

The research of the Learning Resource Management Compatible with many Standards

Xinyu Zhang¹, Li Zheng², Yintao Liu²

1 Computer and Information Management Center, Tsinghua University, Beijing100084, China

2 Department of Computer Science and Technology, Tsinghua University, Beijing100084, China

zxy@cic.tsinghua.edu.cn

Abstract: In this paper, we present a learning resource management approach, which is compatible with many standards. We use metadata generation technique, metadata management technique based on XML database, as well as the standard transformation technique, to design and implement a demonstration of learning resource management system. This system consists of Learning Resource Upload Module, Metadata Generating Module, Learning Object Management Module, Metadata Transformation Module and Standard Metadata API Module. This paper ends with an introduction of the Lifelong Learning System in Shanghai, China, as an example to present the advantages of standardized learning resource management.

Keywords: standards, learning resource management, eLearning, metadata management technique

Introduction

Nowadays, popular use of the web has made it possible for people to get a tremendous amount of information. However, the lack of efficient tools which can transform massive information into useful knowledge caused “the data has exploded but knowledge is poor”. And our aim is to enhance people’s learning process by the use of technology in inclusive learning environments.

It is undeniable that everyone should gain equal access to knowledge and education, regardless of their race, sex, abilities and capabilities. As a developing country, the educational and learning environment in China is far from satisfactory. Although China has accumulated a huge amount of medical and cultural treasure in its long history, however, in modern society, China urgently needs sharing learning resources with the help of information and internet technology in order to offer equal opportunity for the public. Supposing that the rich learning resources can be shared equally among different people in all parts of the world, Chinese learners would be able to access learning resources from other countries, and simultaneously, the world can better assimilate China’s unique historical, cultural and spiritual wealth.

Actually, the linguistic and cultural diversity is the main bottleneck for the realization of resource sharing. Various educational resources has different basis and then creates inevitably

serious problems. In order to eliminate the misunderstanding generated from various metadata standards, we should first break the cultural barrier among different domains and different areas.

It has been recognized that metadata is essential to ensure the accessibility and discovery of information. In terms of reusability and interoperability, the metadata model must be standard-based. IEEE Standard for Learning Object Metadata (IEEE LOM) developed by IEEE LTSC (Learning Technology Standards Committee) is a popular standard in eLearning. The CELTS LOM (China eLearning Technology Standards) based on IEEE LOM, "Specification for Learning Object Metadata", has been developed and widely adopted in China. ISO/IEC JTC1 SC36 is developing an international standard named Metadata for Learning Resources (MLR) with similar objectives. Additionally, this multipart standard takes into account the diversity of cultural and linguistic contexts in which learning resources and their metadata is likely to be created and exploited.

Therefore, a mechanism which is able to transform between the widely used industrial standard, the national standard in China and international standard for learning resources is urgently needed. This collaboration between different standards can greatly increase the interoperability of the platforms by which we can speed up the propagation process of learning resources to improve the education condition of poor areas. Furthermore, we could realize excellent learning resources sharing between China and the outside world.

This paper presents a Learning Resource Management System based on CELTS LOM, which could be transformed to IEEE LOM, MLR, with the help of current technology.

1. Project Objectives and Related Work

Innovated by a common prospect that people from different places, with different statuses, are equal to use the same resources, faced with the invisible barrier between the reality and ideal, we endeavor to contribute to the society with our full energy to break the barrier step by step.

As web-based learning in China is widely used in education and training, the amount of digital learning resources begin to accumulate. Reusability and interoperability of digital learning resources become one of the major challenges. Transferring traditional courseware into standard computer-based instructional eLearning objects and content packages can greatly enhance the reusability and interoperability of digital learning resource. Thus the cost of developing courseware can be lowered by reusing learning objects. Therefore, we take advantage of the most popular standard – IEEE LOM as the basis, forming our own national standard – CELTS LOM.

Most popular educational technology, eLearning repositories and Learning Content Management Systems (LCMS), such as SCORM[5], Blackboard[6], Moodle[7], and Sakai[8] are mainly based on IEEE LOM to describe learning resources, and [9] contains a detailed survey on several popular LOM-based repositories. At the same time, many other systems are using similar standards, such as CELTS LOM (Chinese E-Learning Technology Standard), IMS LRM[10] and many other kinds of metadata standards. Moreover, ISO/IEC standard named MLR is on its Final Committee Draft Voting process. The reasons why so many metadata standards coexist are different cultures and languages, as well as diverse educational and technical backgrounds.

Multiple metadata standards raise a common problem – interoperability, just as the original idea of introducing metadata standard. Are all these standards compatible with each other? How to search, deliver, share resources between different eLearning platforms which are using different

metadata standards? Is any information lost during transmission process of resources? Several tools have been designed to demonstrate and answer the above questions.

ISO/IEC JTC1 SC36 has made a survey on different kinds of eLearning metadata[11], and the result shows that IEEE LOM is the basis of most metadata standards, while they select part of IEEE LOM elements to be mandatory (core) as their own application profiles.

SHAME [17] is a Browser/Server demonstration for multiple metadata generation. It provides user interface to fill metadata forms of IEEE LOM and Dublin Core online. Through B/S architecture, it is easy for other web applications to be integrated into more complex ones, regardless of what client used.

RELOAD Editor [18] is a Content Package and Metadata Editor. It supports creating, editing IMS LRM and LTSN metadata, which are based on IEEE LOM, as similar as CELTS LOM. Generated metadata could be treated as learning object for building Content Package. It is an open source project which is mainly implemented with Java, a cross-platform programming language. It is of significant value to the UK Higher Education community and beyond, since it provides the crucial “missing link” which allows users to author and transfer learning objects, in specification compliant format, between authoring and design tools, local and distributed digital repositories, and Virtual Learning Environments (VLEs).

LomPad[19] is another open source and java-based LOM Editor. It allows users to tag objects according to several major application profiles, namely IEEE LOM, NORMETIC, CanCore and SCORM. The LomPad interface is bilingual, French and English. It also brings a “missing link” for users to better understand and use Canadian metadata standards.

2. Resolution and Implementation of Learning Resource Management

Based on the ideas in the above words, we designed and implemented a learning resource management system, which can generate metadata instances, and transform their format from one metadata standard to another. The standards supported by this system are IEEE LOM, CELTS LOM and MLR.

Due to the hierarchy structure, all these three metadata models could be perfectly matched to XML document. Additionally, IEEE LTSC recommends XML as the binding approach by providing XML Schema for IEEE LOM [20]. MLR is of similar structure with IEEE LOM. Therefore, we choose XML to bind metadata models.

Most work of the system is to add new learning resources for storage, to generate metadata, and to locate the appropriate learning resources by searching the metadata. Therefore, the XML presentation of metadata should be stored for the management of learning resources. XML-native database is a good solution. When the XML documents are stored into the database, the structure of the document is not converted to table-structure, as used in Relational database, neither does the retrieval of the documents need the reverse conversion. Berkeley DB XML uses the XQuery as the query language.

XSLT (Extensible Stylesheet Language Transformations) is adopted to transform among different metadata models. XSLT is an XML-based language used for the transformation of XML documents into other XML documents. It relies upon the W3C's XPath language for identifying subsets of the source document tree.

The architecture is based on the B/S architecture. Contrast to other Client/Server

architectures, B/S is convenient for users, for whom only a browser is required. In addition, the change of the system doesn't affect the users.

Java is our basic programming language for the tool. Being one of the best cross-platform languages, it is proved to be "write once, run anywhere".

We use J2EE technique to implement a web-based learning resource management system. Figure 1 shows its architecture. All metadata files are stored in XML Database, while the learning resources are stored in Learning Resource Repository. There are five core modules in the server's application layer:

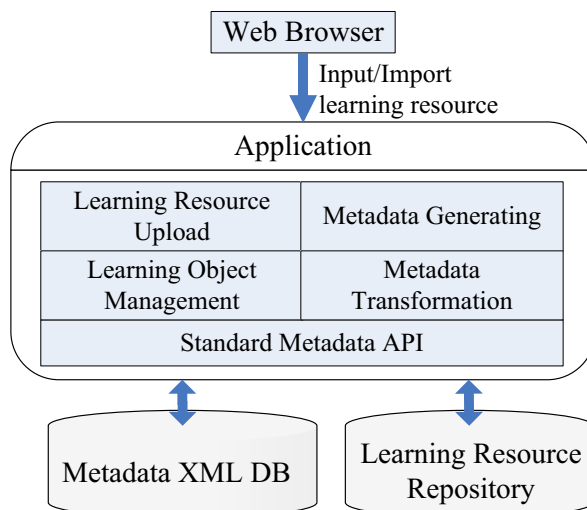


Figure 1. Architecture of learning resource management system

- Learning Resource Upload Module – this module firstly checks the file type. If it is a zip file, it will create a folder in the repository and automatically extract the package into that folder. This is very useful for uploading complex learning resources. If the file is not a zip one, the module would treat it as a single file and upload it into the repository. Its technical information would be filled automatically for the next module;
- Metadata Generating Module – this module provides interactive page for users to fill the metadata form. It also introduces 'template' into the generating process so that users could reuse it while filling other forms efficiently. Users could create, edit, and remove any of their own templates. After the metadata has been completed, it would be saved into database as an XML file;
- Learning Object Management Module – this module contains searching interface for users. Since XML database stores all metadata, we use XQuery to locate, update, and delete corresponding metadata instances;
- Metadata Transformation Module – this module uses XSLT technique to do transforming. As described in Figure 2, we choose CELTS LOM as the basic metadata, and add conversion rules into XSLT as the transformer, which could convert the original CELTS LOM into IEEE LOM or MLR;
- Standard Metadata API Module – this module introduces CELTS specification API [15][16]. It defines programming interface and java implementation of basic LCMS services, such as API of Filing, Course Management, LOM, Database and etc. This tool

mainly adopts the LOM and Database API to deal with CELTS LOM operations and interact with database in a recommended way.

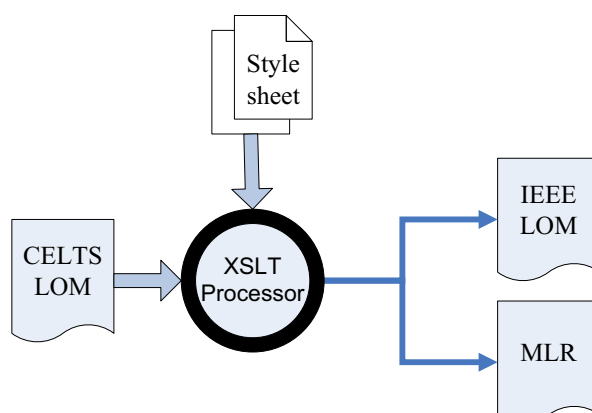


Figure 2. Transformation process

With these 5 core modules, this application is able to provide functions to upload learning resource and make it a reusable learning object, supported by IEEE LOM, CELTS LOM and MLR.

The flow of using this system is shown in Figure 3:

- Select the learning resource file or compressed zip package, and click “upload” button to upload the file;
- Fill the metadata form until all necessary fields gain their contents;
- Since the templates store what users consider the most common values, it is suggested that users select it before filling in their own specific data. Users could also save or update a template;
- After finishing the form, click “submit” button to generate a learning object;
- Review the metadata in a more comprehensive format. Click “IEEE LOM” button to transform current metadata to IEEE LOM format, and so do “CELTS LOM” and “MLR” buttons. Click “exp-ort” button to export the metadata as XML file.

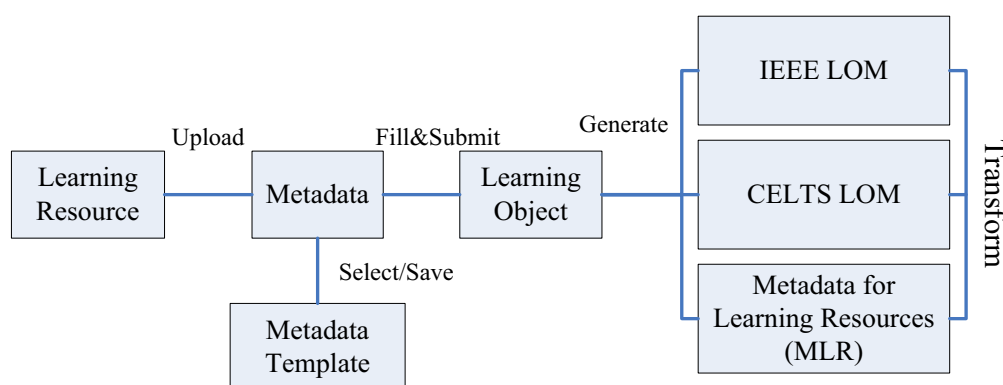


Figure 3. Flow of learning resource management system

Figure 4 illustrates a slice for demonstrating how the system does the transformation. The left side is CELTS LOM instance, indicating the learning resource type information. After

transformation, the upper right is IEEE LOM instance, while the lower right is MLR instance. This figure shows the great differences between LOM and MLR, and also shows that one of the main differences between CELTS LOM and IEEE LOM is the language. More details are listed below:

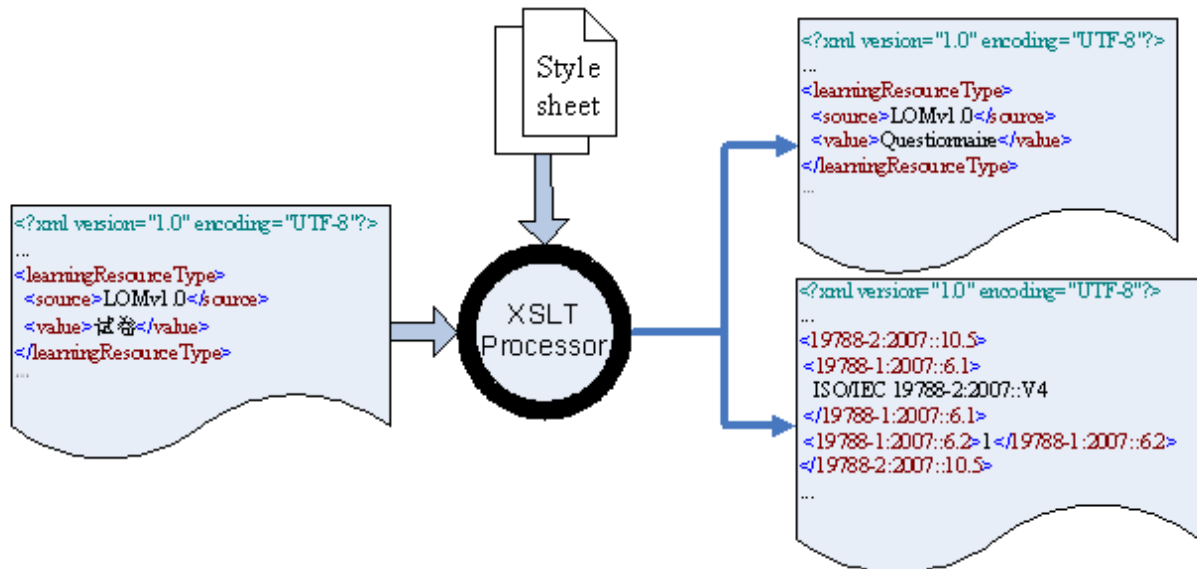


Figure 4. A real metadata transformation case

Since the derivation relationship, CELTS LOM and IEEE LOM share the same structure, terminology and rules. CELTS LOM defines mandatory elements to be the core element set based on China's specified eLearning condition. And all the vocabularies are localized to be in Chinese.

For the mapping between IEEE/CELT LOM and MLR, ISO/IEC provides mapping rule documents [21][22]. [21] is considered to be one part of MLR's multipart standard. [22] is our work which has been presented in ISO/IEC JTC1 SC36 WG4 plenary meetings in Toronto, Canada, 2007.

Together with a Content Packaging tool following our national Content Packaging Standard (CELT CP), we have implemented a Learning Content Management System[12], which uses all the learning objects to build learning content packages. In this system, all the learning resources are reused with the help of metadata. Those packages could be exported to be standard content packages, which are able to be imported in other LCMS that also support CELT CP standard. Similarly, a Learning Design system[13] also makes use of this tool. Therefore, resources are reused, serving as basic bricks to build repositories and more complex eLearning applications.

3. Implementation of Learning Resource Standardization

Similar to RELOAD Editor, this tool helps speed up our national standardization process by providing a link between standard documents and real applications. It is also a good demonstration for Chinese eLearning platforms, learning resource repositories to make their resources standardized. Moreover, its scalability makes it possible to be integrated into higher-level systems.

Shanghai Distant Education Group[14] are standardizing learning resources in their E-Learning system. All of their learning sources are described by CELTS LOM, taking up to 1,859 Gigabytes of hard disk space with 129,216 files. 7 parallel servers are running as its repository. More than 130,000 users benefit from this system, among which the ratio that people from rich and poor places is approximately 6:4. Many internal platforms collaborate with each other through exported XML CELTS LOM files. Also this system is interoperable with several international platforms such as Microsoft LRN, Dokeos, etc. Furthermore, the learning contents they develop support SCORM 1.2.

4. Conclusion and Future Work

The sharing and interoperability of learning resources plays a key role of inclusive learning environment, and standardization is a general solution to this issue. However, due to factors such as linguistic and cultural differences, various metadata standards are established for widely distributed learning resources in all parts of the world, which consequently creates difficulties for sharing learning resources equally among people. The learning resources management systems presented in this paper is well compatible with multiple standards and thus provides an effective approach to realize resource sharing in modern society. Recently, the lifelong learning system in Shanghai, China, has already applied a great deal of standardized resources, which can give equal and brilliant opportunities for learners to access a variety of resources through the standardized learning platform. This is essential for the Chinese users, for it greatly facilitates learning procedures of common people. Especially, it provides inexpensive but rich learning resources for poor people.

Although the standardization of learning resources is the most important, it is just our first step to develop more standards for learning technologies such as learner model, specification for E-Learning system architecture and interface, with the support of the national key scientific and technological plan. Meanwhile, we are trying to establish nationwide learning resource platforms and repositories in order to achieve the standardization of inclusive learning environments in the near future.

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