The Development Of Learning Object Model: It’s Types and Metadata Extension

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Abstract

Learning object is not a new concept in the world of reusable materials. The idea has already emerged as early as in the nineties. However due to the exponential growth of the World Wide Web, the worldwide availability of easily accessible learning materials has sparked the re-emergence of these old concepts in the late nineties and these concepts presently being further developed to generate knowledge and insights into storing and retrieving materials. Though learning object had been an educational agenda for several years now there remain a vacuum in identifying the structure of a learning object, the pedagogical elements in the learning object metadata application profile and reusability of a learning object. Hence the aim of the study is to produce a classification for the learning object based on its granularity, to provide extension to the current learning object metadata (LOM) standards in order to incorporate pedagogical and instructional issues and to develop a learning object repository that uses dynamic metadata to search for the objects. However, this paper will only provide the conceptual work carried out in providing the learning object types and the learning object metadata extensions. In order to produce a complete structure description of a learning object, analysis on the learning object characteristic and types are carried out. Theories on instructional design, learning styles, constructivism instructional design and design potential approach were used to derive the elements associated with pedagogical and instructional aspect. Aspects on ontology and rhetorical relations are also looked into in order to develop the learning object repository. The result of this study is in the form of an enhanced learning object metadata standards tailored to the users needs.

Keywords
Learning Object, LOM, Metadata, LOM Application Profile

1 Introduction

The use of Internet had open end doors to learning opportunities that does not exist a decade ago. Currently the Internet represents the latest restructuring technology expanding the global village with instantaneous, two way communication and a unique ability for anyone to participate and contribute. Hence, online courses, interaction with fellow students and instructors through e-mail and access to research libraries are just some of the emerging capabilities. Whether it is the creation of learning portals, learning management system, content libraries or anything related to e-learning, accredited standards will reduce the risk of making large investments in learning technologies because systems will be able to work together like never before.

Standards for e-Learning refer to a system of common rules for e-learning technology. This rule is to provide the common language for e-Learning courses and learning management system to share data or talk to one another. It has also beginning to set a standard language that defines e-Learning counter parts which is known as learning object.

Learning object is not a new concept in the world of reusable learning materials. The idea of a
learning object has already emerged as early as in the early nineties (Persico et al, 1992). However, due to the exponential growth of the World Wide Web, the worldwide availability of easily accessible learning materials has sparked the re-emergence of these old concepts and it is presently being further developed to generate knowledge and insights into storing and retrieving learning materials.

Though learning object had been an educational agenda for several years now, there remains a vacuum in identifying the structure of learning object, the pedagogical elements in the learning object metadata application profile and reusability of a learning object. Despite of having a lot of written papers regarding learning object a comprehensive definition is yet to be produced (Wiley, 2001; IP et al, 2001; NLII, 2002; Friesen, 2001; Sorsteric, 2004; Mortimer, 2002; Longmire, 2000; Barron, 2000; Eduworks, 2002).

Apart from that various terms are also given to learning object, where it is also known as reusable learning object (Cisco, 2001), JAVA applet (EOE, 2000) and educational learning material (Friesen, 2001).

A learning object is associated with educational material. Hence it needs to have context, chronicle and affiliations and pedagogical intentions. It’s main function is to help enhancing the learning and teaching process through the electronic medium. Therefore to support learning through technology, these objects needs to be discovered, accessed and interoperable.

Armed with this simplistic perspective, the definition of a learning object needs to entail the above matters. Hence the working definition introduced is:

A learning object is a digital file, which can be searched, accessed, adapted, interoperable, used and reused to enhance and extend learning by including affiliation, chronicle and suggestions on the relevant context when using the object.

Other than issues regarding it’s definition, other issues related to learning object can be categorized into four main categories namely the granularity of learning object (Quinn, 2000; Eduworks; 2002; Ip, 2001; Wiley et al, 2000; Oliver, 2001; Muzio, 2001), the types of learning object (Mortimer, 2002), the learning object metadata issues (Quinn, 2000; Friesen, 2001, Forte et al, 1999; Hepburn, 2000; Earle, 2002, Recker, 2000, Carey, 2002; Wiley, 2002) and the search using metadata (Baca, 1998)

From the above-mentioned literature, it is discovered that there is no consensus on the definite size of the learning object or the ranges of size available for the learning object. It is crucial to know the size as it helps to identify the potential for reuse of a learning object. Apart from that by knowing the size of the learning object, it will help in determining the possible combinations between the objects.

Aside from that it is also encountered that there is no indication on how a learning object looks like. There is merely enough indication to describe the structure of the learning object. Nevertheless, there are also issues regarding the metadata attached to the learning object, it is mentioned in the literature that the metadata needs to have context and pedagogy attached to it in order for learning to occur.

Based on the matters raised, current research is carried out to derive a more comprehensive definition of a learning object, to produce classification based on the learning objects granularity, to enhance the learning object metadata standards by instilling the context, pedagogical factors in the metadata and to provide metadata for each types of the learning object derived.

2 Research Organization

In conducting the research, a conceptual methodology developed by Weick (1989) was used to help in deriving the results. The methodology described is mainly used in the conceptual modeling development (Lewis, 1998) where models are developed based on existing literature. Hence in establishing the learning object types and it’s extended metadata literatures are looked at into detail. The methodology framework can be seen in Figure 1.
The research is conducted according to the phases of the methodology. The phases involved are:

**Phase 1: Groundwork**

This phase defines the theoretical domain where the technology literature in the area of educational technology, standards organization, education, information retrieval and system development are explored. The conceptual framework is developed and existing LOM standards such as IEEE (2004), CanCore (2003), CANDLE (2003), Dublincore (2005), UKLOMCore (2003), The Learning Federation (2003) and Curriculum Online(2003) are looked at. The standards are then skimmed and tabulated in the form of tables.

**Phase 2: Induction**

The metadata elements in each standard are looked into in terms of definition, vocabulary recommended, data type and others. Comparison is being made in terms of usage. Once this is completed initial conjectures are developed.

**Phase 3: Iteration**

Based on the conjecture the extended elements are derived.

**Phase 4: Conclusion**

The model is then evaluated against the users to see its usefulness.

The work mentioned in this paper only involves phase one to phase three. As mentioned phase four where the model is evaluated against the user hence it involves the development of the learning object repository, which is not being mentioned here.

3 Results

Based on the literature review, Wiley (2000) had produced the learning object taxonomy, which consists of single type, combined intact, combined modifiable, generative presentation, and generative instructional learning objects. However based on the research conducted, the types of learning object may be reduced into three types of learning object mainly the single type, combined modifiable and generative instructional. The reason for having only three types of learning objects is due to the fact that combined intact may be classified under single type object. From the analysis, it is discovered that the purpose of single type objects are similar to those in combined intact objects. Apart from that, the combined intact object may be considered as single file as the components in the particular object may not be separated. For example, a pdf file of an article or an image file is considered to be single object, as the content in the files may not be separated.

In the same way, the generative presentation object may be classified under combined modifiable object. This is due to the fact that generative presentation has similar purposes as to combined modifiable object. The format for both objects are also found of be the same which are mainly in the form of web application format. Based on the objects derived, for each types of the object, it has it’s own genre and it’s educational application. The types of learning object obtained are as follow (Table 1):
Table 1: Types Of Learning Object

<table>
<thead>
<tr>
<th>Types Of Learning Object</th>
<th>Genre</th>
<th>Educational Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined Modifiable Object</td>
<td>Text &amp; Image</td>
<td>Example Guide Illustration Introduction Practice Scenario Case study Presentation Field activity Journal article Demonstration Simulation Problem solving Best practice</td>
</tr>
<tr>
<td>Generative Instructional Object</td>
<td>Text, audio &amp; image &amp; algorithm</td>
<td>Story problem solving Trouble shooting Logical Problem Decision making Diagnosis Solution Case analysis</td>
</tr>
</tbody>
</table>

As mentioned, literature had raised issues on the learning metadata object standards, where there is a need to instill context and pedagogical factors into the metadata (Jonassen, 2004; Forte et al, 1999; Hepburn, 2000). Realizing this necessity, the first extension to the metadata is by having an extra element, which is learning styles. This particular element is important as it explicitly informed that the learning object is reliable as it embeds the instructional strategy in it. It is believed that the learning styles elements are able to provide information regarding the thinking process supported by the object and how it helps in the learning process. The element constructed is based on the learning styles model developed by Felder and Silverman (1988); and Dunn and Dunn, (1978, 1989). Both work were used as the models were based on the instructional preference and it focuses more on the learner’s preferences. The suggested vocabulary for the learning styles element are auditory/verbal, visual, sensory, intuitive, active, reflective, sequential, global, tactile kinesthetic, internal kinesthetic, impulsive, team interaction, authority and variety.

Other than learning styles, it is also believed that another element is needed to counter the issue on reusability. Hence history element is constructed in this research. The concept behind this element is about relation that exists in the learning object. With the history metadata, a user may know how the object has been used and it’s relation to another object. To construct the element, details on ontology and topic maps are looked into. Ontology and topic maps (Pepper, 1999, 2002; Garshol, 2002, 2004) are used to identify the subject related to the referenced learning object. Hence it will provide the results for the related subjects to the learning objects. This will help the user in obtaining information regarding which subject the object had been used and other related objects that maybe of use. As these theories are used as the foundation to develop the element, it is realized that in order for the element to be constructed it has to be dynamic. The dynamic element allows the user to search the learning objects through their subject classification and allow the users to look at other learning objects related to the subject searched. Hence the dynamic history metadata is composed of topic name/ subject name; topic/subject occurrences; topic/subject associations.

As much as history element is important, the relation category described in the learning object metadata standard (IEEE, 2004) plays an important role in providing information about the relationship between the learning objects with other learning objects. However the vocabulary defined is merely enough, as it should provide more options to the users of the metadata. To extend the relation metadata literature based on rhetorical relation (Seeberg et al, 1999; Mann, 1987) are looked. Rhetorical relation describes the association between the objects and provides didactic relation between the objects. This will help the user in procuring information on how the object had been used whether as an introduction to a bigger topic, an example to another topic and analogy or others. The extended vocabulary derived is as below (Table 2):
Table 2: Extended Vocabulary For Relation Element

<table>
<thead>
<tr>
<th>Name Of Relation</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. is version of</td>
<td>The object A is a version, edition, or adaptation of the referenced object (B).</td>
</tr>
<tr>
<td>2. has version</td>
<td>The object A has a version, edition or adaptation namely the reference object (B)</td>
</tr>
<tr>
<td>3. is required by</td>
<td>The object A is required by the referenced object (B) either physically or logically</td>
</tr>
<tr>
<td>4. requires</td>
<td>The object A is required by the referenced object (B) to support in function, delivery or coherence in content</td>
</tr>
<tr>
<td>5. is part of</td>
<td>The object A is a physical or logical part of the object B</td>
</tr>
<tr>
<td>6. has part</td>
<td>The object A includes the object B either physically or logically</td>
</tr>
<tr>
<td>7. is referenced by</td>
<td>The object A is referenced, cited or otherwise pointed to by the object B</td>
</tr>
<tr>
<td>8. references</td>
<td>The object A referenced, cites or otherwise points to the object B</td>
</tr>
<tr>
<td>9. is format of</td>
<td>The object A has the same intellectual content of the object B, but presented in another format</td>
</tr>
<tr>
<td>10. has format</td>
<td>The object A pre-existed the object B, which is essentially has the same intellectual content presented in another format</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name Of Relation</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. is based on</td>
<td>The object A is derived in whole or in part from the object B.</td>
</tr>
<tr>
<td>12. is basis for</td>
<td></td>
</tr>
<tr>
<td>13. is an introduction to</td>
<td>The object A is derived in whole or in part from the object B.</td>
</tr>
<tr>
<td>14. is an explanation</td>
<td></td>
</tr>
<tr>
<td>15. is an example</td>
<td>The object A is an introduction to the object B.</td>
</tr>
<tr>
<td>16. is an illustration</td>
<td>The object A is an introduction to the object B.</td>
</tr>
<tr>
<td>17. is an alternative</td>
<td>The object A is an introduction to the object B.</td>
</tr>
<tr>
<td>18. is an analogy</td>
<td>The object A is an introduction to the object B.</td>
</tr>
<tr>
<td>19. is the continuation</td>
<td>The object A is an introduction to the object B.</td>
</tr>
<tr>
<td>20. is the opposition</td>
<td>The object A is an introduction to the object B.</td>
</tr>
<tr>
<td>21. is the precondition</td>
<td>The object A is an introduction to the object B.</td>
</tr>
<tr>
<td>22. addresses</td>
<td>The object A is the precondition of the object B.</td>
</tr>
<tr>
<td>23. uses</td>
<td>The object A is the precondition of the object B.</td>
</tr>
<tr>
<td>24. refutes</td>
<td>The object A is the precondition of the object B.</td>
</tr>
<tr>
<td>25. is the sequence</td>
<td>The object A is the precondition of the object B.</td>
</tr>
<tr>
<td>26. confirms</td>
<td>The object A is the precondition of the object B.</td>
</tr>
</tbody>
</table>

The object A is a version, edition, or adaptation of the referenced object (B).
The object A requires the object B to support in function, delivery or coherence in content.
4 Conclusion

The research carried out had focused on the issues raised in the literature regarding the definition of learning object, its structure, and its metadata element and vocabulary. It is hoped that the results obtained will provide a comprehensive description of what a learning object is. Apart from that ameliorate structure had been provided and new metadata elements had been included in order to address the reusability, pedagogical and context issues.

References:
