International Journal of Academic Pedagogical Research (IJAPR)
ISSN: 2643-9123
Vol. 5 Issue 8, August - 2021, Pages: 33-40

Analysis and Implementation of Course Quality Optimization based on Cloud Computing

Zaripov Bahodir, Akhmedov Nurshod, Mirzaliyev Sanjar

Zaripov Bahodir
Tashkent State University of Economics
Department of Digital Economy
Tashkent, Republic of Uzbekistan
amirbahodir@gmail.com

Akhmedov Nurshod
Tashkent University of Information Technologies
Department of Data transmission Networks and Systems
Tashkent, Republic of Uzbekistan
Axmedov.N.M@gmail.com

Mirzaliyev Sanjar
Tashkent Polytechnic University
Department of Mechanical and aerospace engineering
Tashkent, Republic of Uzbekistan
s.mirzaliev@tsue.uz

Abstract—*This article discusses the role of Internet networks and technologies in improving the quality of lessons, the concept and definition of cloud classroom, cloud classroom students' learning objectives and learning resources from the network, communication with teachers and other students through the network and the fact that the process of using it as a way to build one's own knowledge is presented, that the traditional online education system cannot solve the problem of overloading data in the learning mode, and so on and so forth. in problem solving this article offers an online learning system in a cloud classroom under a system of personal recommendations. The proposed system adopts an algorithm of recommendations for co-filtering, which helps to identify potential desires of users and thus complements the recommendations more precisely. This not only emphasizes the main position of personalized curriculum recommendations in the field of online education, but also meets the needs of a more intelligent teaching of cloud classroom of online teaching mode.*

Keywords—*cloud classroom, teaching mode, online learning system, smart learning, online learning platform, cost savings.*

I. INTRODUCTION

Like all industries in the world, the education sector is in the process of transitioning to the online. For example, during the pandemic COVID 19 the transition to the online system based on the Internet, brought number of economic benefits. It is proposed to use cloud technologies in the classroom to increase economic efficiency through the Internet [1]. The cloud class is a product of the efficient presentation of a large data warehouse with unique information technology advantages [2]. Today, along with the gradual and widespread adoption of new technologies such as cloud computing, big data, Internet and mobile computing, the pace of informatization in various economic and social fields is accelerating and providing general informatization of society. The revolutionary impact of information technology on education is becoming increasingly apparent. Classroom teaching is considered a key element of higher education, and the deep integration of information technology and classroom teaching is now the key to the comprehensive integration of information technology and education. It promotes the quality of education and ensures fairness and equality of higher education. At the same time, the cloud classroom will be able to set a personalized curriculum for students, allowing for continuous learning without time and space constraints [3]. It introduces some new learning methods based on online learning, such as mobile learning, ubiquitous learning, and virtual learning, which significantly improves students network-based learning methods, so students can freely choose their own satisfactory methods. Now in-depth study can really mean learning.

With the convenience, economy, high scalability and other advantages, cloud computing enables the enterprise liberation from the heavy pressure of the IT infrastructure management and maintenance. Cloud computing change the Internet into a new computing platform, is a business model that achieve purchase on-demand and pay-per-use in network, has a broad development prospects [1]. This will lead to the solution of financial problems in the field of education

In the world of information technology, cloud computing has generated a remarkable impact all over the globe as the most advancing technology. It will be a major breakthrough for storing data and accessing the Internet from different locations [18]. However, the cloud covers numerous models and features, to access and secure data and internet from various devices and locations such as educational sectors. In addition, it also provides exceeding data storage and speed of connectivity, which is essentially required by the educational institutions. Pluzhnik and Nikulchev [19]

The training content carrier is a cloud-based learning platform that is a course management system platform. The student downloads and installs the platform client and can access the training course platform according to a specific account password. To achieve teaching and learning, both teachers and students need access to a cloud-based learning platform. Teachers access the cloud classroom-learning platform, create and upload the curricula and instructional videos that students need to learn online and offline. Teachers can manage courses, evaluate teaching, monitor the learning process of students, correct homework, conduct online question-and-answer sessions and discussions. Students can

International Journal of Academic Pedagogical Research (IJAPR)
ISSN: 2643-9123
Vol. 5 Issue 8, August - 2021, Pages: 33-40

access the cloud classroom-learning platform, which provides quick access to the system, resource allocation, learning video tutorials, practice exercises, teacher-student interactions, and more. It is necessary to organize the process of unification, which is shown in Fig. 1.

II. CLOUD CLASSROOM TEACHING MODE

Research on a personalized referral system and online learning has shown that users can conduct multiple learning sessions on the same platform, avoid time and space problems, and increase student learning efficiency. Selecting an appropriate recommendation algorithm is the foundation of smart teaching in an online classroom [4]. Based on data collection and processing technology, this article analyzes the relationship between the individual recommendation algorithm and the cloud class.

A. The cloud classroom online learning platform not only creates an online learning environment, but also has the following features:

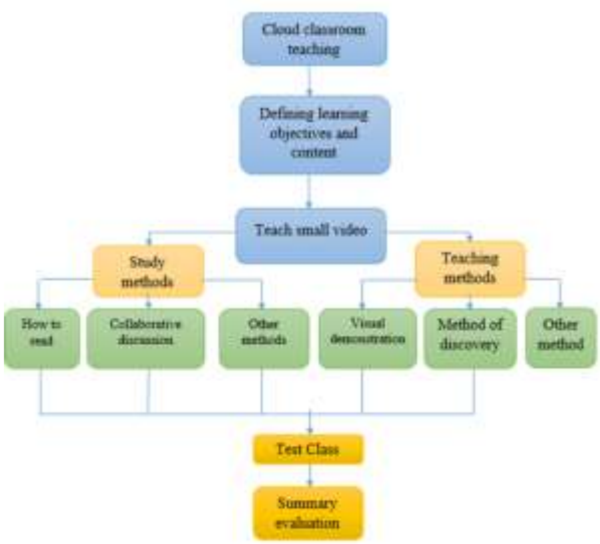

Fig. 1. *Diagram of the process of implementing teaching in a cloud classroom.*

- Teachers and students do not have to spend a lot of time mastering the basic operations of a cloud classroom.
- The cloud classroom has a powerful teaching function. The teacher flexibly organizes the various functional modules in accordance with the current mixed needs of learning to convey the content of teaching, to support teaching activities, to evaluate the effectiveness of teaching and to achieve the set learning objectives possible.
- The cloud class has powerful interactive features. The cloud classroom online learning platform forum, chat room, notification, homework and other modules help to develop the interaction of mixed learning. Teachers can use these functions to organize collaborations, share discussions and organize tasks, and improve the interaction of online learning. This means that interactions between teachers and students, as well as students interacting with each other, can be easily accomplished. The online learning platform in the cloud classroom is shown in Fig. 2.

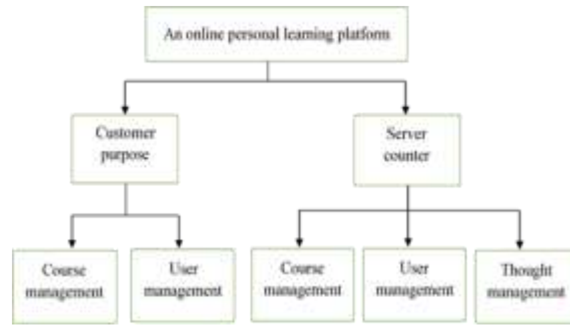

Fig. 2. *Diagram of the process of implementing teaching in a cloud classroom.*

III. ONLINE COURSE OPTIMIZATION ANALYSIS

With the rapid growth of online education, data has moved from text form to multimedia form, with images, audio, video and live broadcasts, and a number of other conveniences. The quality of information and how to determine useful information has become a pressing issue. The accuracy and speed of information retrieval are especially important at the rapid pace of work and study [5]. Providing accurate and effective information to students in such a social environment has become the most important task of online teaching in the cloud classroom. In response to such situations, the local cloud class website provided a few simple answers, but in most cases, users are not very clear about what they actually want. Many of the above problems have contributed to the development of evolving technologies, and as a result, personal recommendation techniques have been created to address the accuracy and efficiency of data acquisition. The basic idea is to recommend information that users really need to match the characteristics of different users. To achieve this, many cloud class websites have personal recommendations as key recommendations to enhance the user experience. Personal recommendations are also of great importance for an online learning platform as an effective means of resolving information overload. Currently, most personalized recommendation systems are adopting a recommendation algorithm for co-filtering. The biggest advantage of the co-filtering recommendation algorithm compared to other traditional algorithms is that it can use unstructured objects. Most personalized recommendation systems adopt a combined filtering recommendation algorithm, which is the most popular recommendation technology and the most widely used referral technology.

IV. Algorithm Models

A. Research in the personalized recommendation system mainly consists of:

- User-based recommendation algorithm [7].
- Content-based recommendation algorithm.
- Collaborative filtering recommendations algorithm.

Through in-depth study of several algorithms, through repetitive experiments, we combined several system algorithms that were recommended to give users recommendations for individual courses, and the model structure is shown in Fig.3.

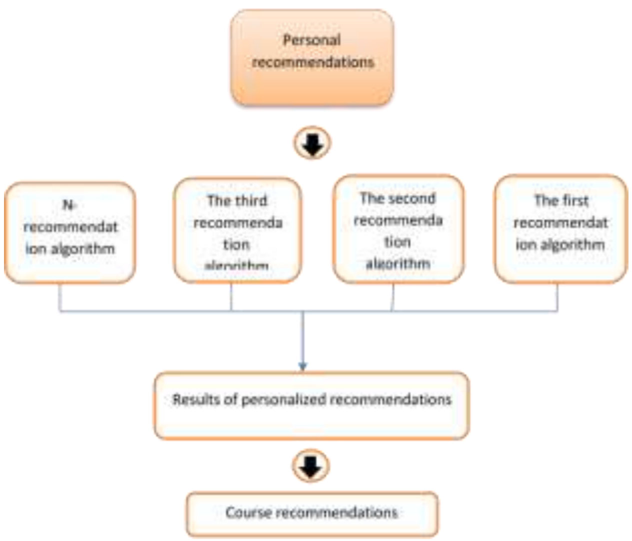

Fig. 3. *Model diagram of a set of individual recommendations algorithm.*

V. User-Based Recommendations

The purpose of the system is to recommend the interests and things that users need to trust in different media to reach out. There are currently three ways to do this:

- The first is to recommend similar products to users through their past posts and on the basis of their ambiguity.
- Second, find users with similar goals and recommend other similar user preferences to the target users.
- Third is to connect users and things through certain features and the goal is to recommend things to users with similar features.

Properties can be represented in a variety of ways, for example, an attribute model of an object or a closed semantic vector, followed by a label. A tag is a non-hierarchical structure that describes information and describes the semantics of an element. Depending on who defines the project, tabbed programs are usually divided into two types. One is a label provided by an official author or expert, and the other is an individual user project label, i.e. a UGC (Unique Games Conjecture) label application, which is an important way to express user interest and element semantics. If the user tags something, the behavior describes the semantics of the element while describing the user's preferences, thereby associating the user with the element [8].

VI. Content-Based Recommendation

It is one of the first developments of content-based recommendation technology. The essence of the recommendation system is to recommend information resources with similar content. Similar projects can be recommended to target users, who can achieve the effect of specific recommendations. The recommended process of this technology is shown in Fig. 4. First, it is necessary to study the information about the user's past behavior. After the analysis, the user interest model is structured according to the content. Through the process of similarity with other projects or other models, this model is constantly trained in this process and the results of the similarity calculation are used to make clear recommendations. This technology is advanced in the field of providing information at the text level [9]. The recommendation process is simple and straightforward, which saves complex operations and plays an important role in recommending textual information. The content-based recommendation procedure is shown in Fig. 4.

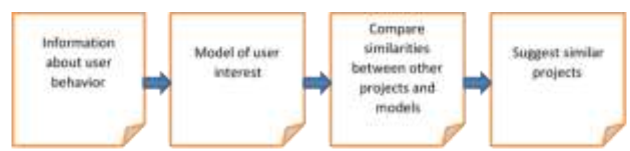

Fig. 4. *Content-based recommendations flow chart.*

VII. Collaboration Algorithms Based On Recommendation

Shared filtering is the most popular recommendation algorithm. The basic idea is that users who previously had the same or similar interests will have the same interests in the future. The proposed algorithm for the base model is based on the sample data. The user evaluation matrix is used to predict the model parameters, the recommendation model is trained, and then the real-time recommendation forecast on the user parameters is performed. The basic idea of decomposition of matrices is to approximate the initial screening matrix with two low-level matrices.

The approximate loss function minimizes the sum of the quadratic errors between the prediction matrix (the product of two sub-order matrices) and the initial fractional matrix. Shared filtering finds neighbors with the current user based on user rating data and then recommends relevant items that are preferred for the current user by neighboring users [9]. The basic idea of the shared filtering method is that if a user makes a good impression on the same project, a user with similar interests may also have a certain interest in the project. First, the algorithm collects and analyzes information about the user's historical behavior and project evaluation, and obtains information on the user's interests. The system then searches for users with similar interests to the target user, calculates their

International Journal of Academic Pedagogical Research (IJAPR)
ISSN: 2643-9123
Vol. 5 Issue 8, August - 2021, Pages: 33-40

similarity in some way, and selects the user with high similarity as the target user's neighbor points to implement the target user's recommendation.

This paper adopts a collaborative filtering recommendation algorithm based on content and a hybrid optimization recommendation algorithm based on it. The content-based collaborative filtering recommendation algorithm uses a scoring matrix to calculate similarities between users or projects and recommendations based on similarities between projects or users. This calculation sequence is done using the Pearson correlation coefficient formula.

$$\sin(u,v) = \frac{\sum_{i\epsilon I_a{}^\wedge I_v}(r_{u,i}-\bar{r}_u)\cdot(r_{v,u}-\bar{r}_v)}{\sqrt{\sum_{i\epsilon I_a{}^\wedge I_v}(r_{u,i}-\bar{r}_u)^2}\cdot\sqrt{\sum_{i\epsilon I_a{}^\wedge I_v}(r_{u,i}-\bar{r}_u)^2}} \qquad (1)$$

As mentioned above, through the Pearson correlation coefficient, we identify and account for similarities of users when we create a cloud class. Exactly the Pearson correlation coefficient corresponds to the co-filtration recommendation.

In general, ($r_{u,i}$ -$\bar{r}_u$) ($r_{v,u}$ -$\bar{r}_v$) $r_{u,i}$ and $r_{v,u}$ are positive if their means are unilaterally similar. Thus, the correlation coefficient is positive if $r_{u,i}$ and $r_{v,u}$ are simultaneously similar or different from their respective means, and $r_{u,i}$ and $r_{v,u}$to be similar on opposite sides of their respective means, the correlation coefficient will be negative (anti-correlation). Also, the stronger the similarity, the greater the absolute value of the correlation coefficient. The goal is that users who previously had the same or similar interests will have the same interests in the future. This process is modeled using the Pearson correlation coefficient.

- Similarity Of Cosine:

$$\sin(u,v) = \frac{\bar{u}\cdot\tilde{v}}{\|\bar{u}\|\cdot\|\bar{v}\|} = \frac{\sum_{i\epsilon I_a{}^\wedge I_v} r_{u,i}\cdot r_{v,i}}{\sqrt{\sum_{i\epsilon I_a{}^\wedge I_v} r_{u,i}{}^2}\cdot\sqrt{\sum_{i\epsilon I_a{}^\wedge I_v} r_{v,i}{}^2}} \qquad (2)$$

- Accuracy Of Cosine Similarity:

$$\sin(u,v) = \frac{\sum_{i\epsilon I_a{}^\wedge I_v}(r_{u,i}-r_i)\cdot(r_{v,i}-r_i)}{\sqrt{\sum_{i\epsilon I_a{}^\wedge I_v}(r_{u,i}-\bar{r}_i)^2}\cdot\sqrt{\sum_{i\epsilon I_a{}^\wedge I_v}(r_{v,i}-\bar{r}_i)^2}} \qquad (3)$$

Sin (u, v) represents the similarity between the users u, v, IU, IV, respectively, representing the set of objects collected by the user u, v.

- Designing An Optimization Algorithm:

A user-based collaborative filtering method is used to manage the target users past behavior. Projects are reviewed and collected, users get information about what they like, collect preference information, then search for users with similar preferences in the system and identify similarities between users. Then, the specified number of adjacent users is captured in the order of similarity magnitude, and the target user's scores on the object are predicted according to the neighboring user's rating value for a particular item. After enumerating the structure, the user is asked to separate the element with a higher estimated score [11]. Since there are no complex limitations, it is possible to adapt to many situations and determine the preferences of users using many abstract projects. User rating data that uses a user-based shared filtering method is an exact value. Identifying similar users of the target user is the most important part of the process and is a prerequisite for prediction and recommendation. Taking into account the above, the design of the optimization algorithm is carried out by the formula of cosine similarity.

- The Similarity Of Cosine:

$$sin(u,v) = \cos(u,v) = \frac{\sum_{i\epsilon I_v} r_{u,i}\cdot r_{v,i}}{\sqrt{\sum_{i\epsilon I_u} r_{ui}}\sqrt{\sum_{i\epsilon I_v} r_{vi}{}^2}} \qquad (4)$$

- Altered Cosine Similarity:

$$sin(u,v) = \frac{\sum_{i\epsilon I_m}(r_{ui}-\bar{r}_u)\cdot(r_{vi}-\bar{r}_v)}{\sqrt{\sum_{i\epsilon I_u}(r_{ui}-\bar{r}_u)^2}\cdot\sqrt{\sum_{i\epsilon I_v}(r_{ui}-\bar{r}_v)^2}} \qquad (5)$$

- Pearson Similarity:

In practice, there are often two users with the same sentence in the same project. But there are some differences in the score. Pearson's similarity formula can be used to resolve disagreements between users. In this case, when calculating user similarity, it is necessary to consider that the data in the previous rating entry has a linear relationship. If present, the similarity is confirmed; if not, the similarity is canceled. Compared to the modified cosine similarity, the former is based on scoring elements that are frequently used among users, and the latter is based on the user's own scores. The calculation formula (6) is as follows:

$$sin(u,v) = \frac{\sum_{i\epsilon I_v}(r_{ui}-\bar{r}_u)\cdot(r_{vi}-\bar{r}_v)}{\sqrt{\sum_{i\epsilon I_m}(r_{ui}-\bar{r}_u)^2}\cdot\sqrt{\sum_{i\epsilon I_v}(r_{vi}-\bar{r}_v)^2}} \qquad (6)$$

The system uses a collaborative filtering-based recommendation algorithm and evaluates neighboring users according to the target user's search content, and recommends a user-appropriate course based on past entries from similar users.

VIII. DESIGNING AN INTELLIGENT LEARNING SYSTEM

To design a smart learning system, we first need to plan the operating environment, the software, and the programming language in which the software should be designed.

1) *System Development Environment*

a) Operating system: Windows 10.

b) Language of development: C #, HTML_5, Python.

c) Development tools: Microsoft Visual Studio 2017, HBuilder.

d) Database version: SQL Server 2014.

e) Server version: Apache 5.1.28-rc-community.

2) *System Platform Design*

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This research is a personalized online learning platform based on collaborative filtering algorithms. The main goal is to break the time and space constraints, increase user learning methods, and use the enthusiasm of new users to increase user learning efficiency [12]. Online learning is a popular learning method that allows students who do not have the time or attend face-to-face courses to learn and acquire the knowledge they need through online courses. It is also the most widely used form of education during the COVID-19 virus, which is very common in the world today.

The design of each functional module includes login module design, teacher data display module design, course data display module, and online live course functions:

a) Login module design: The login interface identifies the user registered. The registered user enters the verification login name, password and verification code. Unregistered users must register and choose the identity of the teacher at registration. Once verified, registration will be successful.

TABLE I. LOGIN MODULE DESIGN

Attributes	Special content	Description
participants	Student number	Use the student number to differentiate each student
	Log in	Student access, academic department or other modular behavior
	Appearance	Students view course content, learning activities or notifications, content in the statistics module
Web	Comment	Student comments about the forum
	Send	The student is handing out assignments
	Download	Curricula and other activities for students to download

b) Teachers data display module design : Information about teachers included in the database is displayed in the module. The student can click on the teacher's picture to access the teacher information page and intuitively see the teacher's style and the teacher's teaching experience. The direction of the lecture and the operation are convenient so that the student can understand the required information.

TABLE II. DESIGNING A TEACHER INFORMATION MODULE

Attributes	Special content	Column Header Goes Here
	Course	Permission for students to enter the course, course ID
	Course department	In the resource module, the student enters the unit, unit ID
	Course programs	The program ID that the student learns in the resource module
Object	Learning activities	Learning activities are reviewed by the student
	Notice	The notice is intended for student review
	Operation	Student's work number
	Member	Member module ID
	Statistical report	Statistic module identifier

c) Course information module design: Course information entered into the database is displayed on both the teacher's login page and the student's login page [12]. Students can intuitively view course name and speaker information and basic information through course information.

TABLE III. COURSE INFORMATION MODULE DESIGN

Project	Claim	Media form	Attributes
Course introduction	The basic information of the course includes specialties, hours and credits, the essence and features of the course, materials and reference categories suitable for the course.	Text	Must choose
Course guide	Course teaching methods, teaching activities and educational support services	Text	Must choose

Course content	The class plan defines the teaching content of the course in the form of a plan, and its content should include the lesson goal, the teaching task, the structure of the teaching content, the goal and task of the module or unit aspiration, the teaching activity. and procedural requirements of the course.	Text	Must choose
Training schedule	The teaching calendar is a clear plan for the organization of course teaching, which should clearly define the learning process, teaching content, homework, teaching methods, and so on.	Text	Must choose

d) Online live course module design: All information about the live online course is displayed in this module. In this module you can check the course information [14 15]. You can get acquainted with the beginning of the online course, the teacher of the lesson, the time of the lesson and the hours of training, as well as the tuition fee. Students can join the online course purchase.

TABLE IV. ONLINE COURSE MODULE

Project	**Claim**	**Media**	**Media**
Purpose of the study	Ensuring clear, specific objectives of the module	Text	Must choose
Knowledge structure	Provide the basic knowledge points and content organization structure available in the game of chess and use the knowledge structure diagram to show the concept map.	Picture	Must choose
Learning advice	Provide valuable learning suggestions and support on the basic and challenging content of the course, and have clear guidelines on different learning activities and teaching methods that are detailed and relevant.	Text or video	Must choose
The content of education	The content of the course is presented in multimedia format, for example, text, graphics / images, sounds, visual images, animations and more. The media format is suitable for students and learning content.	Multi media	Must choose
Video training	Full instructional video of each knowledge point (full coverage of lesson content), recorded by the training department or knowledge point, encourages the use of micro-video teaching video, each video No more than 15 minutes	Multi media	Must choose
Course programs	Provide students with curricula for their own learning	Multi media	Must choose
Example of teaching	Encourage students to use case studies for their learning and provide at least 10 series of text cases or videos	Text	Must choose
Expert report	Provide students with previous lectures related to the course or at least 4 video network connections	Video	Must choose
Summary of the module	Summarize the contents of the module	Text	Must choose

Practice / self-examination	Relevant exercises and answers are provided in the basic and challenging textbooks: each module should provide appropriate online tests to support students 'online self-testing: appropriate for higher-level learning objectives providing upcoming trainings, creative work, or tests.	Text	Must choose
Resources for students	Provide resources such as electronic documents / directories / websites related to the content of this module for students to read and read independently	Text	Must choose

e) Data analysis module: Building a system in cloud class data analysis includes two modules on the general status of the cloud class and the use of the cloud class. The general state of the cloud classroom includes curriculum installation [16]. The three sub-modules include two sub-modules, such as classroom construction and resource building, cloud classroom use, teacher participation, and statistical analysis of student behavior as in Fig. 5. The data visualization system can divide the cloud classroom into five visual modules: curriculum, classroom, resources, teachers and students.

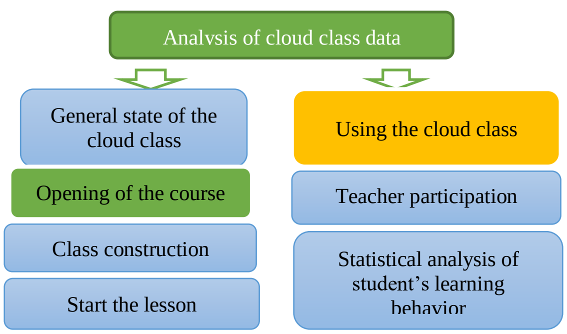

Fig. 5. *Data analysis module diagram*

f) Designing a Course Recommendation Module: The course recommendation includes two recommendations: recommendations for performance courses and recommendations for personalized courses based on collaborative filtering algorithms. In this module, the current multi-processing points are selected by calculating the number of times the course is used, and the active points are recommended on the home page [17]. It also uses a correlation algorithm to evaluate neighboring users based on each user's search content, and recommends appropriate courses to users based on the search content of similar users.

IX. Conclusion

The cloud classroom is an effective, convenient and real-time interactive classroom-learning tool that emerges in the context of big data and the communication between students and teachers is well organized. It has the features and advantages of information technology and attracted wide attention as soon as it appeared. With the widespread popularity of mobile Internet and smart terminals, the Internet has become a new trend in economic development. Online education and personal learning have emerged in our lives. Under the dual pressure of work and study, the implementation of individual recommendations of educational resources has become a major problem to be addressed in online education. A personalized referral system is a key technology for solving a cognitive overload or travel problem when users study online. This approach can be applied from primary education to higher education and even in prisons. This paper explores a system for recommending personalized training programs based on a user-generated filtering algorithm. The initial recommendation and prompt recommendation of the desired course was obtained, which laid the foundation for individual training. The advancement in technology means that new ways are coming up that students can access learning resources easily and contact their educators for support. This way, students benefit from these interactions, as they no longer feel abandoned. The greatest concern remains the security of the information on the cloud, considering the sensitivity of the information shared between learners and educators.

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