PROPOSITION OF PEDAGOGICAL ELEMENT IN LEARNING OBJECT METADATA

Yazrina Yahya & Mohammed Yusoff[1]
Faculty of Technology and Information Science
Universiti Kebangsaan Malaysia
43600 Bangi
yaz@ftsm.ukm.my
1Faculty of Information Technology & Multimedia Communication
Open University Malaysia
50480 Kuala Lumpur
mohd007@oum.edu.my

ABSTRACT

Learning object metadata (LOM) is a method used to identify and describe learning object behaviour, function and used. Metadata in particular is used specifically to assist in retrieving any forms of digital objects available on the network, as such the advance based searching used in most search engines is often referred to as metadata based searching or metadata retrieval method. As learning object (LO) is a form of digital object, evidently metadata is also recognised as the method used in accessing and retrieving LO. Therefore in achieving good search results, it is pre-eminent to determine the element details that would be beneficial to users. This leads to the importance of identifying specific metadata elements needed to describe learning object, in which IEEE LTSC had taken the initiative to establish the LOM standard. The IEEE LOM standard derived has 77 metadata elements distributed among nine categories. Although the standard is widely adopted among LO practitioners and researchers world wide, currently it is highly debated that the existing LOM standard is lack of contextual and pedagogical elements. Researchers argued that existing elements on IEEE LOM do not address all aspects of LO context and the elements are merely used as a means for discovering, sharing and reusing LO. Although measures have been taken by various research groups in the American and European region to include new metadata elements to address context and pedagogical issues, these are still insufficient as most are centred to be of service to a specific learning environment or to the patron organisation. This initiate the current work to provide more general based metadata elements as such context level is enhanced and pedagogical role is included in LOM elements. The determination of new metadata element that addresses context and pedagogical role involves identification of related theories, in which these are analysed thoroughly through comparison and adaptability aspects. As a result a new extended element is proposed and it is currently being used in MELOR (Malaysian Educational Learning Object Repository). It is belief that the element proposed is able to assist users in searching specific objects tailored to their needs and also add pedagogical and context values into LOM and LO specifically.

INTRODUCTION

The emergence of learning object concept is made achievable due to the advent of communication technology in creating digital learning environment where it promotes the sharing of digital objects through the use of Internet. As such the concept is introduced to allow sharing of smaller and portable learning to become the front runner for the position of choice in the development and deliver of learning technology. However, the concept introduced is not fairly new to the world of reusable learning materials. The idea has already emerged as early as in the nineties (Persico et al. 1992) and due to the exponential growth of the WWW, the worldwide availability of easily accessible learning materials has sparked the re-emergence of this concept. Nevertheless despite being an educational agenda world wide for several years now (Richards 2002), researches regarding learning objects are less than satisfying (Sosteric & Hesemeier 2002). Although there are works carried out to identify the definition of learning object (Eduworks 2002; NLII 2002), work regarding development of learning object metadata standards carried out by the IEEE LTSC (2005),IMS (2005) and development of learning object repositories (Nilsson 2004; Paquette et al. 2004), there remains a vacuum in identifying the structure of a learning

object, the pedagogical elements in the learning object metadata and reusability of a learning object (Santally & Senteni 2005; Thompson & Yonekura 2005; Vicente 2005). In addition there are also other challenges faced in the learning object development in which this is further described in Figure 1.

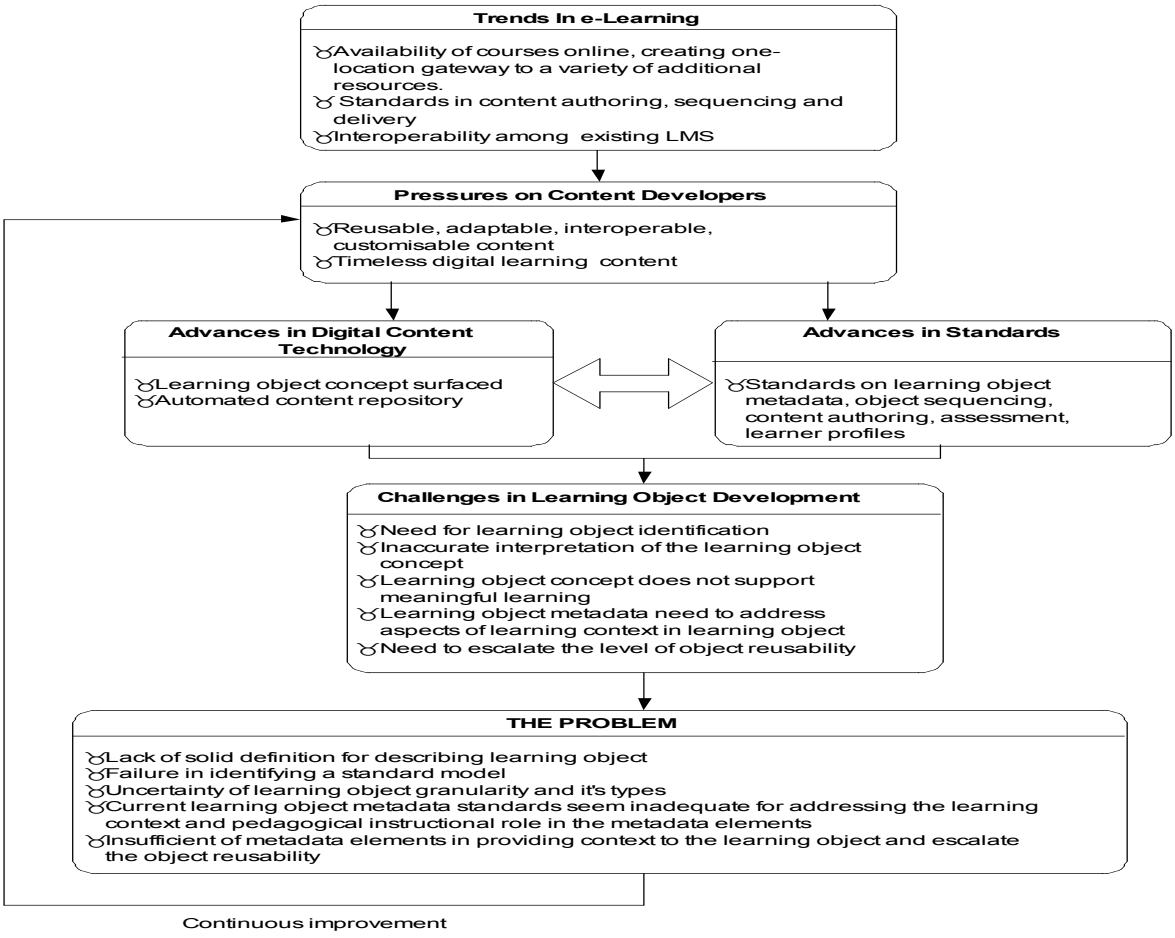

Figure1: Current Trends in e-Learning Environment Leading To the Problem

Although there are various problems related to LO development as shown in Figure 1, the main focus of this paper is to discuss the problems related to LOM specifically as there are increasing needs to identify relevant metadata elements to address the context and pedagogical needs of LO. As such the next section will centre on the LOM issues particularly and measures taken to find the answers to the problems put forward.

LEARNING OBJECT METADATA (LOM)

LOM is a method used to identify and describe learning object behaviour, function and use. The customary intention for using metadata is to describe information regarding the object and these information are given by the data professionals such as museum registrars, library cataloguers and archivists. Nevertheless due to technology advances in educational environment metadata is then used to assist in learning object retrievability. At present learning object metadata standard produced by IEEE LTSC (2005) is used as the benchmark to aid in learning object metadata development. Its usage is further extended to certify the authenticity and context of the object content; to indicate the structure integrity; to provide data for research setting and relationship to other learning object.

The IEEE LOM standard provides 77 metadata elements distributed among nine categories. Although the standard is widely adopted among learning object practitioners and researches world wide, currently it is highly debated that the existing LOM standard is lack of contextual and pedagogical elements (Allert et al. 2004; Friesen 2004; Robson 2004). The researchers argued that existing elements do not address all aspects of learning object context and merely used as a means for discovering, sharing and reusing learning object.

Dillon (2000) on the other hand had argued that the vocabularies presented in the LOM standard are limited in number as such they do not provide adequate instance for the elements to aid in the search process, and helps to escalate the learning object reusability. In addition Phillips et al. (2005) had proposed that researchers provide for an agreed vocabulary or thesaurus to over come the adequacy issues. As such various researchers have established various metadata elements and vocabularies to include learning context, pedagogical instructional role and to aid in search processes (CUBER 2004; Pöyry & Puustjärvi 2003). IEEE as the LOM point of reference had also taken the initiative to include context in an explanatory way through their existing elements such as the educational interactivity element. However these are still insufficient as most of the elements and vocabularies are centred to be the service to a specific learning environment or to the patron organisation. As such, this had initiated the current work to provide more general based metadata elements as such context level is enhanced, pedagogical role is included in the LOM elements and reusability level is escalated.

LEARNING OBJECT METADATA ELEMENT ENHANCEMENT

The determination of new metadata or extended metadata element that addresses the context or pedagogical role is based on the analysis performed on associated theories and themes related to pedagogy matters identified are developmental theory, cultural diversity, learning styles, learning theories, instructional design and assessment. However focus is given specifically to developmental theory, learning theories, instructional design and learning styles as the other themes (i.e. cultural diversity, classroom motivation, classroom management and assessment) have broad vocabularies, therefore this result in difficulties to determine specific vocabularies for the themes. Classroom management and motivation on the other hand involves traditional classroom method, contrast to electronic learning method (the environment for learning object) in which these are not relevant to learning object concept, therefore they are excluded.

Developmental Theory

Developmental theory provides the foundation for teachers or instructors to understand their learners by describing their development differences in systematic patterns. It provides information regarding the ways children mind grow and develop. This will in hand help teachers or instructors to respond more effectively to learner's individual needs. It is important to understand learner's development, as teaching strategies should match the physical, cognitive and social development of learners. By having information regarding learner's development, curriculum may be designed and match according to learners abilities.

The developmental theory consists of cognitive development (Vygotsky 1978), moral development (McDevitt & Ormrod 2002) and psychosocial development theory. Each of these theories provides different insights on how to understand a learner from different perspectives and reveals that teachers or instructors must or should be able to understand learner's moral, cognitive development and psychosocial development. Although the importance of the theory in instructional design is crystal clear, it is not useful to be adopted as a metadata element. This is due to the fact that the theory consists of various theories (i.e. cognitive development; moral development etc) and each contain other details that would create a complex hierarchy structure of values and this is not appropriate for metadata element values. As mentioned earlier, metadata is used for searching objects and this requires metadata element values to be simple, descriptive and assist in improving the searching efficiency.

Learning Theories

Learning theories have its roots back from the psychological theory (Oon Seng et al. 2003) and it is used to understand critical issues raised in the study of learning such as how does learning occurs; which factors influence learning; what is the role of memory; what is the role of motivation; how does transfer occur; which processes are involved in self-regulation; and what are the implications for instruction. In addition it is also used to provide basics for instructional strategies development, which in turn is used for instruction design. Various learning theories are abounded and the most mentioned learning theories in an educational environment are Behaviourism (Skinner 1974), Cognitivism (Gagne 1985) and Constructivism (Merrill 1991). These theories fundamentals and theme elements are useful in providing the basics for the LO content design (Yazrina Yahya 2006). However for the theories to be adopted as a metadata element, it may not provide much contribution in increasing search efficiency. It is discussed that learning theories are used to help in designing instruction but not as a point of access for searching (Juhana Salim et al. 2005). Moreover it is difficult to assign relevant values that may aid in searching processes. In addition learning theory is not a descriptive element for an object but more of a foundation used to design the object. In brief the theories do not provide appropriate features to allow its adoptation as a metadata element, in which it is excluded from being a metadata candidate.

Instructional Design Theory

Instructional design theory is drawn from many theory bases such as general system theory, communication theory, learning theory and instructional theory (Smith & Ragan 1999). These theories had brought forth substantial impact on instructional design development procedures, particularly learning and instructional theory, which has the most substantial influence in developing instructional, design principles. For instance behaviourism and cognitivism are the two learning theories used to produce guidelines and procedures on instruction design (Bonner 1988). Consequently instructional theory had provided methods of developing instruction to promote learning and support learners by providing quality instruction during this learning process (Bloom 1976). This is due to the fact that instructional theory describes attempts to relate specific events of instruction with the learning process and outcome (Gagné & Dick 1983). Other instructional theories that have influence on instructional design theory are Gagné's Theory on Conditions of learning (Gagné 1985); Reigeluth's Elaboration Model (Reigeluth 1983), Collin's Theory of Inquiry Teaching (Collins & Stevens 1983) and Keller's ARC Model of Motivation (Keller 1987).

The influences from various theories had resulted in a definition for instructional design theory, in which it is defined as a theory that shows how to go about tackling a problem in that it links the theoretical solution to the technology of practice (Wilson 1997). These results in the development of instructional design model, which is used and utilised during the instruction design process. The analysis performed on the theory and model reveal that they are used specifically to aid in learning object design, as such; it is not relevant to be adopted as metadata element or as a point of access for searching.

Learning Styles

Kolb (1976) described learning styles as the individuals preferred method for assimilating information and it is an integral part of an active learning cycle. It is also referred as individual set of differences of personal preference for instruction or an association with a particular form of learning activity (Riding & Rayner 1999). Learning styles are determined through difference groups of style model; based on the learning process; based on the orientation of study; based on instructional preference and based on cognitive development. In addition it is also an important concept to aid in student learning and to provide learning materials guidance tailored to learner's style of learning (Claxton & Murrell 1987). As such these would lead to more effective learning (Claxton & Murrell 1987). Experiments performed by Schmidt (2004) reveal that by including the right learning style would aid in learners ability to expand their learning strategies. This indicates the importance of learning styles and its effects on learner's performance. Moreover, it is also an excellent candidate for metadata elements as the theory details help to describe an object contextually. As noted by Sutton (2004) and Mason (2004) contextual attribute is any attributed of

the explicit or implicit process by which the learning objective are achieved. In addition it also describes the object in detail and aid the information seekers to locate the object in which they would decide on the object's worthiness (Miller 2004). This suggests the possibility of learning styles adaptation as one of the metadata element.

Further analysis on learning styles theory reveals that it is able to provide controlled vocabularies based on the types of learning styles available. This is in agreement with metadata needs in which metadata should be coordinated, able to provide controlled vocabularies and application tool (Quam 2004). In brief learning styles is determined as the new extended element that would provide context to learning object (Yazrina Yahya & Mohammed Yusof 2005). As such models on learning styles are further identified and analysed as illustrated in Table 1.

Table 1: Learning Style Models Analysis

Style Models	Description	Adoption As Metadata Element
Models Based On The Learning Process	Model by Kolb (1976). The model is a two-dimensional model comprising of perception which are concrete/abstract thinking) and processing (active/reflective information processing).	This style is based according to the learning process and this suggests its irrelevancy as metadata element or as search criteria, as
	Model by Honey and Mumford (1992) provides preferred modes of learning which shape an individual approach to learning.	it is intricate and only known by the learning style theorists and irrelevant to information seekers.
Models Based in Orientation To Study	Model by Entwistle (1994) provides an integration of instructional preference to information processing in the learner's approach to study. Model by Biggs (1985) provides an integration of approaches to study with motivational orientation. Model by Schmeck et al. (1977) provides the analysis that occurs during learning which relates to the distinctiveness, transferability and durability of memory and fact retention.	The models mainly focused on learning styles based on information processing concept, as such it is not adoptable as an element to the metadata. It is more beneficial in providing guidelines of learning approach, rather than a search criteria or point of access.
Models Based On Instructional Preference	Model by Price et al (1977) and Dunn et al. (1989) provides the learner's response to key stimuli such as environmental (light, heat); sociological (peers, pairs, adults, self); emotional (structure, persistence, motivation); physical (auditory, visual, tactile); psychological (global-analytic, impulsive-reflective). Model by Grasha and Riechmann (1975) provides a social interaction measure, which is used to develop three bipolar dimensions in a construct, which describes a learner's typical approach to the learning situation.	The models mainly focuses on the instructional preference that affects the individual learning behaviour, in which learners need to choose the learning materials according to their learning style preferences and offers verbal-visual dimension. As such it is potentially adopted as a metadata element as it would draw information seekers to search for objects and using the objects according to their learning style preferences that would lead to more effective learning.
Models Based On Cognitive Skills Development	Model by Reinert (1976) provides a profile in terms of perceptual modality Model by Letteri (1980) provides a cognitive profile of three types of learners, which reflects their position in a bi-polar analytic-global continuum, which reflects an individual's cognitive skills development. Model by Keefe and Monk (1986) provides 24 elements in a learning style construct, which is grouped into three dimensions.	The models presume success when an individual progressed and realised skill development. However, the operationalisation of the model is still remain to be achieved and according to De Bello (1990) Dunn & Dunn model has a stronger reliability among other learning style models, as such the model elements are adopted to suit the extended metadata elements.

Learning Styles Extended Metadata Element

Based on the above analysis, a new metadata element known as learning style is proposed. Using the IEEE Standard for LOM format description and CANCORE (2005) way of presenting metadata element, the proposed element takes the form as below:

5.12: Learning Style Explanation	Size	Order	Value Space		Datatype
The preferred learning style of the learning object	Smallest permitted maximum: 10 items	ordered	Auditory/ verbal	Prefer to learn by listening, verbalising and making personal connections	Vocabulary
			Visual	Prefer to learn by seeing images, illustration, diagrams, text and pictures	
			Sensory	Prefer to observe and gather data	
			Intuitive	Prefer to learn through imagination	
			Active	Prefer to learn through explanation and discussion	
			Reflective	Prefer to learn through ownself effort	
			Sequential	Prefer to learn through sequential information, details first	
			Global	Prefer to learn through abstract and concept understood before hand	
			Tactile kinaesthetic	Prefer to learn through hands on approach	
			Internal kinaesthetic	Prefer to learn by discussion and making connections	
			Impulsive	Prefer to start with complex problems	
			Team Interaction	Prefer to work in groups	
			Authority	Prefer to work with people in position of authority	
			Variety	Prefer to work on variety of approaches instead of routine	
This element indicates the learning style embedded in the learning object.					

Figure 2: Learning Style Metadata Element

The proposed learning style metadata element suggests solutions to context and pedagogical issues, as it provides information regarding available learning styles embedded in the learning object. This would aid learning in object's selection according to their preferences, in which research has proven that this has helped to enhance the learning process (Adkins & Brown-Syed 2002; Larkin-Hein & Budny 2003). In brief by incorporating learning styles metadata as the extended metadata element it had provided a platform for occurrence of meaningful learning and had assist in improving the learners learning process. Indirectly this has also proved that the element would aid in maximising the learning object instructional use and provide more pedagogical influence to the object.

History Metadata Element

In addition to learning styles, another extended metadata element proposed is history element, in which it provides information on the past usage and related subject to the learning object. This element provides the learning context to learning object as it makes the information of learning object usefulness in terms of past usage and its educational use available. The history element vocabulary is determined using topic maps concept and is described in great detail in Yazrina Yahya (2006). The history metadata element inhabits most of the topic maps main features and users are needed to provide the values for the past usage and related subject based on their experience of using related objects. As such the element proposed is as below:

5.13: History	**Size**	Order	Value	Datatype

Explanation			Space	
The history usage of the object	Smallest permitted Maximum: 10 items	Unspecified	-	LangString (smp: 1,000 character)
This element indicates the history of the object. It consists of sub-elements such as: • 5.13.1: Past Usage • 5.13.2: Related Subjects				

Figure 3: History Metadata Element

These element (i.e. learning styles and history) are extension of the educational element category as it is related to educational matters of the subject. In addition the elements are established in MELOR (Malaysian Educational Learning Object Repository) through the databases and advance search function where metadata is used in particular. The elements establishment through MELOR suggests that the element is applicable and able to add context and pedagogical aspects to learning object.

CONCLUSION

The inherent limitation of current learning object metadata standard in including context, instructional use and pedagogical features had become an important basis for the current investigation and new extended elements are proposed as solution to the existing limitation. The proposed extended metadata elements are tested and applied into a learning object repository system known as MELOR, in which further analysis performed had provide evidence that the extended elements are applicable and can be used by learners to obtain their desired objects according to their preferences.

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