Gaps between Metadata Standards of Learning Objects and Educational Needs of Multimedia Learning Resources

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Abstract: - Multimedia learning resources have diverse content forms which can satisfy the educational needs including multimodal resources, multi-sensory teaching, virtual situated-teaching, simulation classroom, emotion interaction, and so on. So, many teachers/developers create multimedia resources for learning, education and training. In order to avoid repeated efforts of teachers/developers, metadata standards could be used for sharing and reusing multimedia learning resources. This paper describes existent metadata standards and their features respectively. The educational features and needs of multimedia learning resources are analyzed. Some educational features are different from single media, such as teachers and learners' emotion, discourse and behavior, and so on. According to these differences, the gaps between metadata standards and educational needs of multimedia learning resources are listed. Existent metadata standards don't fully describe educational features of multimedia learning resources to share and reuse.

Key-Words: - Metadata, Multimedia Learning Resource, Sharable Learning Object, Educational Feature, Multimedia Content Structure, MPEG

1 Introduction

Many organizations and departments have defined standards of learning object metadata (LOM) for describing learning objects to support sharing and reuse of learning resources. LOM standards are descriptive structure based on attributes and features of learning objects. Metadata is descriptive information about things. For examples, The Institute of Electrical and Electronics Engineers, Learning Technology Standards Committee, Learning Object Metadata (IEEE LTSC LOM) and Dublin Core Metadata Element Set (DCMES) are popular metadata standards. As a specification, existent LOM standards are widely applied in managing and annotating resources. They help realize the following functions for resources needs: indexing, retrieval, sharing and reusing, evaluation, interoperability, and context.

Multimedia learning resources have arising with the development of technologies. How to make multimedia learning resources be searchable and reusable is very important [8] [13]. The existent LOM standards are not very efficient in searching and reusing multimedia learning resources, and can not solve the integration and delivery of multimedia learning resources [8]. The main reason is that multimedia has diverse forms and formats, which make teachers/developers and learners share and reuse them getting difficult. In addition, existent metadata standards lack descriptions for educational needs of multimedia used in learning, training and education.

There are also some data models in describing multimedia resources, including Dublin Core, MPEG-7, and so on. These data models support descriptive metadata for multimedia resources [4],

but none of them fulfill all requirements of educational multimedia resources yet.

This paper discovers and lists gaps of metadata standards for learning objects and educational needs of multimedia learning resources.

Section 2 describes important metadata standards of learning objects and explains the features of these metadata standards. Moreover, Section 2 compares existent standards. Section 3 discusses the features and educational needs of multimedia learning objects, and tells the gaps between LOM standards and educational needs of multimedia learning resources. Section 4 gives simple summary and possible future jobs.

2 Standards of Sharing Learning Resources

Sharable Learning resources not only make teachers/developers create new learning resources efficiently and decrease many unnecessary efforts, but also promote learning resources be referenced and reused for learning, education and training purposes.

2.1 Standards of Sharable Learning Objects

There are many standards of sharable learning objects. Some famous standards are described in the following sub-sections.

2.1.1 IEEE LTSC LOM

The Institute of Electrical and Electronics Engineers, Learning Technology Standards Committee, Learning Object Metadata formally published 1484.12.1 IEEE standard for LOM in June 2002, which concretely specifies attributes of data element to describe learning objects [11]. These data elements can be grouped into nine categories. Data elements have tree types, including optional data elements, extended data elements, and essential data elements. The vocabulary of data elements may be uniformed to overcome the diversity of cultural and lingual contexts.

There are other standards to define bindings of the LOM records, such as eXtensible Markup Language (XML) Schema Binding for Data Model for Content Object Communication, eXtensible Markup Language (XML) Schema Definition Language Binding for Learning Object Metadata, and so on.

2.1.2 ADL SCORM

Sharable Content Object Reference Model (SCORM) was formed in 1997. The goal of ADL SCORM is to help learners get high quality education and training. ADL SCORM also hopes realize adaptive personalized learning [3] to satisfy different need, knowledge background, cognitive structure and interesting at any time and any where.

According to its goal, SCORM defines “Content Aggregation Model” and “Run-Time Environment” for learning objects [1] [2]. Content Aggregation Model references IEEE LTSC LOM, Content Packing and Metadata Binding of XML of IMS, Content Structure of AICC. Run Time Environment has Launch, API, Data model components. The three components give a public mechanism for learning resources can be reused and cooperated among different learning management systems.

2.1.3 Dublin Core

Dublin Core Metadata Element Set (DCMES) was produced in March 1995. Dublin Core (DC) metadata element set can be applied in any digital resources. Its goal is to provide convenient discovery and retrieval for searching digital information.

Dublin Core Metadata Element Set is a fifteen set of data elements, including title, creator, contributor, publisher, subject, description, data, resource type, format, identifier, source, language, relation, coverage, rights [11]. Each data element has its definition.

According to requirements of education or training, Dublin Core Education Working Group (DC-ED) has added five DC-ED elements on DC elements. The five DC-ED elements contain the Interactivity Type, Interactivity Level, and Typical Learning Time data elements from 1484.12.1 IEEE standard.

2.1.4 ISO/IEC JTC1/SC36

The International Organization for Standardization and the International Electrotechnical Commission, Joint Technical Committee1, Subcommittee 36 (SC36) studies the standard of information technology for learning, education and training (ITLET).

Subcommittee 36 (SC36) designs Metadata for Learning Resources (MLR) to describe learning resources. Metadata for Learning Resources (MLR) is composed by a set of Data Element Concept and Conceptual Domains. Part 1(Part 1: project 19788-1) is frame work to develop subsequent parts fulfilling specific needs. Part 2 (Part 2: project 19788-2) is data element of metadata for learning resources.

2.1.5 IMS

In 1997, the Instructional Management Systems (IMS) Project was founded as one part of the non-profit EDUCOM consortium (now EDUCAUSE) of US institutions of higher education and their vendor partners.

IMS has developed into Instructional Management Systems Global Learning Consortium (IMS GLC) which takes an effort to publish international standards for e-Learning. Now, it has 20 standards including meta-data, content packaging, question & test, common cartridge, enterprise services, sequencing, competencies, access for all, ePortfolio, learner information, tools interoperability, resource list, sharable state persistence, vocabulary definition, and learning design [14].

2.1.6 MPEG-7

The Moving Picture Experts Group (MPEG) is working group of ISO/IEC, namely ISO/IEC JTCI SC29 WG11. The Moving Picture Experts Group (MPEG) contributes to developing standards for coding representation of digital audio and video. The Moving Picture Experts Group 7(MPEG-7) describes the multimedia content data by a standardized tools set.

MPEG-7 support teachers/developers quickly and efficiently search, browse, identify, process and filter multimedia material. Main elements of MPEG-7 are Description Definition Language (DDL), Description schemes (DSs), descriptors (Ds), and system tools.

2.2 Comparison for Standards of Sharable Learning Objects

There are other standards of sharable learning objects, for example, Aviation Industry Computer-based Training Committee (AICC). On the basis of IEEE LTSC LOM, UK Learning Object Metadata Core (UK LOM Core), Canadian Core Learning Resource Metadata Protocol (Can Core), CELTSC LOM are developed and localized. Based on DC, Gateway to Educational Materials (GEM) and Education Network Australia (EdNA) were founded as well.

Therefore many standards of sharable learning objects are generated based on IEEE LTSC LOM or DC. These standards have similar advantages and disadvantages to IEEE LTSC LOM or DC. The comparison shows the general differences among IEEE LTSC LOM, DC and MPEG-7.

The Institute of Electrical and Electronics Engineers, Learning Technology Standards Committee, Learning Object Metadata (IEEE LTSC LOM) has the following advantages and disadvantages:

- It is referenced and localized by many other standards.
- Only a few data elements of IEEE LTSC LOM are used in practice [4].
- Semantic interoperability of data elements have to be improved because different countries have different cultures.
- Poor data typing causes ambiguous situations [3].
- Semantic of learning objects is described to satisfy personalized searching and reusing.

Dublin Core metadata element set has the following features:

- It is general and concise.
- The identification of its functions is good.
- It is not good at describing content [4].

The Moving Picture Experts Group 7(MPEG-7) is a good metadata model for describing multimedia learning objects [13]:

- It has a broad range of applications and supports fine grained description of fragments of the content.
- It is not good at high level information [4].
- Description Definition Language (DDL) of MPEG doesn't facilitate a diverse set of linking mechanisms between descriptions and data, and support the definition of semantic relations. It also lacks particular media-based data types.

3 Educational Needs of Multimedia Resources

Multimedia learning resources can satisfy educational purposes of learners and teachers. And they have educational features which make existent standards can not completely describe multimedia learning resources.

3.1 Educational Needs of multimedia learning resources

Multimedia is the combinations of one or more content forms. So, multimedia learning resources can better satisfy some educational needs:

- *Multi-sensory teaching*. This can promote teaching efficiency because multi-sensory can enhance memory ability. And it also adapts different learners' preferences.
- *Multimodal resources*. Multimodal resources can be created by multimedia.

Education community need multimodal resources ensure personalized learning.

- *Virtual situated-teaching*. Multimedia can construct virtual environment which is useful in realizing some pedagogy theories, such situated-learning, constructivist learning, and so on.
- *Simulation classroom*. Classroom is not the real classroom but the compatible learning environment which learners like, such as classroom, zoo, seaside, and so on. It can change according to learners' interest.
- *Emotion interaction*. Teachers and learners' expressions can be expressed by multimedia. When learners are learning, they can feel emotion not monotonic text.
- *Solving the problem of lacking teachers.* Teaching video can record the teaching scene including content, excellent experiences and pedagogy of teachers. This kind of multimedia learning resources, can be shared in where lack teachers.

The educational needs cause the growth of multimedia learning resources. Metadata standards are used to manage multimedia learning resources for resources needs: indexing, retrieval, sharing and reusing, evaluation, interoperability, and context. However, the existent LOM standards have shortcomings in searching and reusing multimedia learning resources [8]. The reason is that multimedia learning resources have some educational features which are different from single media learning resources.

3.2 Educational Features

There are two kinds of educational features for learning resources. One kind of educational feature comes from the teaching process. The other is feature set to satisfy learners' characteristics.

3.1.1 Educational Features in Teaching

Learning resources not only contain content, teachers, learner, environment and interaction between subjects, but also contain voice, word, expression, image and so on. In teaching, features are described in three aspects.

One is the features of contents included in multimedia learning resources. The followings are some basic features, but not the all:

- *Name*. Any learning resource has its name. The name is identification for indexing or searching. According to the name, we can judge the summary of learning resource.
- *Sequence*. Sequence is the teaching sequence and relationship of knowledge points.
- *Presentation form*. The learning resources are presented by many forms, such as video, audio or others.
- *Difficulty level*. The content of knowledge points is difficult or easy to be understood by learners. The level may be high, middle or low, for example high represents very difficulty in understanding
- *Instructional design*. This records design features of content structure.
- *Teaching goal*. After learners learn this learning resource, they should reach the goal and effect.

Another is the features of teacher in multimedia learning resources, which is mainly in teaching video which is the recording of teaching process in classroom. So, teaching video can completely record teachers' features, such as discourse, expression and body language. This kind of feature completely exists in stage two. Some features of teacher are the following:

- *Teacher's teaching skill*. Teaching skill is recorded to evaluate their teaching qualities. And it also helps search excellent learning resources. The skill can be tagged by different degrees, such as high, middle, low. The degree can be defined according to requirement.
- *Teacher's teaching style*. Teaching style can be classed into many kinds, such as, formal authority, demonstrator or personal model, facilitator, delegator. Different teaching style may adapt different learners.
- *Teacher's teaching language*. Teaching language mainly shows the features of teachers' language, such as humor, encouragement, and so on.
- *Teacher's teaching strategy*. Teaching strategy is the method used by teachers to teach content or reach a teaching goal, such as guided reading, asking question, etc. Different learners may like different methods for the same learning content or teaching goal.
- *Teacher's body language*. It describes teachers' body gesture. For example, a teacher is scratching his/her head when a leaner is causing trouble.
- *Teacher's interactive style.* The interactive style between teachers and learners, teaches and objects or environment, learners and objects or environment.

- *Teacher's pedagogy*. There is much pedagogy. The concrete methods are dialogue, question and answering, and so on.
- *Teacher's discourse*. The discourse includes pronunciation, tone and moves.
- *Teacher's attitude*. The teacher's attitude is positive or negative when he/she is teaching or dealing with things.
- *Teacher's expression*. There are many expressions, such as smile, scowl, and so on. In a situation, the teacher's expression is described which can help analysis if his/her expression plays positive role or not.
- *Teacher's emotion*. Teacher' emotion is positive or negative when he/she communicates with learners or deals with job.

The last is effect which can be classified into several levels. For example, positive effect has three levels including high, middle, and low. The effect is related with some features of teachers and contents which can affect the teaching and learning efficiency.

3.1.2 Educational Features in Learning

From the learning point of view, multimedia learning resources have some features which are to cater for learners' learning features. For example:

- *Learning style and preferences*. Learners' styles and preferences are diverse, such as visual, auditory, read, write and so on. As annotated with learning style and preferences, learning resource can be provided to satisfy the learners' learning characteristics. If the learning resource is tagged with visual learning style, it will adapt learners who are visual style.
- *Learning cognitive level*. The same knowledge point can be created with different difficulty to satisfy learners who have different learning cognitive levels.

And so on.

3.3 Difference between Multimedia Learning Objects and Single media

Multimedia learning resources are the combinations of several content forms, which composed by content, teachers, learner, environment and interaction. Figure 1 shows the differences among text, image, audio and multimedia.

In figure 1, "Yes" indicates a content form has this feature. For row 9 is discourse, and its corresponding line "text" is blank and "multimedia" is "yes", it is to say that the text form has not discourse feature, but multimedia form has. According to figure 1, it is obvious the multimedia learning resources contain more educational features than others in teacher, learner, environment, interaction.

		Text	Image	Audio	Multimedia
Content	Name	yes	yes	yes	yes
	Order	yes	yes	yes	yes
	Expression form	yes	yes	yes	yes
	Difficulty	yes	yes	yes	yes
	Teaching strategy	yes	yes	yes	yes
	Teaching design	yes	yes	yes	yes
	…	yes	yes	yes	yes
Teacher	Discourse Humor Teaching language …			yes	yes
	Emotion Expression: Smile, … Attitude: Kind, … …				yes
	Behavior Eye: Gaze, … Hand: Pat, … Body: Twist, … …		yes		yes
	…				
Learner	Discourse Humor Read …			yes	yes
	Emotion Expression: Smile, … Attitude: Kind, … …				yes
	Behavior Eye: Gaze, … Hand: Write, … Body: Twist, … …		yes		yes
	…				
Environment	Classroom Seaside …		yes		yes
Interaction	Question&Answering …	yes	yes	yes	yes

Figure 1. Comparison Features of Different Content forms

3.4 Gaps between metadata standards and multimedia learning resources

Existent metadata standards are good at describing content. As shown in figure 1, they are not good at describing the following features:

- Seldom reference teacher and learner features. But teachers' features, such as discourse and emotion, may useful in personalized learning.
- Don't completely describe environment. Environment features are important in virtual-learning and situated-learning.
- Pay little attention on interaction features, such as emotion interaction.

If these features are defined, teachers can conveniently search a multimedia learning resource which they want to use in their teaching action. For example, a teacher needs an elicitation teaching example to help know how to prepare teaching content. And the teacher also can search elicitation teaching which is the same to his teaching content. Then he can use the search result in his course. According to the educational needs and features of

multimedia learning resources, existent metadata standards may be worse to support sharing and reusing. This is an obstacle for promote the multimedia learning resources usability and efficiency of e-Learning.

4 Conclusions

This paper listed educational needs of multimedia learning resources and drawbacks of metadata standards for describing multimedia. Firstly, it introduced existent standards of sharable learning objects. Then it analyzed the educational needs and features of multimedia learning objects. According to these features, this paper has briefly presented differences between multimedia and single media learning resources. The drawbacks of existent metadata standards for describing multimedia learning resources are analyzed.

In the following working, the metadata set will be defined to decrease the gaps. In practice, many educational departments define metadata set according to their requirements. And different subjects have differences in educational elements of metadata set. For example, literature and language stresses teaching strategy on writing and reading, but biology put emphasis on operation. An investigation will be designed for teachers, designers and educators. This investigation will help us find common elements in different subjects, educational and core elements of each subject.

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