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Research on the Sharing Strategy of Electronic Book Resources in Universities in the Internet Era

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Abstract

University books are an important information resource. University book resources can be shared not only in the traditional paper form, but also electronic form under the background of the Internet. In order to better manage the sharing of electronic book resources in universities, this study put forward three resource sharing strategies: centralized sharing strategy, distributed sharing strategy, and centralized-distributed sharing strategy by analyzing the combined development of books and the Internet as well as the significance and development of book resource sharing. The centralized sharing strategy, however simple, was difficult to handle large traffic; while the resource nodes were independent and self-consistent, the distributed sharing strategy was not easy to find and had a high repetition rate. Combining the advantages of both strategies, the centralized-distributed sharing strategy was more suitable for the heterogeneous form of university book sharing. Finally, a teaching resources sharing platform for university libraries was designed based on the strategy of centralized and distributed sharing, and three interfaces including platform login, resource search, and resource release were displayed. The results of the simulated comparison experiment showed that centralized and distributed sharing strategies had limitations in resource searching and had low efficiencies; the efficiency of the centralized strategy reduced with an increase in search subjects; however, the centralized-distributed sharing strategy was able to search more resources efficiently and main stability.

Keywords

Electronic Resources, Internet, Sharing Strategy, University Books

1. Introduction

University libraries are important channels for teachers and students in universities to acquire knowledge and information. Generally, every university has a library whose size depends on the scale of the university, but due to limited space, the number of paper books that can be stored is also limited [1]. The emergence of electronic storage technology has greatly increased the storage capacity of book resources. However, even with the increase in storage capacity through electronic resources, a single university library still has limited storage scale. Additionally, for a single university, the large storage capacity of electronic resources does not necessarily mean that the resources are updated quickly. Individual university libraries can easily retrieve existing electronic resources, but they perform poorly in retrieving new electronic resources. Different universities have varying resource update speed [2].

With the development of Internet communication technology, the connection between different uni-

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versity libraries is becoming increasingly easier. Based on this, if the sharing of library electronic resources can be realized, both the storage limit and the updating speed of electronic resources can be solved. In a state of resource sharing, there is no need for every library to store all electronic resources locally; instead, they can be uploaded to the sharing platform [3]. In addition, when in a shared status, any updates made to one library's electronic resources will also update other libraries' electronic resources.

When sharing library electronic resources, various libraries are connected to a sharing platform. However, there exists disparity in terms of the quantity of electronic resources among these libraries. Therefore, a well-designed sharing strategy is required for an equitable allocation of shared electronic resources with the aim of enhancing overall efficiency [4]. Based on the meaning and development of library book resource sharing, this paper proposed three resource sharing strategies: centralized sharing strategy, distributed sharing strategy, and centralized-distributed sharing strategy. A sharing system was established for campus library electronic resources, and the three strategies were compared to verify the performance advantage of the centralized-distributed sharing strategy. This paper analyzed the centralized sharing strategy, the distributed sharing strategy, and the centralized-distributed sharing strategy. Simulated experiments were conducted to verify the advantages and disadvantages of these three sharing strategies. This work provides a reference for selecting electronic resource sharing strategies for university library books. The future research direction is to further explore the configuration of electronic resource sharing strategies in order to improve sharing efficiency.

2. Related Works

Seal [5] provided several examples of successful library/campus collaboration, analyzed the goal, advantages, disadvantages and challenges of such activity, and identified numerous opportunities for cooperation, particularly with student development, teaching excellence centers, information technology, academic departments, writing centers, and more. To address the issues of insufficient resources in individual libraries and difficulties in collecting library resources, Pan et al. [6] designed a library resource sharing system that enables maximum information resource sharing. Saidi and Cousin [7] compared the strategy of constrained sharing, which only applied resource sharing to backup paths, with the strategy of global sharing, which extended resource sharing to main paths and backup paths through simulation. They found that resource sharing between main paths and backup paths had a negligible impact on backup path rejection, i.e., the performance of the two resource sharing strategies was very similar. Wang and Li [8] conducted an in-depth study and analysis on building a digital English resource base for higher education through a cloud platform. The results showed that the cloud platform enabled the integration, efficiency, scalability, and interactivity of the English resource base, addressing the issue of resource sharing across multiple platforms and improving resource utilization in higher education institutions. Hu et al. [9] introduced visual information retrieval technology into digital libraries, which visually displayed the collection structure, popular books, readers' interests, etc. This system accurately reflected the structure, coverage, and utilization rate of library resources, facilitating the visual sharing of library information resources.

Sun et al. [10] designed a cloud computing-based information resource sharing mode for coastal cities. Experimental results showed that, as the shared resources became increasingly scarce, the shared time of the cloud computing-based library information resource sharing model in coastal cities was shorter than that of the traditional model, thus meeting the needs of information resource sharing.

3. Resource Sharing and Strategy Analysis

3.1 The Meaning of University Book Resource Sharing

The core of resource sharing is reciprocity. Participants contribute resources needed by other members, and members can get resources contributed by others according to their own needs [11]. The necessary conditions for the establishment of resource sharing include resources that can be allocated on demand, members who participate in resource sharing, and strategies to facilitate resource sharing. For general libraries, in the process of realizing resource sharing, participants are several libraries [12]. They collectively provide all library functions and allocate different functions reasonably to reduce information isolation, integrate redundant information resources, and improve resource utilization rate.

The development of resource sharing [13] can be roughly divided into three stages: book resource sharing, which began in the 1980s, literature resource sharing in the 1990s, and information resource sharing from the mid-1990s to the present.

University books are the main access to educational resources in colleges and universities. Initially, teachers and students acquire teaching resources by themselves via the Internet. However, this process is often time-consuming and laborious, making it difficult to ensure resource accuracy [14]. After that, the emergence of digital books provides new ways for teachers and students to access [15]. Digital book resources are organized orderly and have retrieval functions, but it is almost impossible for a single library to build a comprehensive digital library that satisfy users, from the aspect of finance or literature resources. Therefore, multiple libraries join together to share resources.

The sharing of resources cannot be accomplished overnight. It is necessary to consider the relationship between government policies, manpower arrangements, and other factors when designing the structural relationship between libraries in order to realize electronic resources. Therefore, the strategy of centralized and distributed sharing is put forward.

3.2 The Strategy of Centralized and Distributed Sharing

From the perspective of system theory, resource sharing strategies include centralized sharing strategy, distributed sharing strategy, and centralized-distributed sharing strategies. These three kinds of sharing strategies are analyzed with examples.

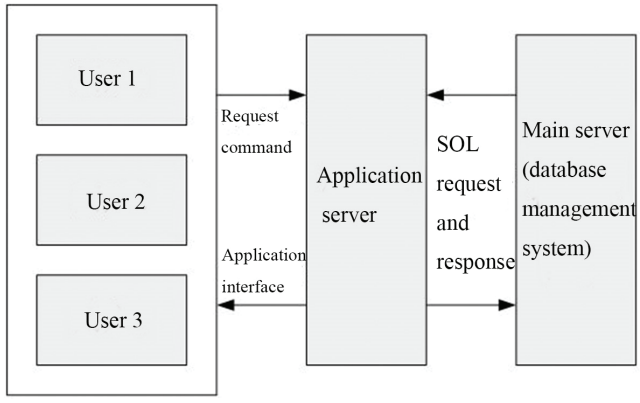

Fig. 1. The structure of a resource management platform.

3.2.1 Centralized sharing strategy

The resource management platform is a software for resource sharing developed by a company. Its resource sharing is centralized, featured by low cost and easy use. The software is primarily used in primary and secondary schools. The structure of the support system is shown in Fig. 1. Only one server is used to manage the entire system, including the storage and classification of electronic resources. The other application server is responsible for responding to users and transmitting instructions to the master server. In this system, users can search, upload, and download electronic resources on school's web pages through a browser without having to install a specific client [16]. Although it is very convenient, there are some problems.

(1) Only one server is used to respond to users and connect to the database. Once the number of visitors sharply increases, the data flow will expand, causing a sharp increase in server load, ultimately resulting in system response slowdown and affecting usage experience.
(2) When users share resources using this strategy, range of query depends entirely on the content of resources in the master server. The update of resources depends on database updating, which imposes a heavy load on the master server.
(3) A database hard disk with large capacity is needed to ensure that the system can provide a sufficient range of resources, including those uploaded by users. However, for some user-uploaded resources, their utilization rate is low, resulting in wastage of database storage space.
(4) In order to solve the above problems, more servers can be added to share the workload, but it will undoubtedly increase the overall cost of the system.

Regarding database content modification, it requires administrator authorization while users only have the ability to upload resources. The administrators are unable to update resources in time, which poses a great obstacle to resource sharing.

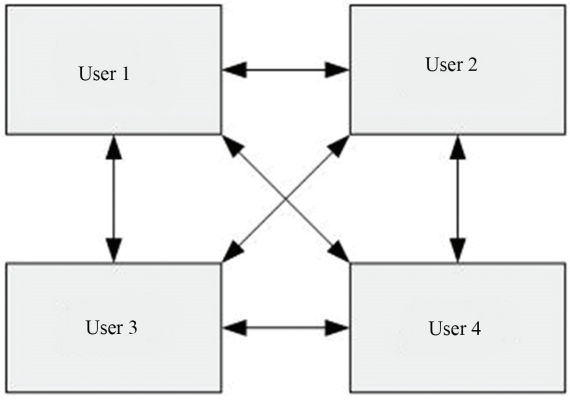

Fig. 2. The structure of Network Neighborhood.

3.2.2 Distributed sharing strategy

"Network Neighborhood" is a resource sharing system unique to Windows operating system [17]. It is a distributed sharing strategy. Its structure is shown in Fig. 2. Unlike the centralized distribution strategy, Network Neighborhood does not rely on a unified database for storing information resources; instead, all the user computers within the campus network act as databases and servers. Users only need to place the

shared resources into the specified file and designate it as a shared file. Subsequently, other users can access this shared file through the campus network. Unlike the centralized sharing strategy, this sharing strategy is not constrained by server traffic or capacity limitations. The speed of resource sharing depends on the quality of the campus network, but the following problems exist.

(1) It is challenging for users to search for resources as they need to know the domain name of the target computer and the name of the shared file before searching. If they have not communicated beforehand, multiple skip queries will be needed.
(2) When resource files are set as shared files, the system will not notify other users. Other users may only discover this when they query, which may cause a severe information transmission lag.
(3) The storage of resources is too fragmented, requiring users to search multiple computers one by one in order to collect complete resources, which is very inconvenient.

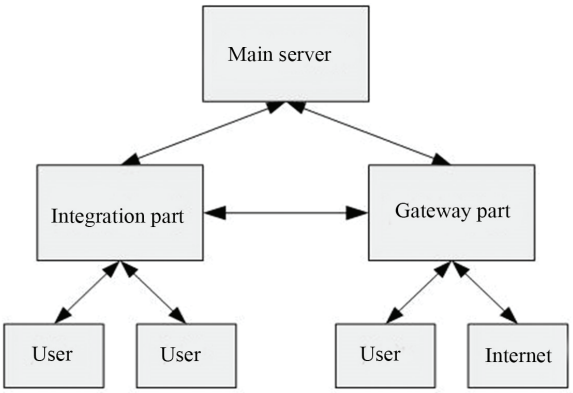

Fig. 3. The sketch map of ecAIMS structure.

3.2.3 Centralized-distributed sharing strategy

ecAIMS, developed by ecSolutions Corp. Ltd., is an e-commerce platform software that adopts a centralized-distributed sharing strategy [18]. The basic structure of ecAIMS is shown in Fig. 3. The master server serves as the central controller, and the integration and gateway parts act as the sub-controllers. The central controller macroscopically controls the sub-controller, while the sub-controller possesses a relatively independent control center responsible for managing its own resources. The specific performance of the software is as follows. The integration part is connected with the master server, from which the information resources of each department of an enterprise can be obtained. The information is sent to external users after being sorted and summarized in the local repository. Moreover, information from outside the enterprise is sent to the master server and gateway part after being sorted and classified in the local database. The gateway part is connected to both the integration part and the Internet. After sorting the collected information, the integration part will send it to the gateway according to its requirements, in addition to uploading it to the master server. Subsequently, it will be transferred to other enterprise users for sharing. Moreover, it will gather relevant information from the Internet and transmit it to the integration part after local processing.

These examples show that the centralized-distributed sharing strategy not only enables a comprehensive understanding of resource sharing configuration in the entire sharing system, but also ensures optimal utilization of local resources. This strategy combines the advantages of centralized and distri-

buted sharing strategies, overcoming their respective shortcomings. For remote heterogeneous sharing in university libraries, the centralized-distributed sharing strategy is a better solution.

3.3 Centralized and Distributed University Book Teaching Resource Sharing Platform

3.3.1 The structure of platform

The structure of the resources sharing platform is shown in Fig. 4. It is primarily divided into four parts, which includes providing series resources, providing self-built resources, customizing characteristic resources, and other functional modules.

(1) Providing a series of resources: this function provides the detailed information of the resources shared on the platform, including their type and name. Moreover, it is connected with network nodes of different resource providers that are self-consistent in order to achieve synchronous updating of platform information and sharing nodes.

(2) Providing self-built resources: This function primarily offers the school's teaching resources, such as curriculum, teaching precedents, and test questions. Once these teaching resources are converted into electronic format on the platform, they can be freely shared. Users who are interested in a particular course at the school can get the teaching resources by others' sharing.

(3) Customizing characteristic resources: the platform function is designed for teachers with specific needs. Teachers in need can publish help-seeking information on this platform, and those who have corresponding resources, whether they are teachers or students, can share their resources and receive corresponding remuneration. Additionally, third-party organizations can centrally collect and share information and provide feedback to the relevant departments such as the Education Bureau to strengthen targeted education construction.

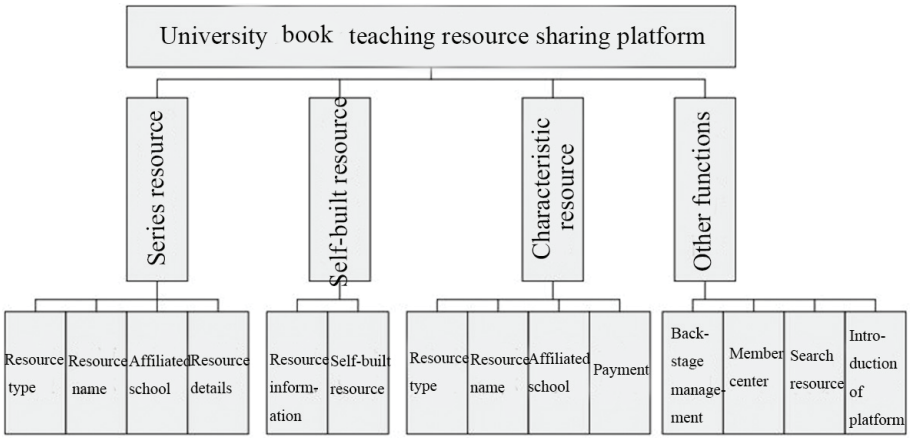

Fig. 4. The structure of the university book electronic teaching resource sharing platform.

3.3.2 Platform development environment

(1) Platform operating system: the mainstream operating systems in the market are Windows, UNIX, and Linux. In this study, the Windows operating system developed by Microsoft Corporation was

chosen. The main reason for this choice is that Windows is more user-friendly for non-professional computer users, who mainly consist of teachers and students. The platform based on Windows operating system is more convenient for its users.

(2) Developing programming language: In order to facilitate the use of teachers and students, the resource sharing platform in this study adopted website services. Therefore, the active server page (ASP) programming tool developed by Microsoft Corp. was selected. ASP can enable databases to interact with other programs and develop web page applications. As a variant of Common Gateway Interface (CGI), ASP can easily and dynamically control the content of the page according to user preferences. One advantages is that only modifications to the web page document on the server is needed when updating the program.

(3) Database: The database is simply a memory with a large capacity. In order to participate in the normal application of the platform, it is necessary to manage database through relevant procedures. In this study, SQL server was selected as the database management system, which can deal with large amount of data and complete maintenance and updates through simple operations.

3.3.3 Main functions of the platform

Main functions of the platform are shown in Table 1.

Table 1. Main functions of the platform

Function management	Details
Rights of administrators	Query member information; manage registered members; resource management and enquiries; recommend resources, etc.
User rights	Unregistered users: browse and query resources, etc. Registered users: include functions of unregistered users, publishing resources, query self-built resources and characteristic resources, manage their own information and published resources, etc.
Providing series resources	Registered users have the right to publish and update resources; the platform's master server synchronizes with network nodes and maintains resources independently; users in nodes have the right to maintain resources.
Providing self-built resource	Registered users can build their own e-learning resources by using their own plug-ins on the platform.
Customizing characteristic resources	Registered users can publish help information on the platform to get special resources.

3.3.4 Use of the sharing platform

(1) Resource search: The platform's resource search interface is shown in Fig. 5. The left interface is for searching series resources, and the right interface is for searching special resources. For example, if a user wants to search for general teaching, such as Professor XX's classroom teaching, they just need to type "video" in the box of resource type on the series resource search interface, "XX's classroom teaching" in the box of resource name, "XX University" in the box of the affiliated school, "general" in the box of level and finally click on "search."

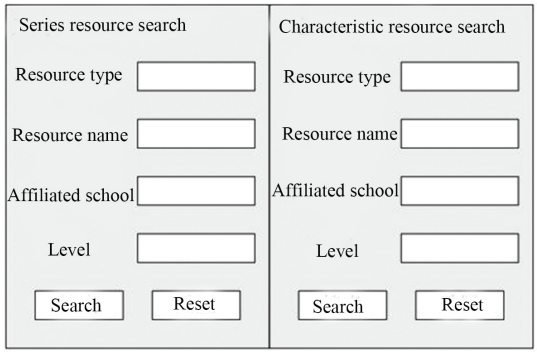

Fig. 5. The interface of resource search.

(2) Resource release: The platform's resource publishing interface is depicted in Fig. 6. The essential information for releasing a resource includes resource name, releaser, and contact information. For example, if someone wishes to release a video of Professor XX's classroom teaching, they should enter "XX's classroom teaching" in the box of resource name, "XXX" in the box of releaser, "XXXX@163.com" in the box of contact information, and then drag and drop the video file into the attachment box. Once updated, click on "confirm."

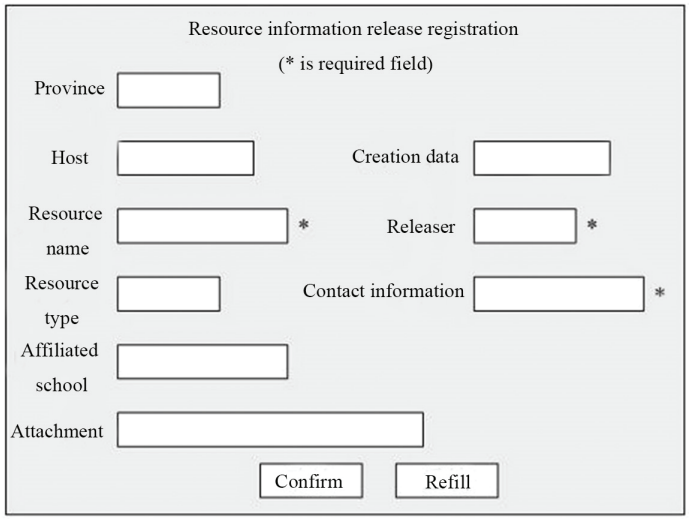

Fig. 6. The interface of resource release.

3.4 Comparative Experiment for Three Sharing Strategies

3.4.1 Experimental setup

The comparative experiment of the three strategies was performed on an electronic resource sharing platform established in a lab server. Firstly, a centralized sharing strategy-based sharing platform was constructed. A server in the lab was used as an intermediate server to provide centralized sharing services, which was connected to the campus library server. The campus library server regularly updated local resources as a mirror station, which was considered a master server integrating all electronic resources.

Different users searched for resources in the master server through the intermediate server.

Then, the distributed sharing strategy-based sharing platform was constructed. Three servers in the lab were used as intermediate servers scattered in different places. All three servers were connected to the campus server and could only access a portion of it, but they could access each other through the network neighborhood.

Finally, the centralized-distributed sharing strategy-based sharing platform was established. A server in the lab was used as an intermediate server, which was connected to the campus library server and could also access the server of the library outside the campus.

3.4.2 Test items

(1) Comparison of resource search function: The topics of "calculus," "artificial intelligence," "architectural design," and "image recognition" were searched in the server clients of the three sharing strategies, respectively. The number of the searched resources was compared.

(2) Comparison of search efficiency: First, the electronic book resources with topics such as "calculus," "artificial intelligence," "architectural design," and "image recognition" were retrieved individually on the server clients of the three sharing strategies, and the average search time was recorded. Then, the topics were then retrieved in pairs, and the average search time was recorded; they were also retrieved in groups of three out of the four mentioned topics, and the average search time was recorded; finally, all four topics were retrieved simultaneously, and the average search time was recorded.

3.4.3 Testing results

It was seen from the comparison in Table 2 that 123 resources about calculus, 102 resources about artificial intelligence, 324 resources about architectural design, and 132 resources about image recognition were obtained after searching under the centralized sharing strategy. The number of resources about different subjects obtained under the distributed sharing strategy was the same as that obtained under the centralized sharing strategy. After searching under the centralized-distributed sharing strategy, there were 332 resources about calculus, 235 resources about artificial intelligence, 532 resources about architectural design, and 451 resources about image recognition. The reason for obtaining the same number of resources under the centralized and distributed sharing strategies is that the resources were sourced from the local server. Compared with the centralized and distributed sharing strategies, the centralized-distributed sharing strategy obtained more resources when searching for the same topic because it searched not only within the local server but also outside.

Table 2. The number of searched resources for four topics under the three sharing strategies

Search topic	Number of entries		
	Centralized sharing strategy	Distributed sharing strategy	Centralized-distributed sharing strategy
Calculus	124	124	332
Artificial intelligence	102	102	235
Architectural design	324	324	532
Image recognition	132	132	451

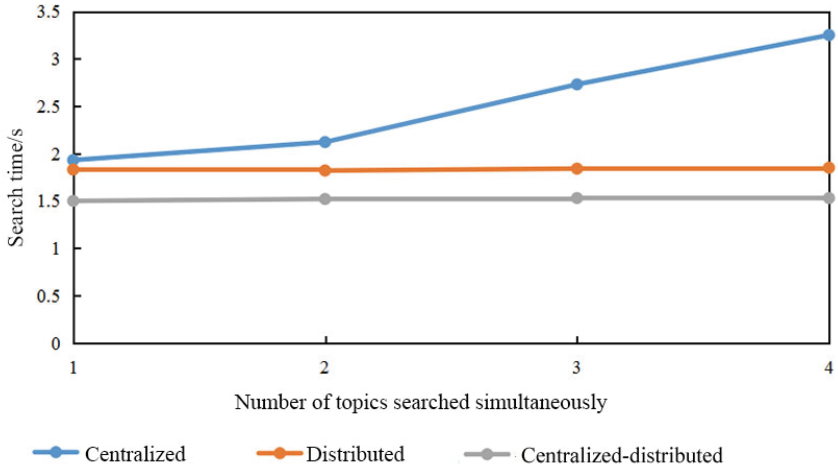

Fig. 7. Comparison of the resource search efficiency between the three strategies.

It was seen from Fig. 7 that when searching a single topic, the centralized strategy consumed 1.9 seconds, the distributed strategy consumed 1.83 seconds, and the combined centralized-distributed strategy consumed 1.50 seconds. When searching two topics simultaneously, the centralized strategy consumed 2.12 seconds, the distributed strategy consumed 1.82 seconds, and the centralized-distributed strategy consumed 1.52 seconds. When searching three topics simultaneously, the time consumption was 2.73, 1.84, and 1.53 seconds, respectively. When searching four topics simultaneously, the time consumption was 3.25, 1.85, and 1.53 seconds, respectively. Fig. 7 shows that the centralized-distributed sharing strategy was significantly more efficient than the other two strategies; with the increase of the searched topics, the search efficiency of the distributed sharing strategy and the centralized-distributed sharing strategy changed little, but the search efficiency of the centralized sharing strategy improved significantly.

4. Conclusion

Through analyzing the development of books and Internet, as well as the meaning and development of book resource sharing, this paper put forward three resource sharing strategies: the centralized sharing strategy, the distributed sharing strategy, and the centralized-distributed sharing strategy. The centralized sharing strategy had a simple structure and high stability. Due to the presence of a single database, resource management was convenient. However, it was only suitable for small areas such as primary and secondary schools due to its slow response to users and difficulty in enhancing the load of the central controller because of insufficient capital and resources. The distributed sharing strategy did not have a central controller, the user acted as a resource node in the network, and the authority between users was equal and independent. The system constituted by the distributed sharing strategy was completely open; as a result, the problems of resource duplication and low security were more serious. Therefore, it was also not suitable for university book resource sharing. The centralized-distributed sharing strategy combined the centralized sharing strategy and distributed sharing strategy to regulate the global system through the central controller under the premise that the subsystem could handle resource sharing

independently. The shortcomings of the two strategies were overcome by this strategy, making it suitable for the remote heterogeneous sharing of university books. A teaching resource sharing platform was designed for university books based on the centralized-distributed sharing strategy. Additionally, three interfaces including platform login, resource search and resource release were displayed. The results of the simulated experiment suggested that the centralized-distributed strategy searched for more resources than the other two strategies and was more efficient and stable.

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