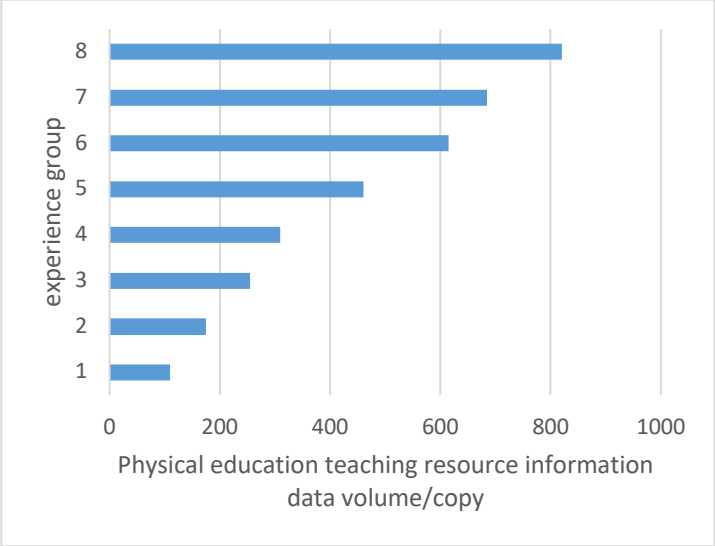
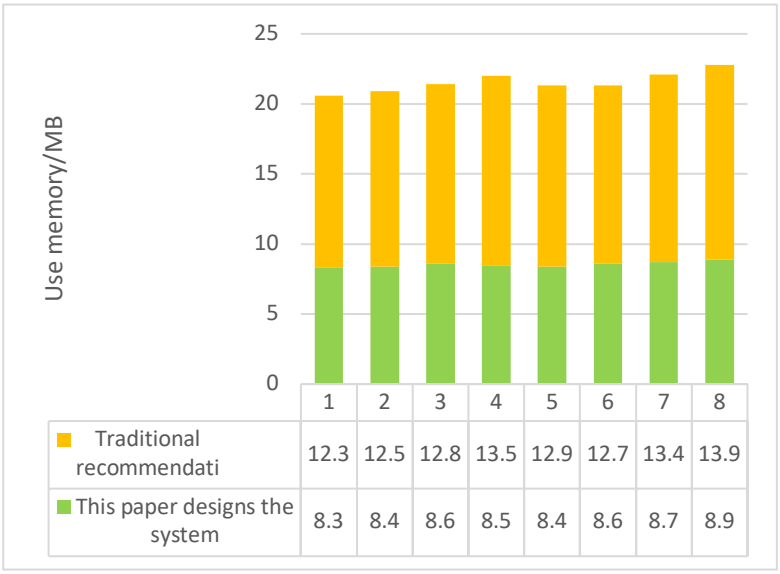



**Figure 5 Simulation curve of simulation experiment**

Before the simulation experiment, prepare two computers with the same configuration model, install the same simulation software, and load the 8 groups of simulation data in Figure 5 into the simulation software. According to the data interface of computer simulation software, it is respectively connected with the traditional sports teaching resources recommendation system and the sports teaching resources recommendation system based on data mining to carry out system response simulation experiments. The resource data obtained will be sampled and analyzed to obtain the performance of the recommendation system and the accuracy rate of teaching resource recommendation for different experimental groups of users.

5.2 Comparative analysis of experiments

The overall performance comparison between the traditional personalized sports teaching resource recommendation system and the personalized sports teaching resource recommendation system based on data mining proposed in this paper is shown in Figure 6.




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Traditional recommendati | 12.3 | 12.5 | 12.8 | 13.5 | 12.9 | 12.7 | 13.4 | 13.9 |
| This paper designs the system | 8.3 | 8.4 | 8.6 | 8.5 | 8.4 | 8.6 | 8.7 | 8.9 |

**Figure 6 Performance comparison of different personalized sports teaching resource recommendation systems**

It is shown by Figure 6. It can be seen from Figure 6 that the memory used by the traditional personalized sports teaching resource recommendation system in the eight groups of experiments can reach 13.9MB at the highest and 12.3MB at the lowest. The overall memory used by the eight groups of experimental groups shows an upward trend, while the personalized sports teaching resource recommendation system designed in this paper based on data mining in the eight groups of experiments can use 8.9MB at the highest and 8.3MB at the lowest, It is obviously lower than the use memory of the traditional recommendation system, which shows that the overall performance of the personalized sports teaching resources recommendation system designed in this paper is better, can better meet the use situation of sports teaching, and is suitable for application in personalized sports teaching. Figure 7 shows the comparison of the recommendation accuracy of the personalized sports teaching resources recommendation method proposed in this paper with the resource recommendation methods proposed in literature [3] and literature [4].

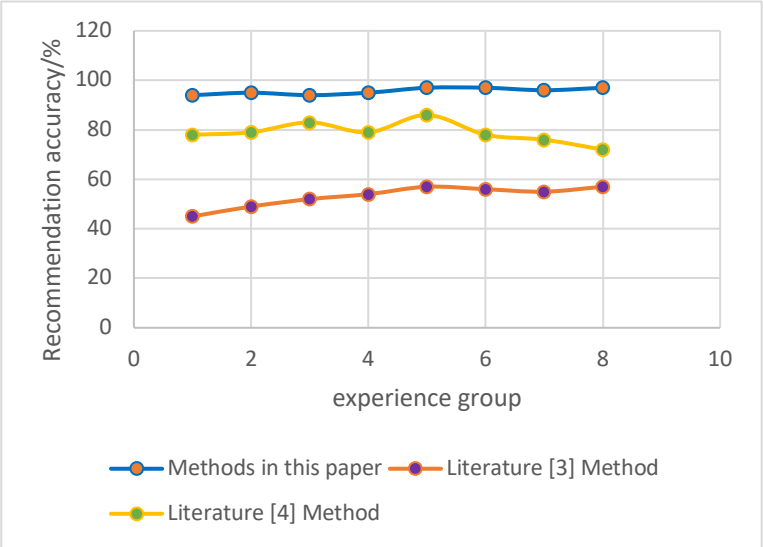



**Figure 7 Comparison of accuracy rate of personalized sports teaching resources recommendation by different methods**

It can be seen from Figure 7 that although the curve of the accuracy rate of the recommendation of physical education teaching resources using the method proposed in literature [3] is relatively stable, it has always been relatively low and not practical. The method proposed in literature [4] is relatively more accurate than the method proposed in literature [3], but the curve fluctuates greatly. The accuracy rate of the recommendation of physical education teaching resources using the method proposed in this paper has always been relatively stable, above 94%, This is because the method proposed in this paper can effectively explore the teaching resources suitable for sports learners by using the data mining method of fuzzy clustering, and make personalized recommendations to learners, stimulate the learning interest of learners, and improve the learning efficiency. This shows that the method proposed in this

paper can effectively improve the utilization rate of teaching resources and the effect of sports teaching.

## 6.Conclusions

With the gradual innovation of Internet technology, the traditional teaching methods have been rapidly innovated, the rise of network teaching platforms, the balance of personalized teaching resources and the individuation of students have been effectively improved. In the traditional teaching system, the learning paths of different students are less different, and the system cannot provide personalized learning paths for learners based on the content that students are interested in. This paper designs a personalized sports teaching resources recommendation system based on data mining. The recommendation system mainly adopts a multi-layer system structure, effectively uses the advantages of personalized data recommendation, recommends more suitable learning resources for learners according to the corresponding characteristics of different students, and better realizes personalized sports teaching based on students, so that the effect of sports teaching is significantly improved. And through the simulation experiment, it is proved that the personalized teaching function of the personalized sports teaching resources recommendation system designed in this paper is better, which can effectively improve the utilization of teaching resources.

## References

[1]T. Hu, “Design of english teaching resource management system based on collaborative recommendation, ”Automation Technology and Application, vol. 38, no.9, pp.158-161, 2019.

[2]F. Li, Y. J. Chen, “Design and simulation of intelligent matching algorithm for online mathematics courses based on fuzzy clustering, ”Modern Electronic Technology, vol.44, no.16, pp.125-128, 2021.

[3]Q. Y. Ming, “Analysis and Design of Video Teaching Recommendation System Based on Personalization,”Microcomputer application, vol.35, no.9, pp.33-36,2019.

[4]G, S, Wang, H. L. Yuan, and X. J. Huang, “Network learning resource recommendation algorithm based on improved collaborative filtering,” Minicomputer system, vol.42, no.5, pp.940-945, 2021.

[5]W. S. Cheng, “Design and Implementation of Personalized Network Intelligent Teaching System Based on Big Data Analysis,”Journal of Changchun Normal University (Natural Science Edition), vol.40,no.6, pp.37-42,2021.

[6]J. Zhang, C. X. Li, and R. H. Zhu, “Massive video teaching resource management system based on cloud platform,”Modern Electronic Technology, vol.43,no.21, pp.151-155,2021.

[7]Q. L. Song, F. Xie, “Personalized recommendation of teaching resources based on cognitive diagnosis,” Journal of hefei normal university,vol.39, no.3, pp.14-16, 2021.

[8]H. W. Zhang, “LDA based personalized teaching resource recommendation system,”Modern information technology, vol.2, no.10, pp.18-20, 2018.

[9]Y. Han, “Construction of online educational resources recommendation model based on subject words, ”Automation Technology and Application, vol.38, no.9,pp.170-173, 2019.

[10]L. Yan, L. Qi, “Research on Big Data Mining Technology of Mobile Learning System Based on Android Platform, ”Modern Electronic Technology, vol.40, no.19,pp.142-144, 2017.
[11]V. A.Mahboob, M. Jalali, and M. V. Jahan, “SWALLOW: RESOURCE AND TAG RECOMMENDER SYSTEM BASED ON HEAT DIFFUSION ALGORITHM IN SOCIAL ANNOTATION SYSTEMS,” Computational Intelligence, vol.33, no.1,pp.99-118, 2017.
[12]N. Thejaswini, C. R. Aditya, “Smart E-Commerce Recommendation System for Handling Limited Resource and Cold Start Problem,” INTERNATIONAL JOURNAL OF COMPUTER SCIENCES AND ENGINEERING,vol.7, no.5,pp.961-964,2019.
[13]G. K.Krishnan, M. Parthasarathy, and D. Sasidhar, “Emotion detection and music recommendation system using machine learning,” International Journal of Pure and Applied Mathematics,vol.119,no.15,pp.1487-1497, 2018.
[14]J.Odeesh, S. Salih, “The Role of Green Human Resource Management Functions in Promoting Blue Ocean Strategy,” Humanities Journal,vol.8, no.1,pp.129-145,2020.
[15]A.Mitchell, S. Petter, and A. L. Harris, “Learning by Doing: Twenty Successful Active Learning Exercises for Information Systems Courses,” Journal of Information Technology Education Innovations in Practice,vol.16,no.1, pp.21-46,2017.
[16]A.Ogunleye, B. E. Anyaegbuna, “An assessment of physics laboratory teaching and learning resources in two Nigerian universities,” Cypriot Journal of Educational Sciences,vol.37,no.13,pp.1-14,2018.
[17]M.Lenin, E. William, and M. Maitrayi, “Personalized news recommendation using graph-based approach,” Intelligent Data Analysis,vol.22,no.4,pp.881-909,2018.
[18]Anthony Watt Arto Grstén, A. Watt, “A Motivational Model of Physical Education and Links to Enjoyment, Knowledge, Performance, Total Physical Activity and Body Mass Index,” Journal of sports science & medicine, vol.16, no.3,pp.318-327, 2017.
[19]G.Escrivaboulley, D. Tessier,and N. Ntoumanis, “Need-supportive professional development in elementary school physical education: Effects of a cluster-randomized control trial on teachers' motivating style and student physical activity,” Sport, Exercise, and Performance Psychology,vol.7, no.2, pp.218-234, 2018.
[20]A.Bekiari, M. Pylarinou, “Instructor Argumentativeness and Socio-Communicative Style and Student Discipline: Using Physical Education Students' Class as an Illustration,” Open Journal of Social Sciences, vol.5,no.3, pp.122-136,2017.