Metadata for K9 e-Learning in Taiwan: an Application Profile Approach

Abstract

The study aims to develop a core set of metadata elements for K9 e-learning resources based on a case study of Education to e-Learning Project under auspice of the Ministry of Education in Taiwan. Eventually, a set of 53 metadata elements has been developed as a LOM-based application profile for Taiwan K9 e-learning resources, and two guidelines are also produced for metadata system implementation and cataloguing. Furthermore, three findings are presented as follows. (1) The LOMAP implied the LOM has attained a high acceptance in Taiwan K9 e-learning community. (2) The Taiwan K9 LOMAP covers functional requirements of element attributes, such as mandatory or optional, for system development. (3) A challenge in controlled vocabulary for interoperability among different LOMAPs will emerge. Finally, this study suggests that the Taiwan K9 LOMAP would be a ground to further include more samples and domains, in order to become a Taiwan LOM Core.

1. Introduction

Metadata, as an interoperability mechanism, has been playing significantly roles for e-learning community, because it promotes easy exchange of content or data between different systems based on different technologies [1]. The purpose of the research includes two folds: one is to develop a core set of metadata elements for K9 learning resources, and the other is to learn more about how metadata can be met the needs between interoperability and localization in the context of learning resource repository.

2. Literature Review

There have been numerous studies of the concept and importance of learning technology standards. For instance, Hodgins and Conner [2] and Campbell [3] traced history experience and addressed that common standards are key to successful e-Learning, where both relay and movement of learning itself is economic and efficient. The term “standard” in the context of learning technology may indicate different development levels of standardizations including approved standards (such as ISO), accredited standards (such as IEEE LOM), application files (such as SCORM and CanCore) and technical specifications (such as IMS specifications) [4] In general, the learning technology standard refers to a vast area as it involves the description of content, activity, role and function for learning resources. In other words, a complete set of standards for application on e-learning management systems needs to be consisted of variety standards including learners, learning resources, learning institutions, question and test, learning design, content packaging, sequencing and so forth [2]. One may recognize that metadata, in a narrow sense, refers to the description of learning resources. However, in a broad sense it covers all aspects of standards above.

In the light of the adoption of metadata standards for learning resources, the IEEE Learning Object Metadata (LOM) standard has been tested by members of e-learning community who are committed to open access and interoperability, and has showed a high degree of informal acceptance in communities that

develop education metadata [5]. Among of these applications, most cases have used a metadata application profile approach to fulfill the needs of both interoperability and customization for learning resources. For instances, SCORM., uklomcore, CanCore, Curriculum Online, and Dublin Core [6].

3. Research Methodology

3.1. Sample

This study employs the LOM application profile (LOMAP) as an approach to develop a metadata elements set for K9 e-learning resources in Taiwan, because application profiles allow designers to 'mix and match' schemas as appropriate for local requirements. In other words, the application profile is an assemblage of metadata elements selected from one or more metadata schemas and combined in a compound schema [7]. In e-learning domain, the IEEE LOM is often selected as a basis to develop a variety of application profiles or specifications for e-learning resources, such as CanCore of Canada. In our study, the 'Education to e-Learning' (EtoE) Project is chosen as a case study to develop a LOMAP for K9 e-learning resources in Taiwan. The Project has been initiated by the Ministry of Education （MOE）of Taiwan since 2003 to provide educators at the elementary and secondary levels with an integrated searchable interface for all learning objects from distributed educational resource repositories among Taiwan [8]. The three major educational resource repositories of the Project chosen for this study are: The Learning Fueling Station (http://content1.edu.tw/), EduCities (http://www.educities.edu.tw), and SCTNet (http://sctnet.edu.tw/index.php).

3.2. Data Collection

The data collection for this case study is conducted in four parts as follows. Firstly, questionnaires are sent to the three educational resources repositories to investigate the current status of usage of metadata elements. Secondly, five existing international metadata standards, application profiles and specifications related to the LOM standard are selected as the reference to identify the common core of the metadata elements for learning resources. These are LOM (v.1.0), SCORM (SCO)(v.1.3), IMS Learning Resource Meta-data Specification (v.1.2.1), CanCore Learning Object Metadata Guidelines (v.1.1), and Dublin Core-Education Application Profile. Thirdly, an in-depth interview is conducted with educational experts and catalogers of the three educational resource repositories. Finally, the feedback is gathered from the staff of repositories after implementing the metadata set for the EtoE Project based on the OAI-PMH.

3.3. Data Analysis

There were multiple approaches to establish a set of LOMAP for the K9 e-learning resources. The First, the local needs are analyzed through the metadata mappings from the schemas of three educational resources repositories in Taiwan to produce a common core (set A). Then, a semantic cross-walk among existing international metadata standards, profiles and specifications of e-learning resource are investigated to form the common core (set B) of LOM elements from a global viewpoint. The union of above two sets of common core {A, B} is established and reviewed by the educational experts and managers of the repositories to acquire their requirements and suggestions for the metadata elements.

4. Results

There are 53 elements identified as the core metadata set for the Taiwan K9 learning resources, which integrated the common core elements (set A, 14 elements) from the research samples, the common core elements (set B, 21 elements) from the international metadata standards, the elements recommendations of the experts, catalogers (set C, 8 elements) and system managers (set D, 16 elements) (see Figure 1). The 53 elements then are restructured according to the LOM data structure (see Table 1).

In addition, two guidelines are developed. The first is the "Guide to Taiwan K9 LOMAP" which provides the following information for each element as a whole: element name, definitions, data contents (cataloguing recommendation), examples, implementation notes, data values (vocabulary recommendation), metadata crosswalks and learning resource types (see Figure 2). The Taiwan K9 LOMAP has been currently used by the EtoE Project for K9 schools which share the same standard to describe their educational resources and have more than 20 thousand metadata records within the OAI based repository.

The second is the "Guide to the Metadata Implementation" (see Table 2) which is a quick guide of functional requirements for system development in the context of Taiwan K9 LOMAP. The guide involves two types of functional requirements. One is information retrieval including the elements for access

point, limitation search and display. The other is metadata creation including the elements with values supplied by system default, by record creator or by controlled term list. In addition, mandatory and optional attributes for elements are identified within this Guide.

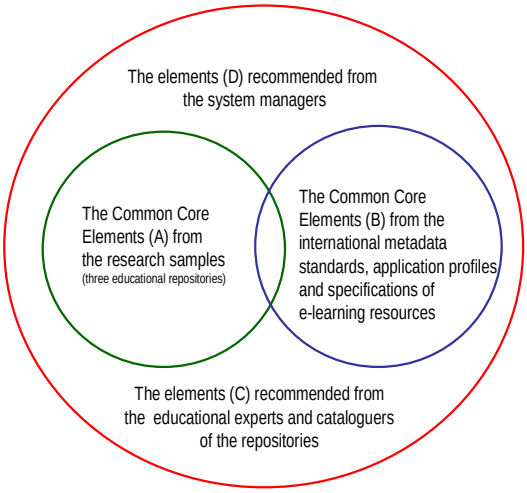

Figure 1. The formulation of K9 LOMAP

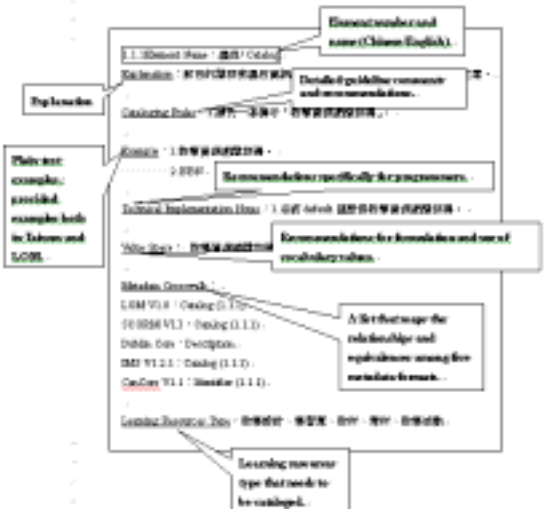

Figure 2. Guide to Taiwan K9 LOMAP

Table 1. LOM v.s. Taiwan K9 LOMAP version1.0

1. General	B	3.3 Metadata Schema	D	5.11 Language	
1.1 Identifier	B	3.4 Language	D	6. Rights	BC
1.1.1 Catalog	B	4. Technical	B	6.1 Cost	C
1.1.2 Entry	B	4.1 Format	B	6.2 Copyright and Other Restrictions	C
1.2 Title	AB	4.2 Size		6.3 Description	C
1.3 Language	B	4.3 Location	B	7. Relation	B
1.4 Description	AB	4.4 Requirement		7.1 Kind	B
1.5 Keyword	A	4.4.1 OrComposite		7.2 Resource	B
1.6 Coverage		4.4.1.1 Type		7.2.1 Identifier	B
1.7 Structure		4.4.1.2 Name		7.2.1.1 Catalog	B
1.8 Aggregation Level		4.4.1.3 Minimum Version		7.2.1.2 Entry	B
2. Life Cycle	C	4.4.1.4 Maximum Version		7.2.2 Description	B
2.1 Version	C	4.5 Installation Remarks		8. Annotation	D
2.2 Status		4.6 Other Platform Requirements		8.1 Entity	D
2.3 Contribute	A	4.7 Duration		8.2 Date	D
2.3.1 Role	A	5. Educational	D	8.3 Description	D
2.3.2 Entity	AB	5.1 Interactivity Type		9. Classification	ABC
2.3.3 Date	AB	5.2 Learning Resource Type	D	9.1 Purpose	A
3. Meta-Metadata	D	5.3 Interactivity Level		9.2 Taxon Path	A
3.1 Identifier	D	5.4 Semantic Density		9.2.1 Source	A
3.1.1 Catalog	D	5.5 Intended End User Role	B	9.2.2 Taxon	A
3.1.2 Entry	D	5.6 Context		9.2.2.1 Id	A
3.2 Contribute	D	5.7 Typical Age Range		9.2.2.2 Entry	A
3.2.1 Role	D	5.8 Difficulty		9.3 Description	
3.2.2 Entity	D	5.9 Typical Learning Time	C	9.4 Keyword	
3.2.3 Date	D	5.10 Description			

Note 1: represents a set of metadata used in K9 education in Taiwan educational repositories. A represents the common core elements from the research samples. B represents the common core elements from the international perspectives. C represents the elements recommended by the educators. D represents the elements recommended by the system managers.

Note 2: [Classification] would repeat 4 times according to the discipline, educational level, competency, and prerequisite.

Table 2. Guide to the metadata implementation (◎access point ※outline display)

	Mandatory	Optional
Automatically Supplied Values	1.1.1 Catalog 1.1.2 Entry 4.3 Location ※ 9.1 Purpose (discipline) 9.2.1 Source (discipline) 9.2.2.2 Entry (discipline) 9.1 Purpose (educational level) 9.2.1 Source (educational level) 9.2.2.2 Entry (educational level) ※	3.1.1 Catalog 3.1.2 Entry 3.2.1 Role 3.2.2 Entity 3.2.3 Date ※ 3.3 Metadata Scheme 3.4 Langue 5.5 Intended end user role 9.1 Purpose (competency) 9.2.1 Source (competency) 9.2.2.2 Entry (competency) 9.1 Purpose (prerequisite)
Values Supplied from Record Creator	1.2 Title ◎※ 1.4 Description ◎※ 1.5 Keyword ◎※ 2.3.2 Entity ◎ 9.2.2.1Identifier(educational level) ◎	2.1 Version 2.3.3 Date 5.9 Typical Learning Time 6.3 Description 7.2.1.2 Entry 7.2.2 Description ※ 8.1 Entity 8.2 Date 8.3 Description 9.2.2.1 Identifier (competency) ※ 9.2.1 Source (prerequisite) 9.2.2.1 Identifier (prerequisite) 9.2.2.2 Entry (prerequisite)
Values Supplied by Term List	2.3.1 Role 5.2 Learning Resource Type ◎ 9.2.2.1 Identifier (discipline)	1.3 Langue 4.1 Format 6.1 Cost 6.2 Copyright and other restrictions 7.1 Kind 7.2.1.1 Catalog

5. Findings

The following findings were discovered in a review and analysis of the results of this study:

1. The 53 metadata elements adopted from the IEEE LOM standard (77 elements) by Taiwan K9 LOMAP implies that the LOM standard has achieved a high degree (69%) of acceptance in the learning community of Taiwan K9.
2. The Taiwan K9 LOMAP covers functional requirements of element attributes, such as mandatory or optional. This enables the system implementation clearer and easier.
3. Although all the metadata elements of the Taiwan K9 LOMAP can be mapped to IEEE LOM, the

controlled vocabularies are difficult to interoperate, such as "learning resource type element", "competency in classification element" This will bring the challenge for interoperability among different LOMAPs.

6. Conclusion and Suggestions

The purpose of this study is to develop a metadata application profile and guideline for e-learning resources. The research has achieved two results. One is the Metadata Application Profile/Guideline, and the other is the Guide for Development of e-Learning Metadata Systems. Both of these are now applied on the installation of the "EtoE Project" of the MOE in Taiwan. The study suggests the following as future research.

6.1. Toward Taiwan LOM Core (Extending the scope of application of the Profile)

This study aims on the three learning repositories for elementary and secondary schools as research samples for discussion of the metadata requirements before launching a set of LOM Core in Taiwan. In the future, the test will be further extended to local learning resources webs, such as the learning resources from 25 counties of Taiwan in 2005. In addition, more research samples will be included, such as high school, community college and advanced education. Trials on widened domains, such as government and enterprise learning repositories, could help to shape a more appropriate Taiwan LOM Core.

6.2. Toward depth in the metadata application profile

For the sake of its interoperability with relevant e-Learning systems worldwide (such as shared systems for Chinese learning resources), the metadata application profile must be compatible not only data structure standards (like IEEE LOM), but also data content and data value standards. For optimal scale and extensibility of e-Learning in the future, the study would suggest the use of IEEE LOM as basis while incorporating local needs and international standards using the application profile approach. Besides the data structure, it would be critical to have all types of vocabularies (such as audience, pedagogy and resource type) to work with international standards for common agreements or crosswalking mechanism. In the light of data content standards, they could guide the choice of terms used in description, and define the order, syntax, and form in which data values should be entered into a data structure [9]. Although parts of the data content standard have been defined in the IEEE LOM and its derived application profiles like CanCore, it still needs to have a will-established data content standard for e-Learning resources.

7. References

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