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A relation metadata extension for SCORM Content Aggregation Model ☆

Eric Jui-Lin Lu [a,*], Chin-Ju Hsieh [b]

[a] Department of Management Information Systems, National Chung Hsing University, 250 Kuo-Kuang Rd., Taichung, 402 Taiwan, ROC
[b] Department of Information Management, Chaoyang University of Technology, 168 Gifeng E. Rd., Wufeng, Taichung County, 413 Taiwan, ROC

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ABSTRACT

To increase the interchangeability and reusability of learning objects, Advanced Distributed Learning Initiative suggested a set of metadata in SCORM Content Aggregation Model to describe learning objects and express relationships between learning objects. However, the suggested relations defined in the metadata of the SCORM CAM are limited. To resolve the problem, new relations were proposed by researchers. Unfortunately, some of the relations are redundant and even inappropriate. In addition, the usability of these relations has never been formally studied. Therefore, in this paper, we summarized and analyzed existing relations, removed duplicated relations, and developed a new relation metadata extension for SCORM CAM. Also, we surveyed 145 students in attempt to understand whether or not the proposed relations can increase their learning effectiveness. The results of the survey showed that learners agreed that the proposed relations are helpful.

1. Introduction

Due to the emergence and flourishing of the Internet, the development of e-learning systems has become an important research topic in both academia and industries. Therefore, many learning systems and learning objects(LOs) were developed. One major problem of these LOs is that they cannot be reused among different learning systems. To resolve the problem, Advanced Distributed Learning Initiative (ADL) [23] developed a reference model called Sharable Content Object Reference Model (SCORM) [25].

There are two kinds of LOs defined in SCORM. One is asset, and the other is SCO [19]. Assets are digital media such as text, images, sound, assessment objects, or any other piece of data. Each SCO is composed of assets or other SCOs. Metadata is utilized to describe details of LOs to increase reusability and interoperability.

The metadata defined in SCORM Content Aggregation Model (CAM) is based on IEEE Learning Object Metadata [12]. All metadata for LOs are classified into nine categories, and one of the categories is "RELATION". A relation in the "RELATION" category is mainly used to describe a LO and express relationships between LOs. When used skillfully, a relation is a very useful metadata that can enhance learning effectiveness as well as increase the reusability of LOs. For example, as shown in Fig. 1, LO_A describes how bubble sort works. At the bottom of LO_A, there is a figure illustrating how bubble sort works in steps. With the relations proposed in this paper, one can define the figure as an learning object of type "Illustration". If the figure is stored in a repository, it can also be easily searched and reused by other learners and authors. Additionally, the application of relations can be further extended. If the author of LO_A wishes to provide more illustrations to help learners, she can easily provide links to other illustrations such as LO_B and LO_C. LOs such as LO_B and LO_C can be created by the author or other authors as long as they can be accessed. Also, these LOs can be searched and reused if they are stored in repositories.

As defined in the metadata of SCORM CAM, there are twelve suggested relations as shown in Table 1 for "RELATION" category. However, these suggested relations can only describe structure-oriented relationships and cannot express semantic relationships between LOs [20]. Therefore, many relations were proposed [6,8,9,14–17,20–22] in the past. These relations were developed mainly based on two major theories. One is instructional design theory (IDT), and the other is rhetorical structure theory (RST). Although these relations could express semantic relationships between LOs, they were limited as follows.

First of all, some of these relations are redundant. For example, both "Example" and "Illustration" relations were not only defined in IDT, but also defined in RST. Secondly, there are a few inappropriate relations. For example, the "Policy" relation defined in IDT describes a set of predefined principles of actions. However, even its creator admitted that the definition of policy was not crystal clear [24]. Finally, although these relations can express semantic relationships between LOs, whether or not they can help learners have not been formally studied yet.

In this paper, we summarized and analyzed existing relations, removed duplicated relations, and developed a "RELATION" metadata

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* Corresponding author. Fax: +886 4 22857173.
E-mail address: jllu@nchu.edu.tw (E.J.-L. Lu).

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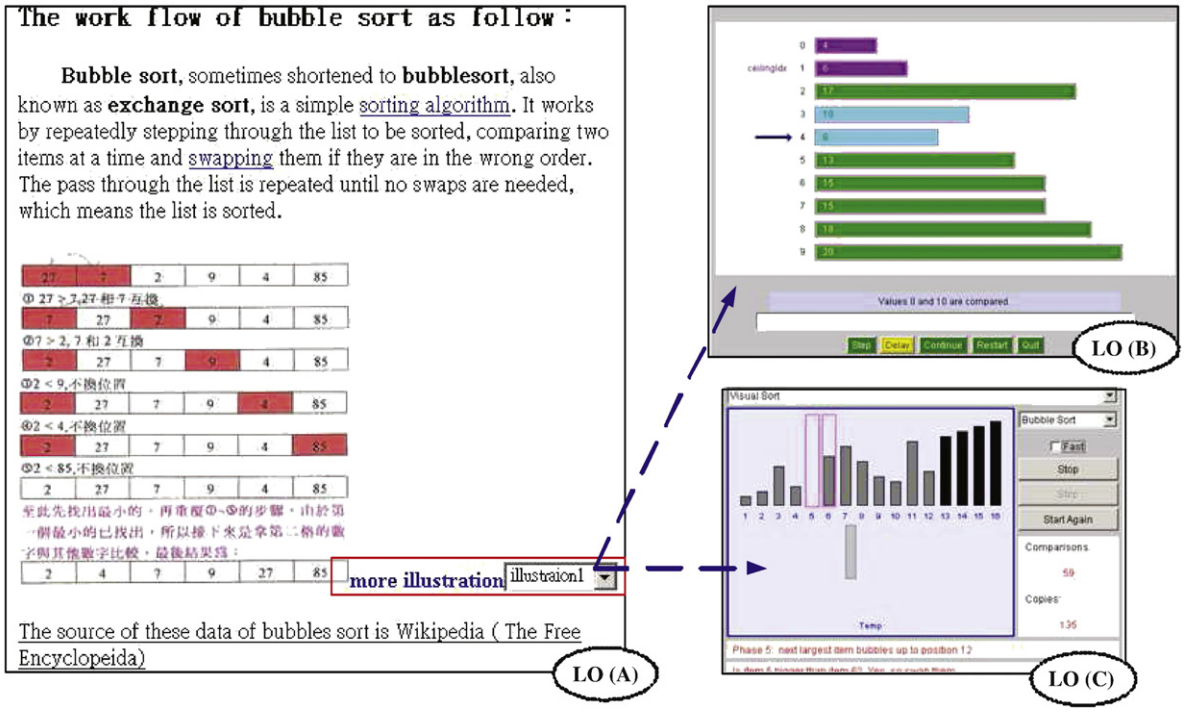

Fig. 1. An example application.

extension for SCORM CAM. The design of the proposed relations was based on the following principles: conform to SCORM as much as possible and can be implemented as easy as possible. To study whether or not the proposed relations is really helpful for learners, we created learning materials similar to Fig. 1 and used questionnaires to survey 145 students. Based on our survey results, the answer is positive. In addition, we discovered an interesting fact that six out of 15 proposed relations are preferable by graduate students than that of undergraduate students. Thus, it would be very helpful for authors to provide relations for different types of learners. It is noted that, because both the learning materials used in the questionnaires and the surveyed students were in the domain of information technology (IT), the proposed relations might be limited to the IT domain.

The rest of the paper is organized as follows. First, we briefly discussed the relationships between LOs in Section 2. Then we described relations proposed in the past. We also discussed and removed duplicated relations and proposed a new relation metadata extension for SCORM CAM in Section 3. In Section 4, we described how the survey was conducted and presented the survey results. Finally, we draw our conclusions and future work in Section 5.

2. Literature review

The relationships between learning resources are classified into three categories: the relationships between learning topics, the relationships between learning topics and learning objects, and the relationships between learning objects.

Table 1
The suggested relations in RELATION category.

ispartOf	haspart	isversionof	hasversion
isformatof	hasformat	references	isreferencesby
isbasedon	isbasisfor	requires	isrequiredBy

2.1. The relationships between learning topics

The main purpose of describing relationships between learning topics is to express ordinal structure in learning such as learning sequence and learning navigation. For example, to learn multiplication, one shall learn addition first. Also, one has to know subtraction before doing division. Due to its importance, many researchers [1,2,7,18] invested a vast amount of efforts in investigating the relationships between learning topics in the past. Recently, ADL developed a model called SCORM Sequencing and Navigation to address this issue. To avoid redundant work, we focused on the other two types of relationships in the rest of the paper.

2.2. The relationships between learning topics and learning objects

The main theory for the relationships between learning topics and learning objects is instructional design theory (IDT) [3] which encourages teachers to search for related learning resource and exploit them to satisfy all possible learning needs and tasks to complete the established goal. Based on IDT, Ullrich [8,21,22] constructed an instructional ontology which is shown in Fig. 2. The instructional ontology includes two kinds of instructional objects. One is fundamental learning objects which are used to convey the central idea of learning topics. The other is auxiliary learning objects which are used to further describe the concepts of fundamental learning objects. According to the definition of the instructional ontology, fundamental learning objects can be used to express the relationships between the learning topics and learning objects, and auxiliary learning objects can be used to express the relationships between learning objects. The details of relations defined in the instructional ontology would be described in Section 3.1.

2.3. The relationships between learning objects

In addition to auxiliary learning objects, some researchers explored the relationships between learning objects using rhetorical