Distributed Distribution and Scheduling of Teaching Resources Based on a Random Matrix Educational Leadership Model

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This paper proposes a distributed distribution and scheduling of teaching resources based on the random matrix educational leadership model. The system adopts a distributed structure based on scheduling servers, and each distribution centre can independently provide personalized distribution services to resource users under the domination of the scheduling server. This paper proposes a professional system-based teaching resource model SLRM based on the SCORM model to establish a common architecture framework and a hierarchical description of teaching resources. Secondly, to reuse teaching resources at multiple levels and realize the sharing of teaching resources, this paper analyzes the LOM learning object metadata standard, Dublin Core metadata standard, IMS learning resource metadata specification, and IMS learning resource metadata specification. Based on the analysis of the LOM learning object metadata standard, Dublin Core metadata standard, IMS learning resource metadata specification, and education resource construction technical specification CELTS-41, this paper proposes the metadata representation method of network teaching resources based on a professional system. The system adopts ant colony clustering and other supporting technologies as personalized services. In addition, the task scheduling optimization based on the ant colony algorithm is adopted in the scheduling server, which effectively solves the distribution problem between resource user groups and distributed distribution centres, thus realizing the system load balancing. Finally, simulation and comparison experiments confirm the effectiveness of the distributed distribution system of educational resources. The practical application of the system will form a new and effective resource distribution service system, so this system has excellent use-value and promotion significance.

Povzetek: Študija predstavlja porazdeljeno distribucijo in razporejanje učnih virov na osnovi modela vodenja izobraževanja z naključnimi matrikami. Sistem uporablja porazdeljeno strukturo, kjer vsak distribucijski center samostojno ponuja prilagojene storitve uporabnikom virov pod nadzorom strežnika za razporejanje. Uporabljeni so modeli SLRM in SCORM za hierarhično opisovanje učnih virov, analize standardov metapodatkov ter algoritmi kolonij mravelj za optimizacijo razporejanja nalog.

1 Introduction

With the rapid development of networks and the wide application of information technology in all walks of life, education informatization has been developed rapidly. The informatization of education has led to the mediatization of educational resources and diversification of teaching methods, and the implementation of education informatization is inseparable from a particular hardware environment, rich teaching resources, and a team of teachers who are well adapted to informatization teaching [1]. After years of construction, specific results have been achieved in all aspects, and the shortage of educational resources has been alleviated to a certain extent. However, a great feature of the distribution of educational resources is that some originate from companies and research groups specializing in the construction of educational resources [2]. With the original accumulation of their resources and the growing customer base, the problem of distribution of educational resources and timely updating of resources has emerged, and the ever-increasing demand for help from users and the backward distribution mode of educational resources has become a current educational informatization process [3]. The growing demand for resources from users and the backward educational resource distribution model have become an urgent problem in the current method of educational informatization and a bottleneck that restricts the further development of educational informatization.

At present, most educational resource construction manufacturers tend to focus only on the number of resources, the size of the user group, the sales performance of software products, etc., but seldom pay attention to the effective update of resources, coupled with the duplication of educational resources construction, etc., resulting in the update and upgrade of resources is often in a weak position, or even ignored. The disadvantage of this form is that the update cycle is too long; usually, it takes a semester or even half a year to update once [4]. And because of the timeliness of teaching resources, many are already facing the embarrassing situation of being eliminated before they are used, which eventually leads to wasting human and material resources. Lack of attention to the user's individual needs: the current resource distribution method often provides all the updated resources to the user, regardless of whether the user needs them or not, completely ignoring the user's individual needs characteristics instead of causing a burden to teachers and students, frustrating their enthusiasm to use multimedia teaching resources for teaching and learning [5].

There is an urgent need to design and develop an efficient educational resource distribution model to provide timely and comprehensive educational resource services to relevant academic institutions, schools, and students [6]. Education Resources Purvey System (ERPS, Education Resources Purvey System) is a resource supply model that provides timely, fast, and comprehensive educational resources in various media forms for resource demand users (schools, teachers, students, and relevant academic institutions) in a medium or several mediums integrated environment. In addition, the two significant factors affecting information processing and services are the processing speed of computers and network bandwidth [7]. With the development of hardware and network technology, the processing speed of computers is no longer the bottleneck of information processing and service [8]. Still, the main factor affecting the effective development of information service lies in the adequate bandwidth of the network and efficient information service mode. The solution of proper network bandwidth cannot be achieved overnight, which is determined by the actual situation of a country; at the same time, an efficient information service model can save bandwidth to a certain extent, so it is perfectly feasible to design and develop an efficient network-based educational resource distribution system under the condition that the customer environment is reasonably available [9]. In this paper, we analyze the current situation of the education resource supply model, apply the random matrix education leadership model, and combine the loosely coupled Web Service and XML technology to design and develop a highly reliable and scalable resource distribution system.

2 Related works

With the expansion of scholars' research fields on leadership and the shift toward a non-powered understanding of leadership, the study of college student leadership education has received extensive attention [10]. The area of leadership research has shifted from the traditional focus on leaders in the administrative system to managers in the corporate sphere and college student leadership education, and scholars are increasingly concerned with college student leadership education [11]. Related research is rapidly developing; from the dimension of leadership education for college students, the first concern is the reasonable understanding of leadership, that is, the question of what leadership theory is used for leadership education for college students [12]. Any educational practice is carried out under the guidance of relevant ideas. Without the guidance of relevant theories, the course will fall into blindness or even develop in the wrong direction. Therefore, for the development of leadership education for college students, the first concern is what leadership theory is used to guide the practice of leadership education to achieve the intended goal [13].

The construction of education informatization started late, which led to the lagging behind in the research on the sharing of teaching resources. However, with the development of network and information technology and the state's emphasis on education informatization construction, the construction and sharing of online teaching resources have developed rapidly, and fruitful results have been achieved in both theoretical research and practical exploration. Regarding academic research, representative research results are as follows [14]. Martono S and KHOIRUDDIN M summarize the achievements of regional sharing of teaching resources in colleges and universities in recent years based on the survey on the current situation of sharing and put forward countermeasures and suggestions for regional sharing of teaching resources in colleges and universities in terms of development strategy attention, efforts to promote and construction of long-term mechanism [15]. Jha S and Prashar D combined the current situation of digital teaching resources sharing in colleges and universities with the research on the current situation and constructed the regional sharing of teaching resources in terms of a sound guarantee mechanism, the establishment of the distribution centre, completion of the standard platform, creation of navigation service, and discussed the core problems in the construction of the sharing service system [16]. To realize the sharing of teaching resources, Jiang X combined the advantages and characteristics of the application of cloud computing and proposed the sharing scheme of teaching resources based on cloud computing [17]. The main problems encountered in the process of resource upgrading are the long resource update cycle, the relatively high cost of resource update, the need to be operated by special personnel, ignoring the personalized needs of users, and often providing all new resources to users regardless of whether they need them or not [18]. Many people have put forward their insights on resource construction and upgrading, such as: establishing a school interoperable resource-sharing method to encourage teachers to participate in resource construction and share them on the same platform, relying on the network environment to realize network-based automated resource upgrading services to reduce manual operations; it is essential to capture users' personalized needs when upgrading resources, improve the usefulness of resources and reduce the cost of upgrading resources for users, etc.

After the 1990s, schools established and accumulated many resource libraries, from courseware to ideas. However, most of the network education resources are isolated and scattered, the standards are not unified, and few of them can be used for communication and sharing

[19]. The construction and maintenance of resources are carried out independently by a specific department or unit so that resources cannot be shared between schools and students, or teachers can only get the help of their school, which makes the total amount of resources ample duplicated and redundant [20]. The resources available to individuals are limited and not of high quality; the result is that the resources built are not adapted to the teaching needs of most schools; for the reasons listed above, the utilization rate of teachers' resource libraries is reduced [21]. Still, in the usual teaching accumulation and use of resource library, teachers often collect suitable teaching materials and build up their resource library, which is closer to teaching and learning and contains the summaries of teachers' experiences for many years; such courseware is informative and of high quality, but because of the lack of communication and sharing platform and the limitation of teachers' information technology level, these resources are not available. However, these resources are only for my use because of the lack of communication and sharing platforms and teachers' information technology level limitations [22]. They do not keep up with technology development and new teaching trends. They lack the transformation from scientific research results to practical product storage and management of video information [23]. Most schools store their resource libraries on one or more computers, and the video screen resources occupy a lot of space. The managers have limited skills and lack the technology to compress further and encode the video screens. The existing networks and platforms are referred to or imitated by each other, the functional level is low and not innovative, and text media materials are commonly used; even in the form of streaming media, streaming media teaching resources cannot completely solve the problems people have in learning and need to be combined with other methods.

3 Design of a distributed distribution and scheduling system for teaching resources based on a random matrix educational leadership model

3.1 Random matrix educational leadership model construction

Stochastic matrix theory, in general, is the theory of randomized matrix processes; that is, this theory is the product of the combination of matrix theory and stochastic processes. At the same time, stochastic matrix theory is also an essential primary mathematical research discipline in the diversified field of stochastic statistics and data analysis engineering. With the advent of the era of big data, the face of statistics is gradually changing and is closely integrated with the fields of information and computing; it is one of the essential axes in data science.

Sample covariance matrix: Suppose the matrix$x_n = \{X_{I,J}\}_{nxn}$ where the elements $X_{I,J}$ are independently and equally distributed, the expectation$e(X_{I,J}) = 0$, and the variance $\sigma^2(X_{I,J}) = 1$.

$$s_n = \sum_{n=1} \frac{1}{n}(X_I + X_I^h) - \frac{1}{n}(x_n - x_n^h) \quad (1)$$

Where sn is called the sample covariance matrix of the matrix X. xi is the i column of xn and h denotes the covariance transpose $Marchenko - Pastur$Moore's law: If the random matrix is of order $N \times n$ when both$n$ and$N$ tend to infinity and satisfy $lim \frac{n}{N} = C$, and the mean is fixed to 0 for each random element in this matrix, the variance $\sigma^2 = 1$. Then one kernel density of the covariance matrix of the matrix X can be used to estimate the MP law according to which the density function converges.

$$f_{MP} = \sum \frac{\sqrt{(B + X)} + \sqrt{(X + A)}}{2\pi CX} \quad (2)$$

Single-loop theorem: a random matrix$x = \{X_{i,j}\}_{n\times t}$ is a non-$Hermitian$ matrix, the elements of which are all random variables and satisfy independent equal distribution, with expectation$E(X_{i,j}) = 0$, variance$\sigma^2(X_{i,j}) = 1$ on L non-$Hermitian$ matrices$X_I(1,2,\cdots,L)$, the matrix product is expressed as

$$X_P = \bigcap \frac{X_{u,i} - 1}{\sqrt{L - 1}} \quad (3)$$

Where$Xu\ i$ is the singular value equivalence matrix of xi . After obtaining xp and then normalizing the transformation, the standard matrix product is obtained, which is expressed as

$$X = \sum (X_{I,J} - n \times n) \quad (4)$$

When the elements Xsatisfy an independent equal distribution(i,i,d) with mean $E(X_{i,j}) = 0$ and variance $\sigma^2(X_{i,j}) = \frac{1}{n}$ and when both N and T are infinite and$c = n/t$converge to a constant, the spectrum of the eigenvalues X will connect to the one-loop theorem with the probability density function expressed as follows.

$$f_{esd}(\lambda - z) = \sum \frac{\lambda(2 - \frac{2}{L})}{\pi cl} + (1 + c)^{L-2} \quad (5)$$

Where$c \in (0,1)$. According to the above equation, the eigenvalues of the standard matrix product X will then be distributed on the complex plane as a circle, where the inner ring radius $(1 - c)L/2$ and the outer ring radius are 1. The characteristic diagram of the random matrix theorem is shown in Figure 1.

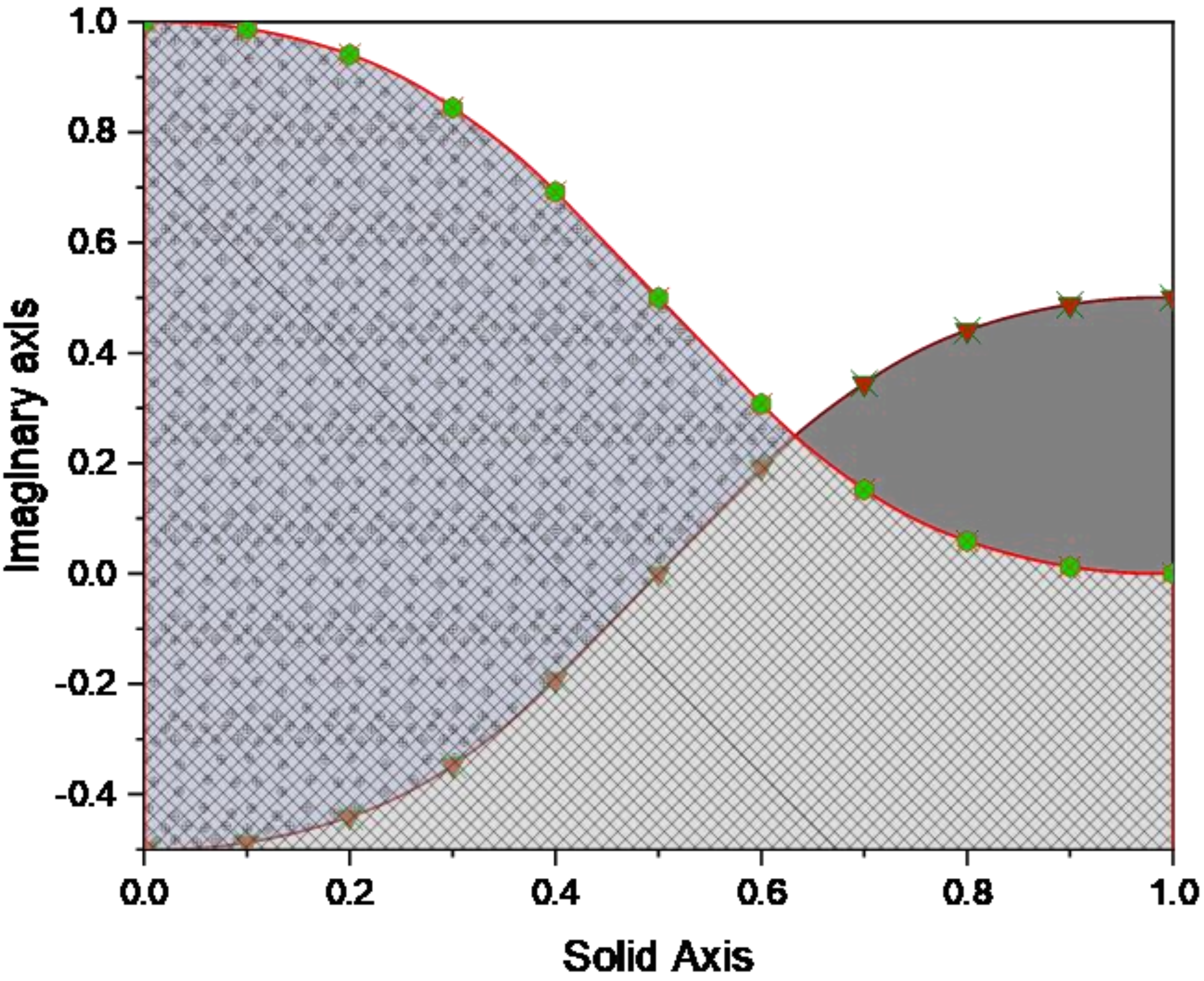

Figure 1: Characteristic diagram of random matrix theorem

Linear eigenstatistic: used to represent the status of the distribution of eigenvalues of a random matrix for n the random matrix of order X , defined as:

$$n_{\varphi} = \sum_{i=1} \frac{\varphi(\lambda_i - 1)}{N + 1} \quad (6)$$

In a distributed network, the degree of a node represents the degree of influence of the node represented by the node on the web. Specifically, suppose the degree of a node is more significant. In that case, the number of its neighbours is more meaningful [24]. It can communicate with all its neighbours, at which time the communication volume is more significant, and the influence on the network is also more considerable; conversely, if the degree of a node is minor, the number of its neighbours is smaller, and thus the communication volume is smaller, and the impact on the network is also more minor.

Since the leadership process is a very complex behaviour, focusing on one leadership skill alone cannot truly achieve successful and effective leadership. The "Leadership Model" has emerged as the basis for cultivating and improving organizational leadership by effectively integrating various elements. A leadership model is the sum of the best behaviours and leadership competencies required to support the organization in achieving its strategic goals and driving its growth under specific organizational, industry, and environmental requirements. The components of the leadership model include a leader's qualities, competencies, attitudes, and behaviours. If we compare it to an iceberg, qualities and competencies are the parts hidden beneath the surface, where qualities belong to the bottom layer and competencies to the middle layer, which is the foundation and determines outward attitudes and behaviours. At the quality level, good intelligence, personality, motivation, energy, endurance, and other intrinsic endowments constitute the primary conditions of a leader; at the ability level, strategic awareness, resource integration, team building, public relations activities, motivating others, language expression, etc. are the necessary abilities of a leader, and can be gradually formed and continuously enhanced through acquired exercise and training; attitude and behaviour are the natural elements of leadership, with high character Positive attitudes and behaviours, such as high character, passion, seriousness and responsibility, the courage to deny oneself, efforts to learn and innovate, good communication and understanding, can promote the full play of leadership. As a leader, it is essential to strengthen self-cultivation and achieve the organic combination of quality, ability, attitude, and behaviour to enhance one's leadership and lead the organization to sustainable development. The educational leadership model is shown in Figure 2.

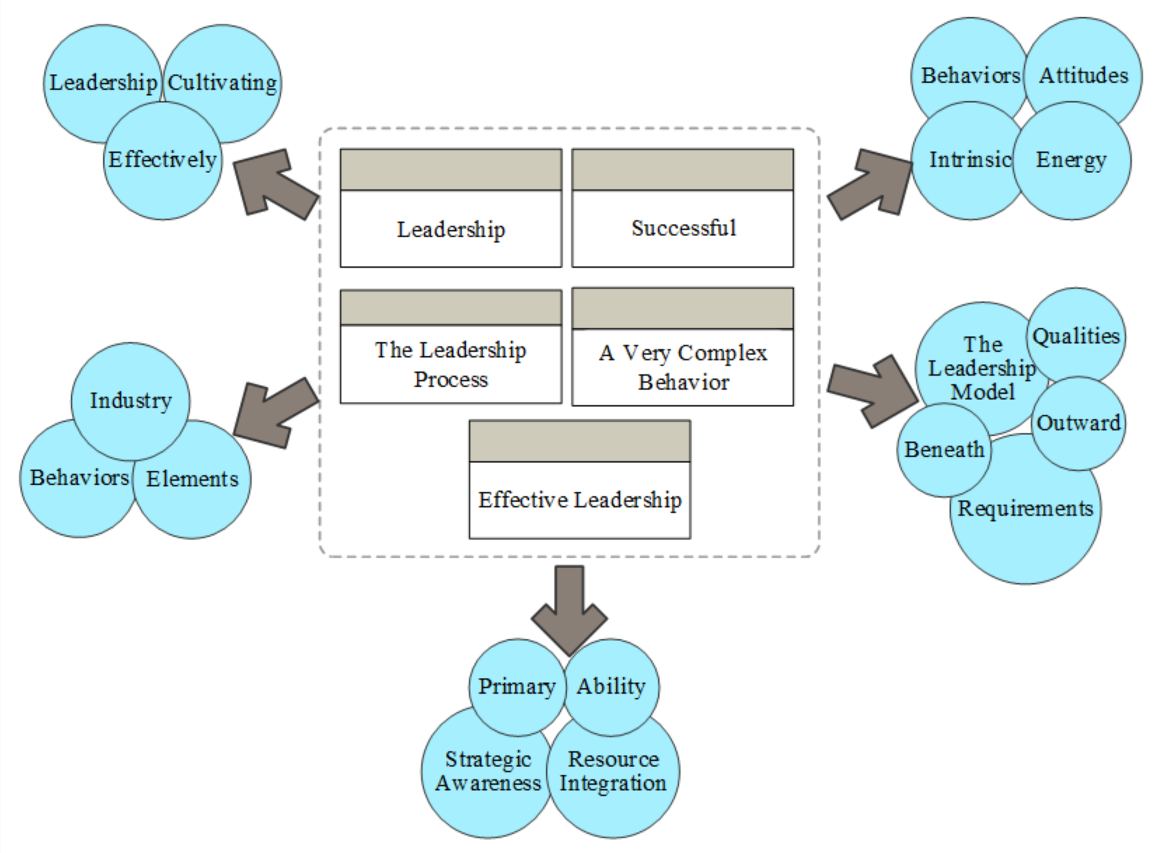

Figure 2: Educational leadership model

The emergence of distributed leadership is of great significance to the leadership practice of colleges and universities, as it enables more teachers with leadership ability and talent to undertake specific leadership tasks, maximizes the sense of ownership of teachers, and fully mobilizes their enthusiasm for their work. Henceforth, the principal will no longer be an isolated leader but a leadership team leader. The core of distributed leadership is to distribute power; the principal should disperse specific power to teachers who can lead so that teachers as leaders can have equal power and responsibility. This power often refers to the professional capacity of education and teaching. Teachers with outstanding teaching performance should be fully empowered to teach autonomously, and teachers should have professional autonomy in curriculum development and development, instructional design and implementation, and so on. Thus, teachers with excellent teaching leadership should be motivated to realize themselves and achieve others. Of course, when giving teachers professional authority in educational leadership, we need to adhere to the principle of incomplete trust, to "fully empower teachers with virtue and talent, to empower teachers with virtue and no talent in a limited way, and not to empower those without virtue and talent without virtue."

With the progress of society, the connection between college education and community is getting closer and closer as the indirect beneficiaries of college education, parents and community members need to consider running school together with parents and the community, not only to combine family education and community education with a college education to cultivate students but also to absorb parents and community members to participate in college education, to provide the main guarantee for creating an excellent nurturing environment so that parents and community members should also become leaders in the requirements of the distributed theory[25]. To strengthen the connection with parents and communities, principals need to consider two conditions: firstly, to create a platform parents and community members can be invited to participate in college education through thematic activities such as parents' meetings and college celebrations; secondly, to complement each other's advantages, parents can make full use of their different occupations and abilities to make up for the shortage of college education, like some parents may be firefighters, they can make use of their advantages to carry out fire safety education for students.

3.2 Design of distributed distribution and scheduling system of teaching resources

A distributed database system is a set of data sets that logically belong to the same design but are physically dispersed across multiple site nodes connected in a computer network. The data on each site is generally used to describe the real world of the site, the site-local database data sources, and most user applications reside typically in the area; that is, each site can independently process site autonomy, can perform local applications, in addition, the site can also perform global applications through network communication. For the user, a distributed database logically, like a centralized database, the user can perform international applications at any one site [26]. Distributed database system makes the system with appropriate data redundancy through replication, thus increasing the reliability and availability of the system; provides local autonomous data sharing and coordination between sites, thus making the system with fast data processing capability; in addition, through the combination of database technology and parallel processing technology, using the scale benefits generated by parallel processing of multiple processors can be in terms of resource distribution mode There are three main modes of resource distribution based on the Internet network at present as follows.

(1) Centralized distribution: The resource scheduling system holds all the resources and helpful information. The resource scheduling solution can be generated efficiently for a user request task, and the system is relatively easy to implement. However, when there are more users in the whole system, it is difficult for this scheduling system to handle the central load balancing problem, which is the bottleneck of centralized distribution.

(2) Layered distribution consists of a two-tier or multi-tier scheduling system. For a two-tier system, the scheduling system at the upper level is called the global scheduling system. The scheduling system at the lower level is collectively called the local scheduling system or the local scheduling system. The advantage of this structure is that it is easier to dispatch the system globally. The dispatch system at the upper level can control the system at the lower level, but it also brings some problems. When the system is extensive, the global system can become the bottleneck of the system, and once it is down, it cannot continue to operate. The composition of the hierarchical distribution scheduling system is shown in Figure 3.

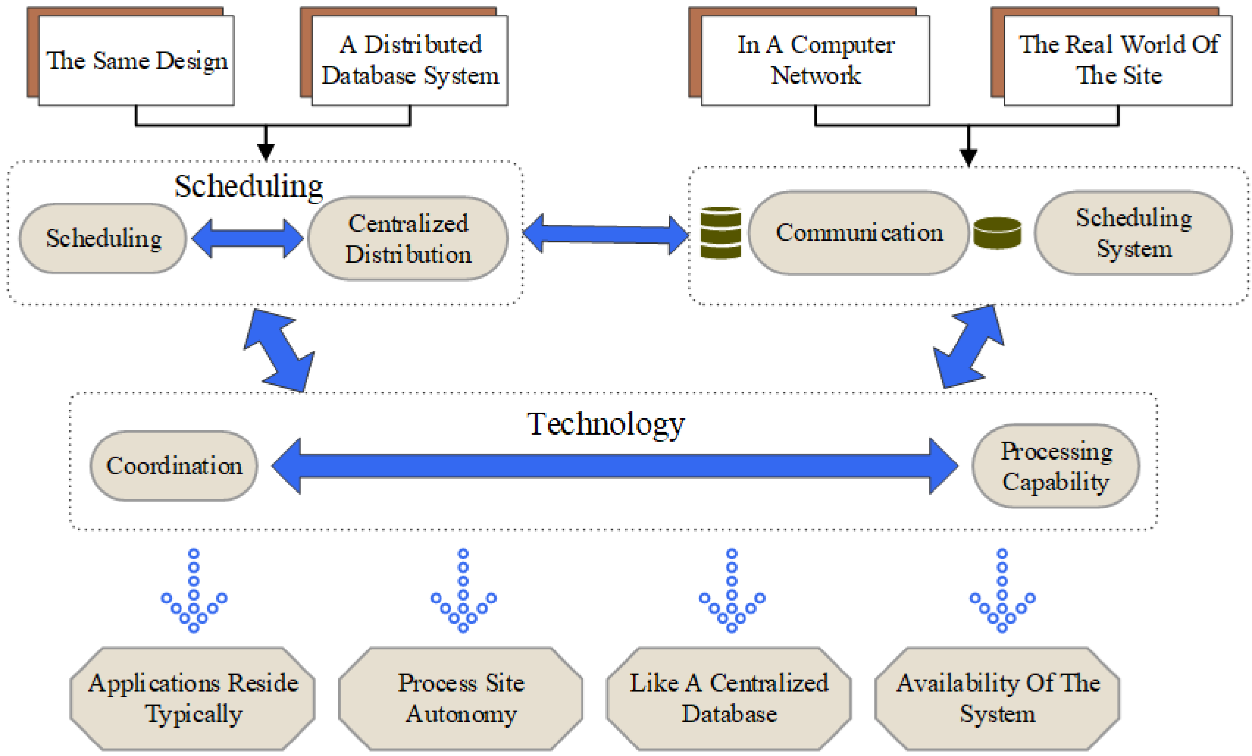

Figure 3: Composition of hierarchical distribution scheduling system

(3) Mesh distribution: The Peer-to-Peer principle is used in the system, and each node, is both a user and a distribution centre. However, it is found that individual resource users are very reluctant to contribute their hardware resources to this distribution model.

We measure each possible scheduling solution from the perspective of a specific task and select from them the scheduling solution that can best meet the requirements of the task, such as the requirement to minimize the execution time of the task, the need to reduce the amount of network communication resources occupied, etc. Measure each possible scheduling solution from the whole system's perspective, and select the one that can maximize the entire system's performance, such as throughput rate, load balancing, etc. By drawing an analogy between the network environment and the market environment, with the user as the buyer and the resource owner as the seller, the scheduling process is a transaction process between the buyer and the seller, and various models from macroeconomics and microeconomics are applied to the scheduling process.

In the system, server resource packaging automatically perceives the progress of server-side resource development and resource production requirements submitted by users or retrieved by the system, and automatically performs unpacking, compression, encryption and packaging through the perceived situation; server resource distribution monitoring will automatically perceive the release of updated resources after the completion of the packaging link, and perceive the user resource requirements through the interaction with user resource distribution monitoring, and after the user identity verification is passed Client-side resource distribution automatically distributes server-side resources to the client; client-side resource distribution unpacks the client-side resources after the interaction with server resource distribution, and the upgrade automatically senses the upgrade situation and the user's use of resources to automatically hook up the resources to the corresponding knowledge points defined by the user to complete the whole resource distribution. Among them, server resource distribution monitoring and client resource distribution monitoring provide a user interaction interface; through client resource distribution monitoring, the system completes the acquisition of basic initialization information, and server resource distribution monitoring can also modify the client information configuration according to the specific actual situation, and query statistics on resource distribution. The overall functional model of the system is shown in Figure 4.

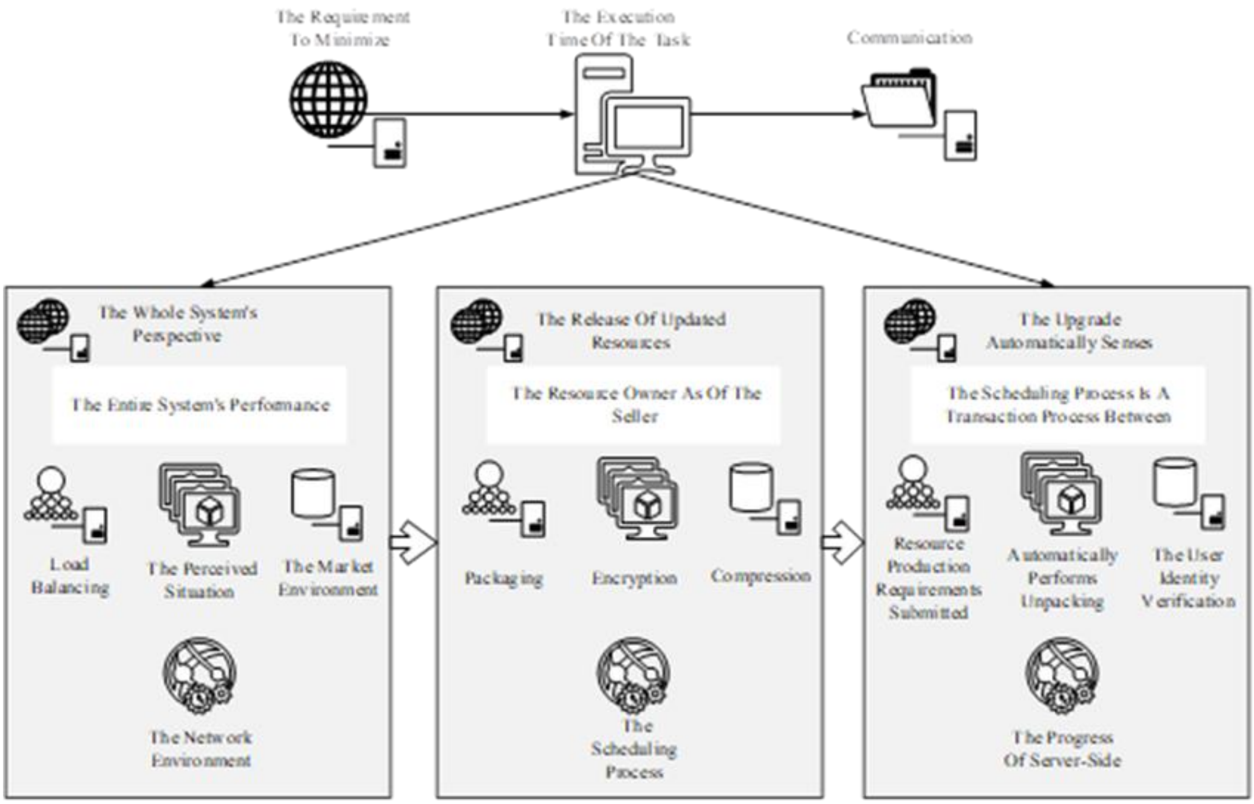

Figure 4: System overall functional model diagram

Retaining the needed resources in the massive data is fundamentally different from the traditional database query. Therefore, in the Hadoop cluster environment, all the resources uploaded to HDFS are stored in each other DataNode nodes, and the index files corresponding to the resources are also generated. To improve the speed and accuracy of recovery, the parallelized retrieval design uses a MapReduce program to parallelize the lookup on multiple data nodes. It then merges the retrieval results, encapsulates them into a specific format, and delivers them to the user. The whole process, from the keyword segmentation to the generation of retrieval results, is performed in a Hadoop cluster with parallel computation, and calls to Map and Reduce functions are executed. Specifically, when the retrieval request is reached, the JobTracker in the NameNode will distribute the retrieval function to each DataNode. Of course, the design of the retrieval function is also based on Map and Reduce [27]. Before executing the retrieval, the keywords entered by the user are shared among multiple Map/Reduce functions as global variables after binning. During the retrieval process, each DataNode executes the business logic in Map to retrieve the results on this node that match the keywords. The return of each DataNode finally requires a call to Reduce to merge the results, thus returning the retrieval results to the user.

4 Analysis of results

4.1 Analysis of the distributed distribution and scheduling model of teaching resources based on the random matrix educational leadership model

To test the performance of the ERDDS designed in this paper, simulation experiments are conducted for the personalized services and the task scheduling between users and distribution centres discussed in the article, respectively. Since both personalized services and task scheduling between users and distribution centres are implemented in the scheduling server, which provides access interfaces to resource users, distribution centres, and headquarters resource centres in the form of Web Services in the actual operation of the system, there is no visual interface. The visualization Windows program was used to conduct the simulation experiment to visually observe the system's processing and results. Users of various disciplines in the information technology platform universities were used as the simulation experiments, and the simulation experiments of personalized resource selection based on content filtering technology, interest group clustering, personalized resource selection based on collaborative filtering technology, and task scheduling between users and the distribution centre were conducted respectively.

Based on functional satisfaction, the system's performance must be tested to run smoothly and efficiently. The system is deployed in a LINUX environment. To monitor the status of the system during operation, this paper uses the neon tool monitoring, which can monitor CPU usage, memory utilization, disk read/write ratio, network I/O speed, etc., in real-time, and its monitoring results can display all-important performance optimization information on one screen and update it dynamically, which is beneficial to LINUX system performance data analysis. CPU utilization, memory usage, kernel, load balancing, network I/O, and disk I/O information can be seen, and the system status data shows that the system is running relatively smoothly and as expected. It is also possible to view the system operation status through graphical statistics, and the system data usage is shown in Figure 5.

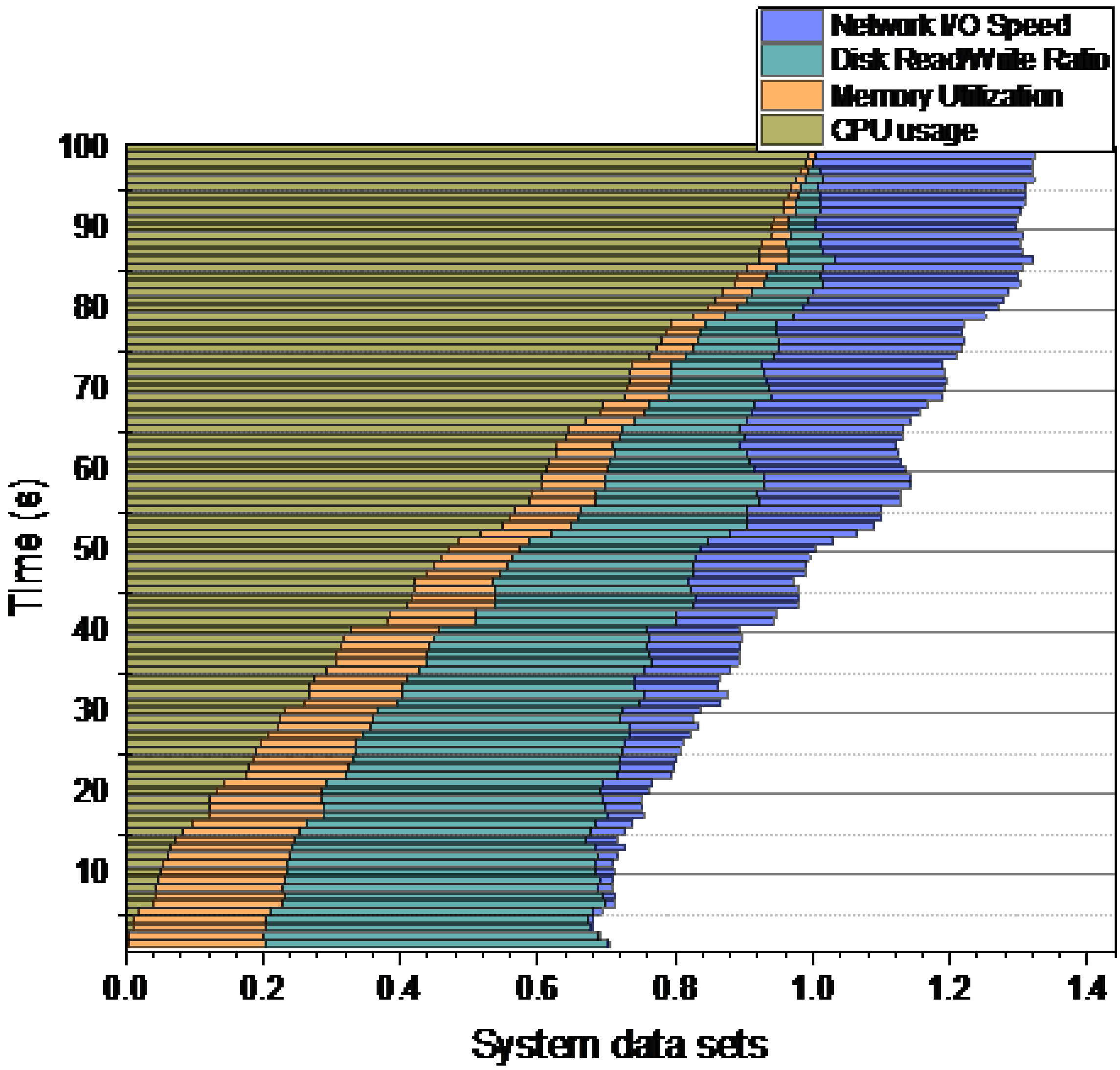

Figure 5: System data usage

To ensure the quality of service of educational resources in the process of inter-server database transmission, this study proposes and implements the optimal scheduling of resources based on the ant colony algorithm, simulating the business travel problem, treating each sub-node educational resource server as a school and the video files to be transmitted as educational resources, and deriving the optimal path for file transmission according to the ant colony algorithm, and then sending the video files to each server in this order. Node, and in the design and implementation of algorithm-based scheduling problem mainly faced and solved a problem: how to obtain the utilization rate of each educational resource server generally, a high concurrency, high communication server program occupancy rate will be apparent only after the program has been running for some time, once the utilization rate in about oscillation, is a danger signal, should consider selecting other servers, may be very dangerous. Therefore, monitoring and evaluating the ease of use of each partner school's educational resource server management and the operating system selected is essential.

Stress testing is also an essential part of software testing. Stress testing can ensure that the software can generally respond to the increase in the number of accesses under normal function and then obtain a boundary of access. The system is expected not to have abnormal software functions, crash, stop running, etc. Usually, the stress test has four specific aspects: CPU utilization, memory usage, total time spent, and average response time of the server, and whether these indicators will change significantly when the number of concurrencies increases dramatically. When the number of users was 1000, the system's minimum and maximum execution values were 35.234 and 97.622, respectively, and the final average value was 68.975. The average value of the system is 70.332, and the minimum and maximum execution values are 26.436 and 125.75, respectively. When the number of users of the system increases, the system can still run stably and respond accordingly. In the process, the time consumption does not increase significantly, and the performance continues to be stable. A comparison of the system performance test results is shown in Figure 6.

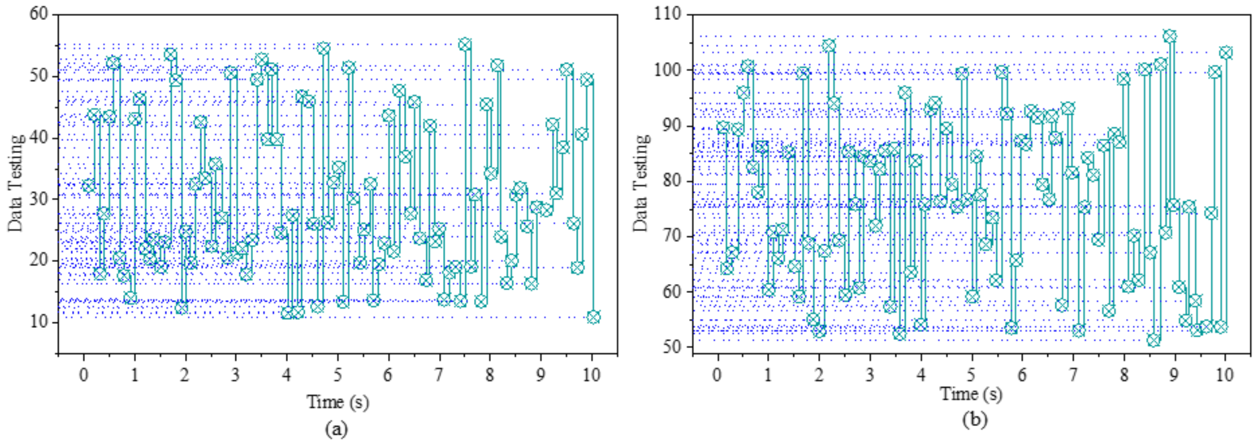

Figure 6: Comparison of system performance test results

The user information collection module collects local information on the client side and periodically submits user-related information to the proxy server. The user modelling module in the proxy server constructs and updates the user model and stores it in the information base [28]. The personalized service module provides related service policies and contents to users according to the user model. The advantages of this design structure are: firstly, since the personalization service is realized in the scheduling server, it can recognize collaborative personalization service in the agent's user group; secondly since the collection of user information is discovered in the client, it can collect rich and accurate information to build the user model. The disadvantage is that it requires the transmission of user information, which also tends to cause the violation of user privacy. Still, in the context of this system, resource users do not have strict requirements for the confidentiality of their interest information, so this structure is reasonable and feasible.

4.2 Distributed distribution and scheduling of teaching resources

This study adopts a two-stage education resource service model and strategy oriented to the learning process to realize the concept of distributed distribution and dispatching active service of teaching resources. Based on the matching mapping service model of learners' essential characteristics and interest preferences, a rule-based recommendation method is used to build a simulation platform for educational information resource push service. This stage mainly adopts the matching mapping relationship based on learners and resources. The cold start problem is effectively solved. To promote the formation of learning communities among learners, collaborative filtering can be used for group pushing and personalization for individual learners. Based mainly on learners' learning behaviour records and contexts, the tensor-based high-order singular value decomposition algorithm is used to achieve clustering and recommendation, which can effectively realize active pushing based on dynamic contexts and learning states. The database layer mainly stores student information, resource information, learner behaviour information, corresponding matching rules, etc. All the contents in the database are updated and dynamically evolved in real time. The student database stores the essential characteristics and preferences of learners and the learning context information; the resource database mainly stores the content, objective attributes, and semantic relations of resources; the behaviour database especially holds the learning behaviour records of learners at different times, space, and contexts; the matching rule library mainly covers some matching mapping relations and recommendation rules in the recommended learning system. To demonstrate the optimization performance of task scheduling based on the ant colony algorithm, the constants in the ant colony algorithm are initialized as $\alpha=2$, $\beta=2$, $\rho=0.1$, $Q=1$, $C=0.1$, and the number of iterations is 200 generations. The objective function results solved by the ant colony algorithm are shown in Figure 7.

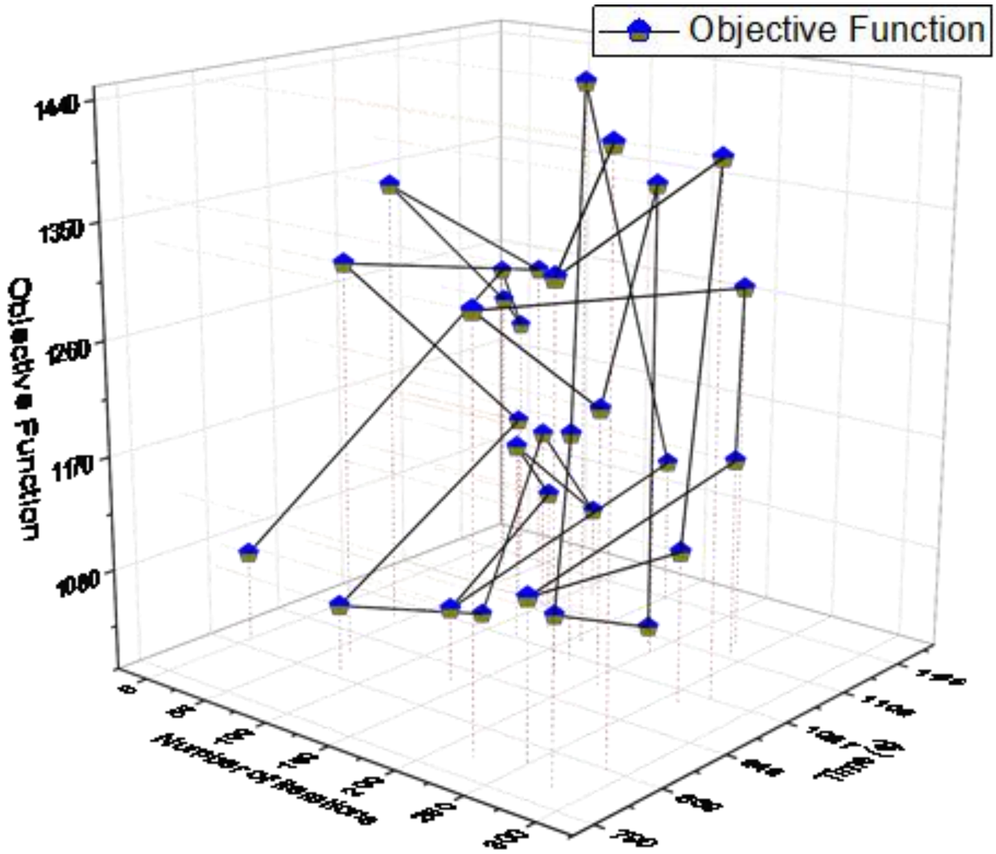

Figure 7: Result of objective function solved by ant colony algorithm

Based on the above-mentioned "learner-resource" fusion fifth-order tensor and the existing experimental data, this study writes a personalized recommendation system based on learner behaviour and context through the MATLAB platform to verify the performance of this recommendation system. The accuracy of the recommendation system based on learner behaviour and context is mainly affected by the historical learning trajectory data, so to explore the impact of different historical trajectory data on the results, this study designed three scales of data based on the original learning trajectory data. The size of different scales of data sets is mainly based on the average number of times each learner learns the resources. Fifteen times, an average of 20-25 times on scale 2, and an average of 30-35 times on scale 3. Then, depending on the scale, the learning records are randomly selected in the learning record set, and 80% of their learning records are used as the training set and the remaining 20% as the test set. In this H-scale dataset, the smaller the scale, the less likely the learners will learn the resources at different times, locations, and devices. This is more conducive to evaluating recommendation effectiveness for new users in specific contexts. The larger the size, the greater the likelihood of learners learning resources at different times, locations, and devices. This is more favourable for evaluating the recommendation effectiveness of old users in a specific context. To test the degree of influence of the data scale on recommendation results, this study conducted many simulation experiments on three data sets of different scales. The experiments show that recommendation effectiveness varies with the number of lists (top-K) on the same scale. The comprehensive comparison of recommendation results at different scales is shown in Figure 8.

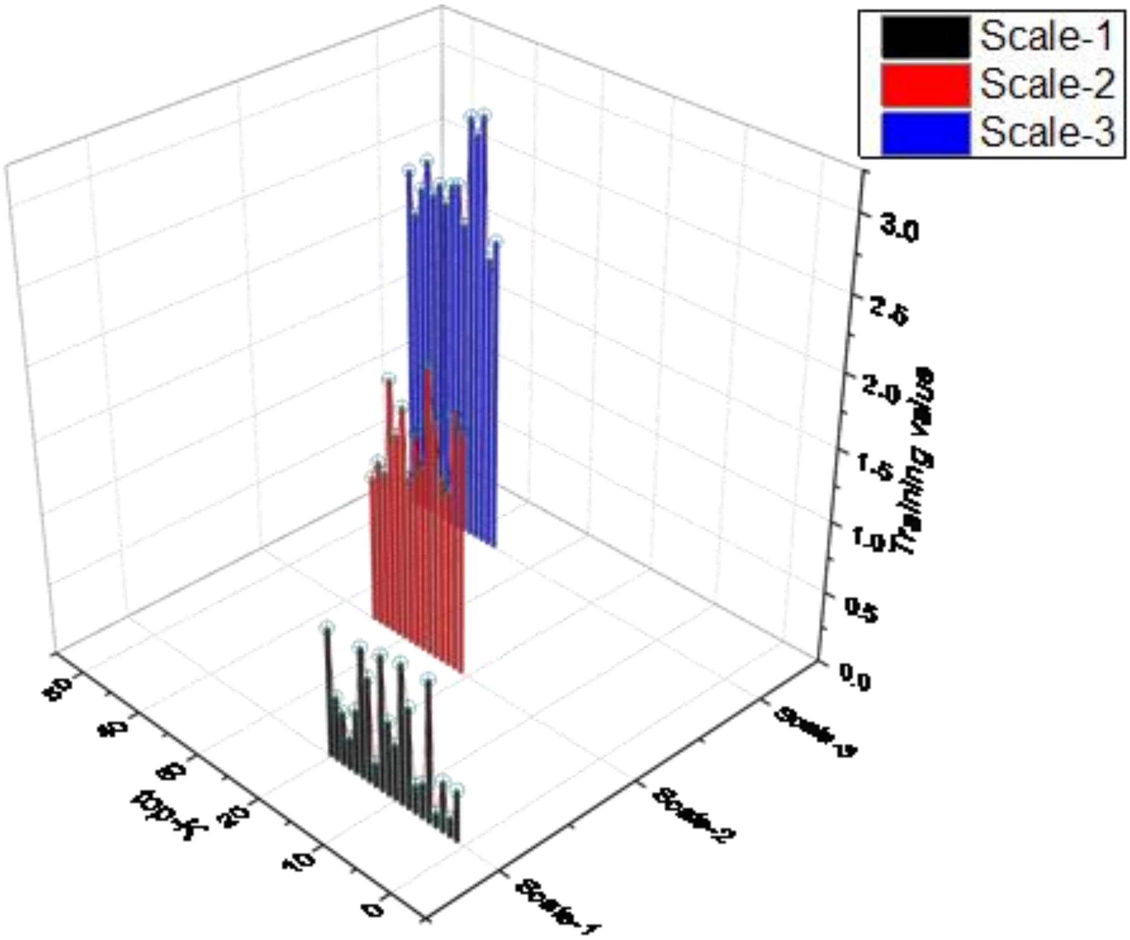

Figure 8: Comprehensive comparison of recommendation results at different scales

Teaching resource distribution requires calling MapReduce to find results matching keywords in multiple index files. Of course, the index is automatically generated by the system after the resource upload is completed. When performing parallelized retrieval, the main retrieval algorithm is encapsulated in the run method of HadoopSearch. After completing the return, the system will sort the retrieval results according to the keyword matching degree. The orderSearchResulto() method will be called and finally displayed to the user as a list. This paper optimizes the retrieval of HBase to achieve rapid distributed distribution and scheduling of teaching resources. It combines Solr's indexing mechanism to achieve perfect integration with HBase indexes, i.e., some (or all) columns of HBase table data are indexed into Soli index in near real-time, with high flexibility and scalability, and optimizes the customization of Soli's retrieval scoring rules, thus meeting the needs of retrieval for massive teaching resources in this paper. The distributed algorithm runs for 100 rounds on both datasets. When the number of computational threads is 1, the fully asynchronous algorithm degenerates to the classical stochastic gradient descent method, which takes about 1 minute on the Slashdot dataset and about 2 minutes on the Epinions dataset.

In comparison, the corresponding running time is 7 seconds versus 10 seconds for a thread count of 40. The fully asynchronous algorithm runs less often than the partially asynchronous algorithm for both single and multiple threads. This verifies that the fully asynchronous algorithm is faster and the somewhat asynchronous algorithm consumes synchronization time. The test results of distributed distribution and scheduling of teaching resources are shown in Figure 9.

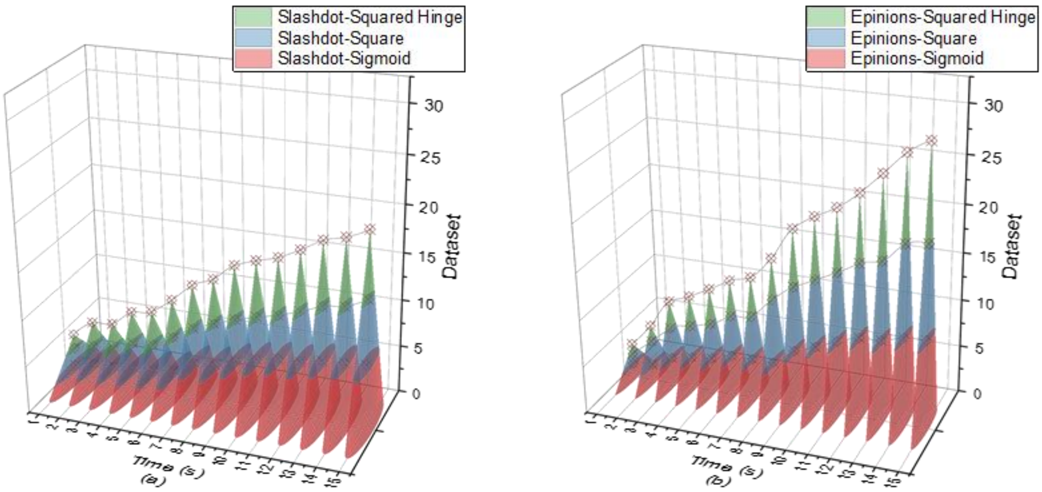

Figure 9: Test results of distributed distribution and scheduling of teaching resources

5 Conclusion

The construction of teaching resources is the foundation of education informatization. Its research focuses on the metadata representation of teaching resources, the granularity of learning objects, the reconstruction of learning objects, and the construction of teaching resource libraries. Metadata is data about data, specifically structured data about data. Semantics can be seen as the meaning of the concepts represented by the data and the relationship between these meanings, an abstraction, or a higher-level logical representation of the data. The personalized service mechanism is adopted in the system.

On the one hand, the rule-based recommendation technology is adopted according to the basic information of resource users, which effectively realizes the personalized initial resource selection for new users of the information platform; on the other hand, the mixed recommendation technology is based on content and collaboration is adopted according to the user interest information, which effectively realizes the personalized updated resource selection for old users of the information platform. In the process of personalized initial resource selection, decision tree technology is used to obtain personalized resource distribution rules, and fuzzy matching and inference technology are used to operate the distribution rules for personalized resource selection. In the customized update resource selection process, ant colony clustering analysis is used to establish user interest groups, thus realizing hybrid personalized resource recommendations and improving personalized service performance. The task scheduling optimization based on the ant colony algorithm is used in the scheduling server to effectively solve the allocation problem between resource user groups and distributed distribution centres, thus realizing system load balancing.

Competing of interests

The authors declare no competing of interests

Authorship contribution statement

- Bo Ni: Writing-Original draft preparation, Conceptualization, Supervision, Project administration.
- Xiaona Xie: Validation, Formal analysis, Methodology, Language review.

Data Availability

On Request

Declarations

Not applicable

References

[1] P. P. Utami and N. Vioreza, "Teacher Work Productivity in Senior High School.," *International Journal of Instruction*, vol. 14, no. 1, pp. 599–614, 2021. https://doi.org/10.29333/iji.2021.14136a

[2] J. C. Bedoya, M. Ostadijafari, C.-C. Liu, and A. Dubey, "Decentralized transactive energy for flexible resources in distribution systems," *IEEE Trans Sustain Energy*, vol. 12, no. 2, pp. 1009–1019, 2020. https://doi.org/10.1109/TSTE.2020.3029977

[3] Z. Lv, Y. Han, A. K. Singh, G. Manogaran, and H. Lv, "Trustworthiness in industrial IoT systems based on artificial intelligence," *IEEE Trans Industr Inform*, vol. 17, no. 2, pp. 1496–1504, 2020. https://doi.org/10.1109/TII.2020.2994747

[4] C. Hochbein and C. Meyers, "Incorporating time demands into studies of principal time use," *School Leadership & Management*, vol. 41, no. 3, pp. 175–193, 2021. https://doi.org/10.1080/13632434.2020.1851671

[5] S. Bin and G. Sun, "Optimal energy resources allocation method of wireless sensor networks for intelligent railway systems," *Sensors*, vol. 20, no. 2, p. 482, 2020. https://doi.org/10.3390/s20020482

[6] C. Lin, G. Han, X. Qi, M. Guizani, and L. Shu, "A distributed mobile fog computing scheme for mobile delay-sensitive applications in SDN-enabled vehicular networks," *IEEE Trans Veh Technol*, vol. 69, no. 5, pp. 5481–5493, 2020. https://doi.org/10.1109/TVT.2020.2980934

[7] J. Park *et al.*, "Communication-efficient and distributed learning over wireless networks: Principles and applications," *Proceedings of the IEEE*, vol. 109, no. 5, pp. 796–819, 2021. https://doi.org/10.1109/JPROC.2021.3055679

[8] S. G. Huber and C. Helm, "COVID-19 and schooling: evaluation, assessment and accountability in times of crises—reacting quickly to explore key issues for policy, practice and research with the school barometer," *Educ Assess Eval Account*, vol. 32, pp. 237–270, 2020. https://doi.org/10.1007/s11092-020-09322-y

[9] X. Tang *et al.*, "Cost-efficient workflow scheduling algorithm for applications with deadline constraint on heterogeneous clouds," *IEEE Transactions on Parallel and Distributed Systems*, vol. 33, no. 9, pp. 2079–2092, 2021. https://doi.org/10.1109/TPDS.2021.3134247

[10] S. Lillejord and K. Børte, "Middle leaders and the teaching profession: building intelligent accountability from within," *Journal of Educational Change*, vol. 21, no. 1, pp. 83–107, 2020. https://doi.org/10.1007/s10833-019-09362-2

[11] E. B. Tirkolaee, A. Goli, and G.-W. Weber, "Fuzzy mathematical programming and self-adaptive artificial fish swarm algorithm for just-in-time energy-aware flow shop scheduling problem with outsourcing option," *IEEE transactions on fuzzy systems*, vol. 28, no. 11, pp. 2772–2783, 2020. https://doi.org/10.1109/TFUZZ.2020.2998174

[12] B. Billingsley, E. Bettini, H. M. Mathews, and J. McLeskey, "Improving working conditions to support special educators' effectiveness: A call for leadership," *Teach Educ Spec Educ*, vol. 43, no. 1, pp. 7–27, 2020. https://doi.org/10.1177/0888406419880353

[13] Y. Owusu-Agyeman, "Transformational leadership and innovation in higher education: A participative process approach," *International Journal of Leadership in Education*, vol. 24, no. 5, pp. 694–716, 2021. https://doi.org/10.1080/13603124.2019.1623919

[14] T. A. Drake, "Learning by doing: A daily life study of principal interns' leadership activities during the school year," *Journal of Research on Leadership Education*, vol. 17, no. 1, pp. 24–54, 2022. https://doi.org/10.1177/1942775120941549

[15] S. Martono, M. KHOIRUDDIN, A. WIJAYANTO, S. RIDLOAH, N. A. WULANSARI, and U. Udin, "Increasing teamwork, organizational commitment and effectiveness through the implementation of collaborative resolution," *The Journal of Asian Finance, Economics and Business (JAFEB)*, vol. 7, no. 6, pp. 427–437, 2020. doi: 10.13106/jafeb.2020.vol7.no6.427

[16] S. Jha, D. Prashar, and A. A. Elngar, "A novel approach using modified filtering algorithm (MFA) for effective completion of cloud tasks," *Journal of Intelligent & Fuzzy Systems*, vol. 39, no. 6, pp. 8409–8417, 2020. DOI: 10.3233/JIFS-189159

[17] X. Jiang, F. R. Yu, T. Song, and V. C. M. Leung, "A survey on multi-access edge computing applied to video streaming: Some research issues and challenges," *IEEE Communications Surveys & Tutorials*, vol. 23, no. 2, pp. 871–903, 2021. https://doi.org/10.1109/COMST.2021.3065237

[18] A. Spelt *et al.*, "Urban gulls adapt foraging schedule to human-activity patterns," *Ibis*, vol. 163, no. 1, pp. 274–282, 2021. https://doi.org/10.1111/ibi.12892

[19] L. He, D. Fan, W. Liang, Q. Wang, and J. Fang, "Matrix metalloproteinase-responsive PEGylated lipid nanoparticles for controlled drug delivery in the treatment of rheumatoid arthritis," *ACS Appl Bio Mater*, vol. 3, no. 5, pp. 3276–3284, 2020. https://doi.org/10.1021/acsabm.0c00242

[20] L. Hellström and C. Hagquist, "School effectiveness in Sweden: psychometric properties of an instrument to measure pedagogical and social climate (PESOC) focusing on pedagogical leadership," *International Journal of Leadership in Education*, 2019. https://doi.org/10.1080/13603124.2019.1623921

[21] S. Mostafavi and V. Hakami, "A stochastic approximation approach for foresighted task scheduling in cloud computing," *Wirel Pers Commun*, vol. 114, pp. 901–925, 2020. https://doi.org/10.1007/s11277-020-07398-9

[22] R. Bansal and V. K. Singh, "Proposed technique for efficient cloud computing model in effective digital training towards sustainable livelihoods for unemployed youths," *International journal of cloud applications and computing (IJCAC)*, vol. 10, no. 4, pp. 13–27, 2020. DOI: 10.4018/IJCAC.2020100102

[23] C. Zan, "A Distributed Distribution and Scheduling Algorithm of Educational Resources Based on Vector Space Model.," *International Journal of Emerging Technologies in Learning*, vol. 14, no. 4, 2019. https://doi.org/10.3991/ijet.v14i04.10132

[24] S. T. Jong *et al.*, "Adolescents' perspectives on a school-based physical activity intervention: A mixed method study," *J Sport Health Sci*, vol. 9, no. 1, pp. 28–40, 2020. https://doi.org/10.1016/j.jshs.2019.06.007

[25] Y. Wang, "What is the role of emotions in educational leaders' decision making? Proposing an organizing framework," *Educational Administration Quarterly*, vol. 57, no. 3, pp. 372–402, 2021. https://doi.org/10.1177/0013161X20938856

[26] C. Mi, J. Chen, Z. Zhang, S. Huang, and O. Postolache, "Visual sensor network task scheduling algorithm at automated container terminal," *IEEE Sens J*, vol. 22, no. 6, pp. 6042–6051, 2021. https://doi.org/10.1109/JSEN.2021.3138929

[27] M. D. Filabadi, A. Asadi, R. Giahi, A. T. Ardakani, and A. Azadeh, "A new stochastic model for bus rapid transit scheduling with uncertainty," *Future Transportation*, vol. 2, no. 1, pp. 165–183, 2022. https://doi.org/10.3390/futuretransp2010009

[28] Q. Qi *et al.*, "Scalable parallel task scheduling for autonomous driving using multi-task deep reinforcement learning," *IEEE Trans Veh Technol*, vol. 69, no. 11, pp. 13861–13874, 2020. https://doi.org/10.1109/TVT.2020.3029864