Design and Implementation of a Knowledge-Based Traditional Chinese Medicine Learning Resource Association System

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Abstract. With the advent of the digital age, learning resources for traditional Chinese medicine (TCM) have experienced explosive growth. However, the issues of scattered and weak correlation resources have become increasingly prominent. Learners need to switch between multiple platforms, leading to low learning efficiency. To address the problems of scattered and weakly correlated TCM learning resources, and to enhance the utilization and sharing of digital resources, this paper designs and implements a knowledge-based TCM learning resource association system.

Keywords: Traditional Chinese Medicine Knowledge, Learning Resources, Resource Association.

1 Introduction

The construction and development of digital TCM learning resources are an important component of the educational digitalization strategy and the "Digital China" initiative. National strategies such as "Digital China" and "Education Modernization 2035" have placed educational digital transformation in a significant position. This transformation requires the digital reconstruction of all elements and processes in teaching and learning, with its core foundation being the construction of high-quality, efficient, and shareable digital resources [1,2].

As an essential part of the traditional medicine of the Chinese nation, TCM possesses a unique theoretical system and rich clinical experience. Traditional TCM education faces issues such as an emphasis on theoretical indoctrination over practical skill cultivation and a singular learning approach, making it difficult to meet personalized learning needs. With the rapid development of “Internet+” and artificial intelligence technologies, the quantity of digital learning resources has grown swiftly. The TCM field has generated a massive amount of digital learning resources, including classical literature, formula databases, clinical cases, and instructional videos. However, these resources are scattered across different platforms and databases, lacking unified structured organization and semantic associations. This leads to difficulties for learners in discovering and understanding resources [3]. Furthermore, traditional re-

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source management methods struggle to meet personalized learning demands, hindering the dissemination and innovation of TCM knowledge [4,5].

A knowledge-based TCM learning resource association system is a comprehensive platform or framework that utilizes modern information technology to organize, associate, dynamically aggregate, and provide precise services for multi-source, heterogeneous, and dispersed TCM digital learning resources [6,7]. Currently, various TCM institutions have established a large number of databases (e.g., ancient texts, Chinese materia medica, formula libraries), high-quality courses, and online resource repositories, providing a data foundation for the association system [8]. To effectively improve resource utilization and learning efficiency, and to promote the systematic inheritance and innovation of TCM knowledge, this paper constructs a knowledge-based TCM learning resource association system.

2 System Design

2.1 System Design Principles

Based on research into the current development status of existing TCM digital resources and considering users' actual needs, this TCM learning resource association system primarily adheres to the following design principles:

Convenience. The system should adopt a responsive design, be easy to access, operate, and understand, allowing users to obtain required resources anytime, anywhere, quickly and efficiently, thereby enhancing the system's adoption rate and frequency of use.

Universality. The system should be able to compatibly process resources from different institutions and in various formats, possessing broad compatibility, interoperability, and openness. It should break down "information silos", promote resource co-construction and sharing, and avoid redundant construction.

Flexibility. The system should adopt a microservices architecture, allowing it to be decomposed into independent modules. It should possess configurable, scalable, and evolvable capabilities to adapt to the changing needs of different users and scenarios, and to continuously evolve with technological development and knowledge updates [9].

2.2 The Basic Framework of the System

The basic framework design of the knowledge-based TCM learning resource association system is shown in Fig.1. The underlying database mainly includes user information databases, resource information databases, etc. The user information database primarily contains basic user information such as username, password, affiliated insti-

tution, name, contact phone number, and email. The resource information database is a very important database in the entire system, mainly containing resource name, resource link, knowledge points, annotating user, etc.

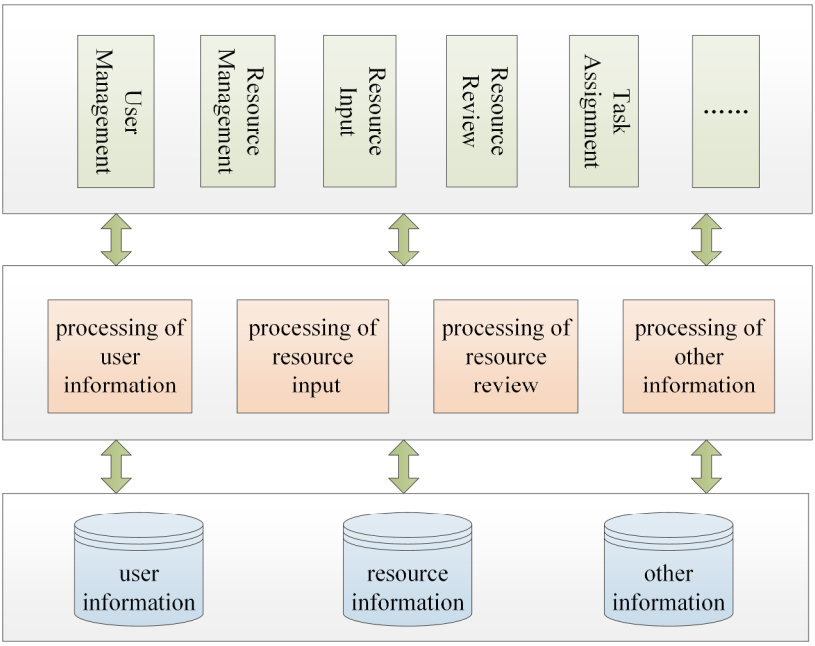

Fig. 1. System basic framework

The middle layer of the system's basic framework mainly handles specific processing tasks, including user information review processes, resource input review processes, resource review processes, etc. By processing user information and resource information, the system presents resources and knowledge points to users in an organized and structured manner.

The top layer of the system's basic framework is the presentation of all system functions, and the results processed by the system backend will be returned to the system interface for user queries [10].

2.3 System Role Division

The knowledge-based TCM learning resource association system includes two types of users: administrators and regular users, each with different permissions.

Administrators have access to resource management and user management permissions. They can view and export resource lists and user lists, search, modify, add, delete resources and users, review resources, and assign resources to users for knowledge point annotation.

Regular users only have access to resource association management permissions. They can view and modify their own user information, view resource lists, add re-

sources, modify and view resources they have entered, and perform knowledge point association on resources assigned by administrators.

2.4 System Function Analysis

The system is mainly divided into several functional modules: resource management, user management, and resource association management, as shown in Fig.2. The detailed functional design of each module is as follows:

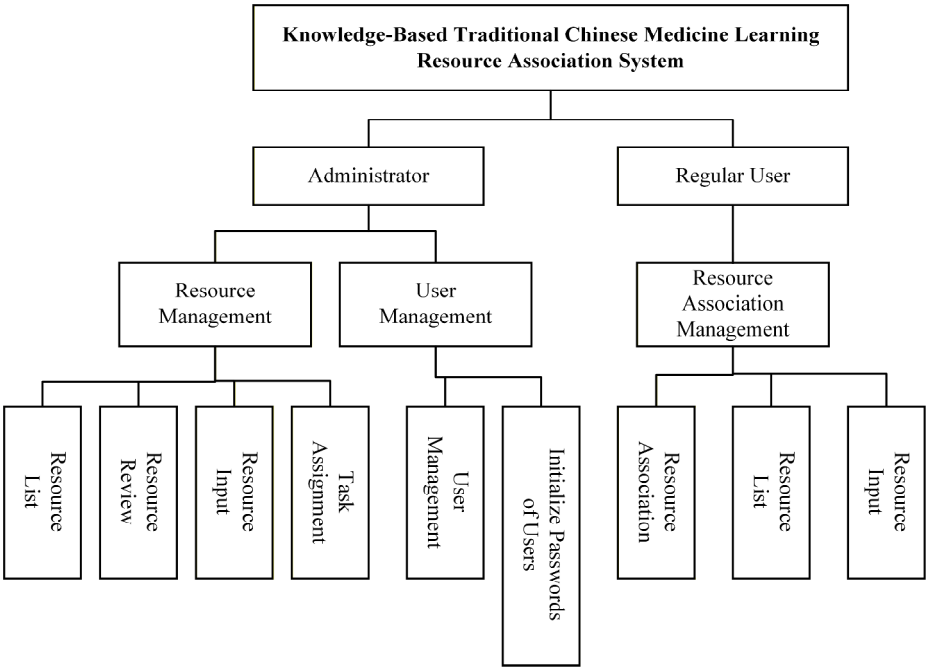

Fig. 2. Functional division

Resource Management. The resource management functional module includes four sub-modules: resource list, resource review, resource input, and task assignment.

Resource List. The resource list page displays resources that have completed knowledge point annotation and passed administrator review. On the resource list page, administrators can view resource content via resource links, and can also add, delete, view, modify, and search for resources. When an administrator adds a resource, only the resource name and resource link are added. At this point, the added resource enters the unassigned list in the task assignment page, in an unassigned state. The delete resource function permanently removes the resource from the database, and it cannot be recovered. The view resource function allows viewing detailed resource information, including resource name, resource link, knowledge points, and

completer (the user who completed the knowledge point annotation). The modify resource function allows modifying the resource link, knowledge points, and completer. The resource name cannot be modified once entered. The search resource function allows searching by resource name, knowledge points, and completer. Search results are displayed as a resource list on the page. Administrators can export information for all resources that have associated knowledge points and passed review to an Excel file.

Resource Review. The resource review page displays a list of resources pending review. These resources have had knowledge points annotated by users. Administrators can view the annotation results, view detailed resource information by resource name, view resource content via the resource link, search for resources by resource name, knowledge points, or completer (results displayed as a list), and can perform "approve" or "reject" operations on each resource. Approved resources will enter the resource list page; rejected resources will enter the task assignment module, awaiting reassignment to users for knowledge point annotation.

Resource Input. The resource input function performs the operation of adding a resource, which is the same as the add resource function in the resource list module. Both add the resource name and resource link. At this point, the knowledge points and completer for this resource are empty, and the resource is in an unassigned state.

Task Assignment. The main function of the task assignment module is to assign resources to users for them to complete knowledge point annotation. The task assignment page displays all unreviewed resources, including resources not assigned to any user, resources assigned to users, and resources assigned to users with completed knowledge point annotation. On the task assignment page, administrators can view the unassigned user list and the assigned user list, search for resources by resource name, view resource content via the resource link, view the assigned user via the "Assigned User" field, and assign a user for knowledge point annotation via the "Assign User" function. When assigning a user, the administrator first selects an assignment scheme. The user dropdown list will change dynamically based on the selected scheme. The administrator then selects a user from the user dropdown list.

User Management. The user management module includes two functional modules: user management and initialize all user passwords.

User Management. The user management page displays information for all users, including administrators. On the user management page, administrators can add, delete, view, modify, and search for users, and can also reset users' passwords. When an administrator adds a user, only the username and institution name are added, the user password is set to the default password "123456", and the user type defaults to regular user, but can be selected as administrator from a dropdown list. The user's research direction, real name, contact phone number, and contact email are empty by default. Deleting a user permanently removes the user from the database, and the user cannot

be recovered. Administrators can view detailed user information, including username, user type, institution name, research direction, name, contact phone number, contact email, etc. They can also modify the user's type, institution name, research direction, name, contact phone number, and contact email. The username cannot be modified once entered. Administrators can also search for users by username, institution name, and user type. Search results are displayed as a user list on the page. Administrators can reset a user's password; after resetting, the password becomes the default "123456".

Initialize Passwords of User. Administrators can initialize passwords for all users. After resetting all user passwords, the passwords become the default "123456".

Resource Association Management. The resource association management functional module includes three sub-modules: resource association, resource list, and resource input.

Resource Association. The resource association page displays resources assigned to the current user for knowledge point association, including unassociated resources and associated resources. On the resource association page, users can view resource content via the resource link, enter the associate knowledge points page via the "Unassociated" link to add knowledge points to a resource, view the knowledge points associated with a resource via the "Associated" link, view the unassociated resource list, view the associated resource list, and search for resources by resource name.

Resource List. The resource list page displays resources that have completed knowledge point annotation but have not yet been reviewed by an administrator. On the resource list page, users can view resource content via the resource link, and can also add, view, modify, and search for resources. When a user adds a resource, they add the resource name, resource link, and knowledge points. The completer is the user themselves. At this point, the added resource enters the resource association page, in an associated but unreviewed state. The view resource function allows viewing detailed resource information, including resource name, resource link, knowledge points, and completer (the user who completed the knowledge point annotation, which is the user themselves here). Regular users can only modify the resource link and knowledge points. The resource name cannot be modified once entered. The search resource function allows searching by resource name and knowledge points. Search results are displayed as a resource list on the page.

Resource Input. The resource input function performs the operation of adding a resource, which is the same as the add resource function in the resource list module. Both add the resource name, resource link, and knowledge points. At this point, the completer for this resource association is the user themselves, and the resource is in an assigned but unreviewed state.

3 System Implementation

3.1 Implementation Environment

The system was developed using ASP + IIS + MySQL, that is mature, stable and widely used. The implementation process is shown in Fig.3. ASP is a simple and convenient programming tool that can quickly implement dynamic web pages and can perform various tasks with a low development threshold. ASP has good extensibility. When accessing the database, it uses ADO objects, and when accessing files, it uses the File System Object (FSO). This approach enhances the flexibility and maintainability of the system.

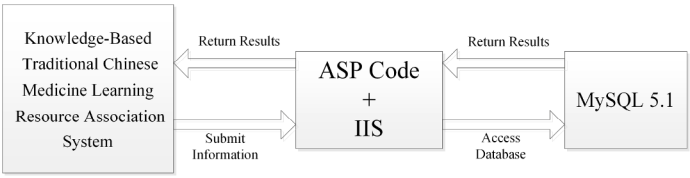

Fig. 3. Implementation process

3.2 System Operation Flow

Opening the system URL, the user needs to input their username and password. After clicking login, the system establishes a connection with the MySQL database. Upon successful connection, the system verifies if the entered username and password are correct. If the username or password is incorrect, the system returns to the login interface. If the username and password are correct, the system determines whether the user is an administrator or a regular user, and then enters the corresponding interface based on the judgment. The overall system operation flow is shown in Fig.4.

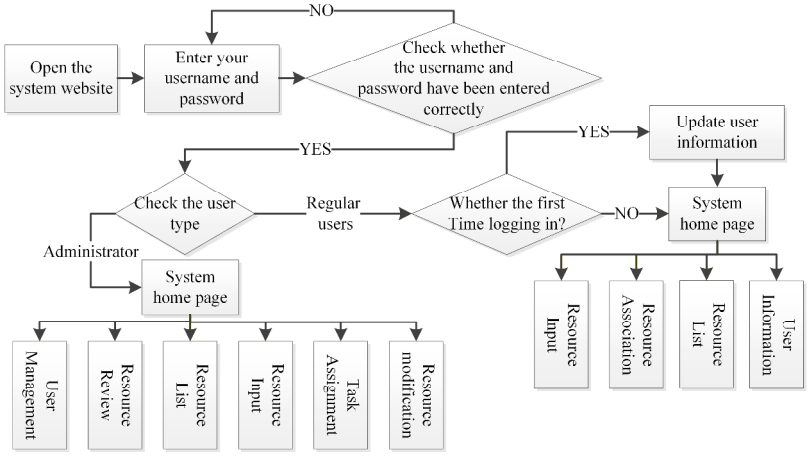

Fig. 4. Overall system operation flow

3.3 System Operation Results

This system adheres to the relevant design principles and achieves the intended function of knowledge interconnection. Taking the administrator user as an example, its operation results are shown in Fig.5.

Fig. 5. System interface

4 Conclusion

Addressing the issues of scattered and weak correlation TCM digital learning resources, this paper designs and implements a knowledge-based TCM learning resource association system. By adding existing TCM learning resources to this system, the system assigns resources to different users according to a task assignment mechanism. Users complete knowledge point association based on resource content, thereby forming an effective utilization mechanism for TCM learning resources. In the future, the system can be further optimized in areas such as dynamic knowledge updates and task assignment schemes.

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