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Hybrid Teaching Platform Design for Ideological and Political Courses Based on K-Means Clustering

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Abstract. In order to cluster based on the obtained user basic information and interest characteristics to improve traditional online teaching systems, a design scheme for a mixed teaching mobile platform for ideological and political courses based on K -means algorithm is proposed. In terms of software design, the K-means algorithm optimized by GA is used to cluster student information, and the hierarchical method is used to set up knowledge point structure modules, and the specific implementation method is provided. It also adopts MVC+JSP as the script framework, and determines the overall workflow through demand analysis. Finally, with the assistance of Eclipse, the experiments and software tests prove the feasibility and effectiveness of the platform, and the clustering results are relatively stable and the running time is significantly reduced. Therefore, it provides a new way to strengthen and improve the teaching of college students' ideological and political courses in the new era.

Keywords. hybrid teaching platform; k-means clustering; ideological and political course; MVC+JSP; Android

1. Introduction

At present, many ideological and political course teachers in universities are actively exploring and applying mobile teaching platforms, and have achieved fruitful results. They have innovated teaching methods, broken the limitations of time and space, improved the fun of teaching, and enhanced the effectiveness of education and teaching. Therefore, how to combine constructivist teaching concepts and build a network teaching platform centered on situational learning mode, so that the entire platform teaching process is based on virtual classrooms, enabling teachers and students to complete knowledge teaching and learning in a pleasant and relaxed atmosphere, is one of the cutting-edge topics that scholars need to explore at present. Due to the single performance impact of the original auxiliary teaching system, the differences in students' learning needs cannot be met, resulting in a decrease in their academic performance. Therefore, a computer professional auxiliary teaching system is designed by integrating ideological and political elements. The use of clustering technology can effectively analyze the learning characteristics and behaviors of learners in mobile learning, thereby designing targeted course resources and teaching processes, and improving the topological structure of mobile learning systems At present, clustering analysis mainly uses K-Means algorithm to group samples based on the similarity between sample attribute values. After the initial k classes are randomly defined, they

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will be continuously updated and optimized during the update. When further optimization is not possible, the algorithm will stop and the model will be generated. Firstly, analyze the data types of clustering samples and design clustering criterion functions based on the analysis results [1,2]

The research work of this article is performed in conjunction with data mining in teaching reform, focusing on how to apply K-means method in clustering analysis technology to cluster analysis of educational and teaching data, and explore various educational and teaching laws contained in educational and teaching data. A mobile oriented teaching platform based on MVC architecture is proposed. This solution uses Oracle as the database, Tomcat as the JSP server engine, and adopts a three-tier architecture design that separates the interface from the business logic. In the key module design, the clustering rule mining module of this system is implemented in Java language, and the system is used to mine rules for educational and teaching data. The k-means algorithm is improved and optimized using genetic algorithm. The system design fully considers the integration of ideological and political elements to formulate knowledge point deduction rules, and ultimately completes the design of a hybrid mobile teaching system. The results show that the scheme has good design concept, functional operation and network situation, which unifies students' cognition, learning environment, progress dynamics and various assessments, and enables teachers and students to share new knowledge in the process of joint participation.

2. System Demand Analysis

2.1 Demand Analysis

With the help of the construction of the integrated teaching management platform, the mobile teaching management system can improve the overall ability of the informatization level of the school's double high construction and daily teaching management. The smart teaching carried out on this basis can assist teachers to carry out mixed teaching in schools. Mobile teaching can be carried out through mobile terminals, teacher terminals and management terminals. At the same time, the platform integrates the original scattered teaching to form a rich teaching resource library; Personalized curriculum customization enables students to customize their own curriculum according to their own conditions. it processes the acquired data, in addition to the functionality of general teaching statistics software, and the system can perform cluster analysis, clustering rules are generated for teaching evaluation and student academic diagnosis, guiding the deepening of educational and teaching reform practices.

- In order to satisfy users' learning anytime and anywhere, the platform includes the following main functional modules:
- Firstly, it provides teaching information portal, mainly including information display, single sign on, personalized customization, business system data integration display, public information display, etc;
- Second, it provides teaching resources and an application store, which fully covers the mobile teaching resources required by the three basic teaching scenarios before, during and after class; Users can download the teaching resources they need in the app store according to their needs;

• Thirdly, it provides an open learning platform. Students can learn anytime, anywhere, check their learning dynamics and manage their learning progress by installing an APP on a mobile phone

2.2 System Functional Demand

During the process of system design and implementation, it is necessary to use a new design concept to realize the safe and stable information teaching anytime, anywhere, zero distance. It shall be considered as far as possible that the system can run on a low-cost hardware and software platform, and provide a good user interface to facilitate user operation.

(1) The system interface design shall conform to the general rules of human-computer interaction design, and the general design methods of human-computer interaction interface can be used. The medium density screen is designed as a benchmark, and then the corresponding image resources are provided for other density screens. Finally, the system automatically handles the adaptation;

(2) Error prompt friendliness

At the same time, it is required to be able to handle all system level and application level errors, including memory stack overflow, null object reference, permission restrictions, hardware read errors, etc.

(3) The non key business functions include the number of concurrent users, the operation response time of important business, the online storage capacity of important data, etc. When a system failure occurs, the time from processing to system recovery cannot exceed 5 minutes

(4) The scalability of the system, including file storage, data protection and backup, extends to data management, sharing, analysis and data security.

3. Hybrid Mobile Ideological and Political Course Teaching Platform Design Based on K-means

3.1 System Overall Structure

The overall architecture of the system is the logical model of the whole system, including six layers and two sets of systems: the former includes user interface and terminal layer, application service layer, business operation support layer, core service layer, data resource layer, and infrastructure layer; The latter includes safety management system and system operation and maintenance support system, as shown in Figure 1. The reason why the data persistence layer is proposed as a layer of the J2EE system alone is that it can provide a successful enterprise level mapping solution between the object relational database. This layer directly interacts with the background database. Common technologies include EJB, JDBC and JDO; The business layer, as the core of the entire teaching platform, is responsible for specific business processing, including domain object models, domain entities, business rules, validation rules, business processes, etc; The presentation layer is an interface layer for various users to interact with the network teaching platform. It is responsible for collecting various kinds of information and displaying the data returned by users' requests. Users use various functions provided by the network teaching platform through the browser, and the server displays the processing results to users through the web page [3].



Figure 1. The overall logical structure of the hybrid situational teaching platform.

3.2 Implementation of Cluster Rule Mining Module

The education and teaching data obey the normal distribution, so the following hybrid model can be established for global dataset $X(x_1, x_2, ..., x_k)$ as

$$p(\mathbf{X}) = \sum_{k=1}^{K} p_k (\mathbf{X} \mid \boldsymbol{\theta}_k) \boldsymbol{\pi}_k$$
(1)

The object of system is converted to find the minimum value of $S(\theta)$. Let $g(\theta) = S'(\theta) = \partial s(\theta) / \partial(\theta)$ and assume the optimal solution emerges at η , that is, $g(\eta) = 0$. According to Taylor expansion we can acquire the approaching point ξ to η as

$$g(\eta) \approx g(\xi) + (\xi - \eta)g'(\xi)$$
⁽²⁾

The total distribution of X is separated into the weighted linear combination of K components and each class is a simple distribution model with parameter θ_k ; π_k is the probability generated by k components to a data point randomly chosen. Thus, when X is divided k clusterings, it is represented by K tuples as $X(X_1, X_2, ..., X_k)$. For each component X_i , its optimal function is defined as $e_k = \sum_{i \in C_k} ||X(i) - \mu_k||^2$, that is, the Sse of each clustering. Then the optimal function of X is $S(\theta) = \sum_{k=0}^{K} e_k$.

The above shows that given an initial value ξ , by continuous adjustment the

optimal solution of $S(\theta)$ can be acquired to improve the searching accuracy. $S(\theta)$ will be adopted as the fitness function of GA for iteration searching.

3.3 Other Functional Modules Design

(1) Open teaching platform

Starting from the connotation of open teaching and the characteristics of Android technology, the open learning platform adopts architecture specifications to enable third-party software providers to participate Through cloud computing and 5G technology, we can also adopt the design idea of independent application unit from five aspects of theoretical basis, teaching objectives, operating procedures, implementation conditions, teaching evaluation and academic monitoring to form an application open

platform construction scheme [4]. The system supports the B/S structure of PC and mobile terminals, including the course learning system, course management system and course discovery system, to ensure the high sharing of resources in the open learning zone.

(2) Resource management module

It is the main module of the system, including viewing resources, downloading resources, uploading resources and maintenance resources, to realize the mobile application of course management and teaching service functions provided by the network teaching management system. This part of resource supervision is built in the cloud computing service device, that is, the school service device and the cloud computing terminal are used to realize interaction. This part includes resource search, preview, recommendation and collection functions to complete resource interaction. You can publish announcements, course materials, tasks, links to teaching resources, teacher profiles and other information. Teachers can freely write and set course introduction, cover, teaching requirements, teacher team, etc. according to their authority, and support the addition, deletion and location adjustment of modules. The scope of operation covers all mobile terminal operating users who have installed the system software in the mobile terminal of J2EE mobile intelligent operating system. The activity flow of the resource management module is shown in Figure 2.



Figure 2. Activity diagram of resource management module.

(3) User authentication interface design

Users can directly access the application system or a module of the application through the Web link on the portal system. The system provides comprehensive single sign on (SSO) support, enabling users to log in successfully at one time, and using the same unified user certificate, according to the system level access permissions configured by the portal system, there is no need to log in repeatedly when accessing authorized business systems. If you are a teacher, obtain the teaching courses arranged by the teacher in the current institution. Pass the user information (uid), institution id and course id to the server to obtain the first 20 resource lists of the course. Part of the key codes of such process is described as follows:

```
var getCheckObject = function() {
var tipP = tip = document.createElement("p");
ip.appendChild(document.createTextNode(" password error"));
var tipU = tip = document.createElement("p");
tip.appendChild(document.createTextNode("user name error"));
function addErrorTip(node, type) {
node.className +=' ' + 'error' +' ';
if(type =="username") {
node.parentNode.appendChild(tipU);
} else if (type == "password") {
node.parentNode.appendChild(tipP);
}
(4) JSP Execution process
```

The execution process of processing JSP file requests by the Web container mainly includes the following parts:

• The client sends a request

• The source code for JSP Container to translate JSP into Servlet

•The generated servlet source code is compiled and loaded into memory for execution

•Send the result Response to the client

•The server sends the HTML code generated after the class file is executed to the client, and the client browser displays the corresponding view according to the corresponding HTML code.

3.4 DBS Design

After the standardized reorganization of the basic data structure, the standardized database system structure is established. Establishment of relational data structure: It is easy to maintain and modify after the standardized reorganization of the basic data structure. Determine a single parent record structure: in the created tables, try to make the relationship between records in all tables appear as a tree structure. The database and data table can be established through the database management system software The database of the system adopts MSSQL 2016. Take the teacher information table as an example to illustrate the logical architecture of the main data tables in the database, as shown in table 1.

Field	Data type	Size	NULL
UserId	Int	10	N
Password	varchar	20	Y
Name	varchar	10	Y
Sex	varchar	2	N
Tel	varchar	20	Y
Email	varchar	20	Y
SchooID	Char	10	N
Subject	char	30	Y

Table 1. Teacher information list

4. System Implementation and Test Analysis

The course content of the platform is organized in a tree structure, which supports the level of an unlimited content hierarchy tree. The nodes of the course content tree can be moved, adjusted, and dragged to adjust the order of the tree nodes. According to the Windows tree directory structure, the open characteristics of the open learning platform and the non-linear, random, multi angle access and micro interaction characteristics of learning activities are shown [5-7]. The system provides feedback learning assessment, which provides sufficient feedback information for teachers and students to adjust and improve teaching. Students can choose learning content according to the recommended level, so that excellent learning resources can be more effectively disseminated among students. In response to the problems of delayed, subjective, and one-sided feedback in traditional teaching, a design model for an evaluation feedback system to promote effective learning is proposed, and a prototype system for intelligent learning is implemented. The system evaluates students' participation, focus, and interaction quality through image recognition algorithms and data analysis, providing teachers with real-time feedback on teaching effectiveness. The data flow graph of such systems with transactional structure is often radial. One process separates its input into several divergent data flows, thus forming several active paths. The main resource list page after the user logs in is shown in Figure 3.



Figure 3. Resource list interface

When a learner chooses a course, in the bottom right corner of the selection page, the push system will automatically push "related courses" related to the course to the learner for reference. The purpose of pushing related courses is to help learners delve into learning and explore topics related to their chosen course. Such push can provide more learning resources and opportunities, allowing learners to further broaden their knowledge and potentially help them achieve better results in related fields. This push system usually determines the relevant courses based on factors such as the theme, content, and difficulty of the selected courses by learners. It may consider the similarity, complementarity, or advancement of courses in order to provide learners with a more comprehensive learning experience.

The specific calculation rules are as follows: if the elective courses are different, then sum the squares of the respective course grades [8]. Assuming learner A has taken

course A and achieved a score of A_ Score, learner B took course B and achieved a score of B_ Score, then the calculation formula is: sum of squares of grades=A_ Score $^{2+B}$ Score 2 . Using selected features and standardized data, run the k-means algorithm for clustering. The algorithm assigns learners to k groups, making the learners within each group as similar as possible, while the learners between different groups are as different as possible. Push learning resources: Based on the characteristics and needs of each learning materials, courses, articles, videos, and other resources for group learners based on their shared interests and learning history. As shown in Figure 4, the system automatically selects the top ranked learning resources as push objects.

The question answering application follows the open learning platform interface specification. The platform interface construction specification aims to delimit a framework boundary for interface development, testing and use, define technical objectives and requirements, and provide complete interface documentation The mutual cooperation between teachers and students forms a community of cooperative learning in the classroom: both teachers and students, as members of a cooperative group, participate in the discussion and the whole process of teaching. We can reply directly in the query interface, or can enter the details interface to view the specific answers, as shown in Figure 5.





Figure 4. Application demonstration of k-means clustering results in content push.

Figure 5. Teacher student interaction interface on mobile platform.

In the performance testing of the system, considering that concurrent retrieval by multiple users is a performance bottleneck, stress testing is used to treat concurrent query resources by multiple users as testing transactions. A stress test is conducted on four classes of students from a certain high school, and the test results are shown in table 2. From the test results, it can be seen that in the stress test of the platform, when the number of concurrent users reaches 500, the system can operate normally and maintain good stability.

Concurrent	Transaction	CPU utilization(%)	Memory	Transaction success
quantity	name		(KB)	rate
50	Resource query	10	50234	100%
100	Resource query	13	50234	100%
200	Resource query	25	50234	100%
500	Resource query	36	50234	100%

5. Conclusion

This paper establishes a k-means clustering based Hybrid teaching platform under Android environment. By studying the data analysis model and selecting the clustering analysis algorithm as the data analysis method for learning resource classification, the corresponding functional module is designed and implemented. The development of the project uses JSP technology to establish a network teaching platform for college students' ideological and political practice courses, and uses the powerful development function of Eclipse to gradually research, analyze and design the teaching platform through software modeling, finally realizing the overall function of the platform, and has been applied and tested in practice. The program makes teachers more humanized and personalized in teaching management, curriculum design and assessment design, thus promoting the virtuous circle development of ideological and political curriculum.

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