A Digital Library based on Virtual Learning Environment

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Abstract — The integration of digital library and Virtual learning environment is beneficial to fully exploiting and utilizing digital resources, and to carrying out network teaching activities with powerful technical support from the digital library. Metadata Sharing and Interactive Manipulation, Database, and Middleware Technology of the digital library based on VLE are designed to show how to the integration of digital library and virtual learning environment.

Keywords - Digital library; Virtual learning

I. INTRODUCTION

Developing from the middle of 1980s, digital library is an organization or service center from which documents are purchased or collected according to certain policies and formats, and are processed, re-arranged and kept under such a digital network environment, which provides certain users with access to utilize information from those documents [1]. In China, the research of digital library started from the middle of 1990s. In November of 1998, the National Planning Commission has approved the project of China Academic Library and Information System (CALIS), devoting to the co-construction and sharing of digital resources. In university libraries, the development of digital resources includes introducing Chinese and foreign language database, self-built database, discipline navigation, etc [2]. The research of digital library has linked library science to the development of computer technology and network communication technology, which has changed the traditional use of the library for activity and study, and has provided library users with more abundant and convenient information and knowledge service. Since the user-focused Library 2.0 was proposed based on Web2.0, the library has carried out continuous reform and innovation concerning interactions with users and ways of service, and has developed user-centered information customization, retrieval and push service. In the future, digital library will emphasize on user-oriented acquisition of information knowledge, on a more convenient integrated service with more comprehensive information resources, which helps to enhance the efficiency of information acquisition, and to build a new service platform on discipline knowledge more scientifically and reasonably.

II. VIRTUAL LEARNING ENVIRONMENT

The rise of e-education and informational education has promoted the revolution of learning methods. Because of network technology and multi-media technology, information learning and Virtual learning have presented a teaching and learning process under the digital environment. This learning method is learner-oriented, as interactive live courses are tailored based on individual demands and characteristics with emphasis on timely feedbacks and learning effects reflected by learners. This informational learning environment from which teaching management could be carried out and learning resources and tools could be provided and shared with the backing of network support is regarded as Virtual Learning Environment (VLE). It is an innovative model of information service, as a platform on which professional users are able to learn on-line resources, to build knowledge base, and to exchange information. By combining the advantages of both traditional and digital learning styles, VLE gives the teacher a leading role in guiding, enlightening, and monitoring the teaching process, and enables students to fully present their initiation, enthusiasm and creativity.

VLE consists of curriculum teaching resources, evaluation, course administrations and so forth, from which interactive and cooperative personalized learning activities include voting, test, questionnaire, chat room, discussion forum, Wikipedia, blog, RS, label, etc. Currently, there are some influential VLE on the world such as Blackboard, WebCT, COSE, Modle, TopClas, Sakai, ANGEL.

III. THE INTEGRATION OF DIGITAL LIBRARY AND VIRTUAL LEARNING ENVIRONMENT

Digital library contains various information resources of different disciplines, including online bibliographic database, full-text electronic journal database, e-books, audio-video data, network CD-ROM, all kinds of library-related internet information, etc. The library provides teachers and students with various academic information resources, support of the development of academic education, study and research, and premium service. The integration of digital library and Virtual learning environment is beneficial to fully exploiting and utilizing digital resources, and to carrying out network teaching activities with powerful technical support from the digital library [3].

In addition to traditional service function, contemporary university library is responsible for information literacy education. As the center of academic information resources, it not only offers fundamental information retrieval service, but direct service of providing information resources for...
academic teaching and research activities by initiatively integrating in those processes. Information literacy education focuses on cultivating students to improve their abilities to efficiently and effectively acquire, utilize, and accurately evaluate information by using computer and information technologies. The integration of digital library and VLE has provided an open integrated learning environment with information acquisition and utilization, which helped developed more learning methods and promoted information literacy education level.

In such a system that integrates digital library with VLE, the digital resources from the library can help users to independently learn, and fulfill their demands for sharing, quickly obtaining, and timely updating information. This integration also has a positive effect on course teaching. Both students and teachers can acquire teaching resources and digital learning resources to carry out integrated study once logged into the VLE. For instance, in the VLE, the teacher can set some reference materials in advance, then students can use those fixed materials in the system in their Virtual learning process, besides, they also can acquire latest e-resources, such as e-textbooks and e-journals, in the digital library at any time according to their needs just by clicking. The goal of the integration is to build a completely unified on-line learning environment with seamless connection and interactive manipulation between the digital library and the VLE, in order to offer customized and flexible service by one-stop access to information. Figure1 shows the integrated system.

![Diagram of VLE and Digital Library Integration](image)

**Figure1**: The integration between VLE and the digital library.

Foreign research institutions have made more researches on the integration. Taking the DiVLE project plan [4] supported by Joint Information Systems Committee (JISC) as an example, it explored how to integrate the digital library resources into the VLE, involving issues related with the integration process such as technology, teaching, and organization, etc. As for the sub-project OLIVE which used Blackboard as the VLE, it has realized the resource list function under the library integrated management system Aleph and the resource integrated system MetaLib by utilizing plug-in technology, and came out with the acquisition of digital library resources and search function based on metadata construction and study resources on SFX course. USA has launched the united digital library and class-teaching plan supported by National Science Foundation (NSF) [5], but in China, the research was still at an initial stage with few case studies. Therefore, the realization of seamless connection and interactive manipulation between VLE and the digital library via technical means has become one of the critical domains for research exploratory development.

IV. THE APPLICATION OF TECHNOLOGIES INTO THE DIGITAL LIBRARY BASED ON VLE

Metadata is like the specification and explanation of different forms of digital resources. In the integration process, the first step is to gather metadata, and transfer it into file formats that are compatible under VLE. After that, the data between digital library and VLE can be connected and exchanged by using technologies such as middleware and OpenURL, and metadata can be stored in relational database (RDB).

A. Metadata Sharing and Interactive Manipulation

Metadata is an explanation of the characteristics and attributes of information resources or data itself, to provide a specified and ordinary description of various digital information units and resource collection for information retrieval and sharing. In VLE, metadata standards that specify the learning object mainly include Learning Object Metadata (LOM) standard formulated by Standard for IEEE Learning Technology Committee, SCORM standard constituted from the advanced distributed study plan by US Department of Defense, LRM standard set up by IMS Global Learning Consortium, etc. Digital library usually use standards such as Machine-Readable Catalog (MARC) standard formulated by Library of Congress, Dublin Core (DC) metadata standard jointly formulated by OCLC and National Center for Supercomputer Applications (NCSA), etc., among which DC standard is adopted by an increasing number of library application system due to its simplicity and general nature. In order to better integrate VLE and digital library resources, the top priority is to solve the sharing and interactive manipulation issue between the two systems.

There are 15 DC basic element collections of library resource collection, and LOM from VLE has defined the hierarchical structures of data elements into 9 levels. There are corresponding relations between DC and LOM metadata collection, for example, ‘ DC Title ’ matches ‘ General.Title ’ from LOM, DC. Creator matches LifeCycle. Contribute. Entity if Contribute. Role = author, ‘ DC. Rights ’ matches ‘ Rights. Description ’, etc. Likewise, these relations can also be found between DC and SCORM metadata. Data reflects the relations, which promotes the implementation of sharing DC database elements. By using the DC data editing tools, DC metadata can be extracted and then transferred to LOM XML or SCORM XML, in order to transfer metadata across different systems.

To create an integrated Virtual learning environment, metadata should be collected from resources, and stored as XML format to communicate across different systems according to SOAP protocol. The MARC and DC metadata is transferred into LOM or SCORM metadata by using collecting tools, which assures the sharing of library information resources. In the meantime, the combination of
resource metadata collected from the library and courseware in the VLE has enriched teaching resources. For those resource systems that are compatible with DC, metadata is obtained according to OAIPM H protocol.

B. Database

Database, a core component of VLE, stores metadata from the users, events, processes and courseware. The use of relational database (RDB) can better store and retrieve metadata from library resources and learning objects, making the system reliable and efficient, such as Oracle, SQL Server, MySQL, etc. The use of Structured Query Language (SQL) standard has simplified the operational complexity, making the system easier to modify and alter. Taking DC metadata as an example, DC metadata and related resource URLs are mainly stored in the database, that relative information can be easily acquired just by retrieving and describing the name of objects, such as ‘Creator’, ‘Subject’, ‘Description’, or, by searching key words.

C. Middleware Technology

1) Middleware based on Learning Object Metadata

Learning objects from different VLEs are described and stored via metadata, which is beneficial to sharing information. The metadata of learning objects is generated from the learning object management system that is usually designed with three structural levels——user interface, application server (middleware), and database server, which makes the system highly flexible and secure. To be specific, HTML+JavaScript is serving as the user interface, MicrosoftASP3.0 as the script environment for the server-side, and SQL as the back-end database. In the system, it is easy to operate learning objects in the database by using ASP script component, and the design of user interface can be done completed by ActionScript of FlashMX, which increased the dynamic interaction with users, and strengthened the drive application to relational database.

2) Obtaining Library Digital Resources

To link the VLE to the digital library, digital resources from the library are integrated into VLE, to adding learning object contents in the VLE. Middleware technology let users able to retrieve library bibliographic record metadata across database, and organize those acquired metadata in form of a resource list, to finally send information to users via data acquisition software. During the process, software tools should be designed in order to allow users in the VLE to obtain library digital information resources within the curriculum system, and to transfer them to the learning environment. In China, digital libraries have adopted international standard Z39.50 protocol set up by American National Standards Institute (ANSI) as the standard for information retrieval, and used Java to design client and server components, more specific, JavaBean to design the Z39.50 client, which offers Java interface as retrieving in the Z39.50 server, so that the retrieval can be done via search of XML format, with its query result record obtained as XML files (like MARC XML by MARC) or as other formats (like DC) by using XSLT to convert. The system diagram is shown in Figure2.

![Figure2: Integration structure diagram based on Z39.50 protocol.](image)

For those library database that are compatible to Z39.50 protocol, metadata such as library booklist metadata and MARC metadata of other resources can all be obtained by following the above-mentioned method. For those not compatible, SQL query can be done under database connection protocol——Open Database Connectivity (ODBC) ---- based on API standard, which is to say, an external agent could carry out SQL query in library database once a local SQL server was set which has established a mapping from library database under ODBC, and because of the mapping
relationship, all the modifications of contents in the library database would be reflected in the SQL server.

3) OpenURL

OpenURL is a mechanism that allows for open interconnection under Web academic information environment, which standard based on HTTP protocol, providing grammar of transferring bibliography metadata and object identifier lying in the information service. In the integration process, OpenURL can be regarded as the interface between VLE and integration system. In addition, it has effectively externally linked electronic resources together accurately and logically, which could further help linking heterogeneous library resources. The SFX context-sensitive connection server of ExLibris under OpenURL has successfully made context-sensitive connections among different Web resources under the academic environment. In VLE, integrated digital resources can be obtained by using MetaLib / SFX platform purchased by Fudan University Library, and various connected library collections and external e-resources can also be acquired by using OpenURL service from SFX server, such as the local collections from Open Public Access Catalogue (OPAC), the local database, the full-text database provided by suppliers, full-text e-journals, related internet resources, etc.

V. CONCLUSION

For a long time, the digital library and vital learning environment have been applied and developed under individual circumstances, that neither could have acquired direct support from the research and development of the other. The integration of the two can provide a powerful technical support for scholar teaching research. During the integration process, technical feasibility is a key issue, as live teaching resources and related digital library resources can be continuously obtained by using a series of functional technical research and development, which could enrich online learning experiences for students and fulfill integrated learning. However, in the practical operating process of the integration system, there is still a series of questions needs further research and discussion, such as the personnel organization of teaching staff and library staff, the authority to use data, the copyright of e-resources, the influence and assessment toward teaching and learning, etc.

REFERENCES