2012 12th IEEE International Conference on Advanced Learning Technologies

Integrating Navigational and Structural Information in SCORM Content Aggregation Modeling

Antonio Maratea, Alfredo Petrosino, Mario Manzo
Department of Applied Science
University of Naples "Parthenope"
Centro Direzionale isola C4, I-80143, Naples, Italy
{*antonio.maratea,alfredo.petrosino,mario.manzo*}*@uniparthenope.it*

***Abstract*—Standards are essential to guarantee reusability and interoperability of e-learning content. Course designers should use standards in each step of the production of a learning unit, including documentation and drafting. While UML diagrams have already been proposed in web-based e-learning modeling, the navigational (dynamic) and structural (static) aspects have been kept separated. We propose the use of a UML profile that, together with course structure, semantically expresses different possible choices in user learning path. A real world application to a University course is presented.**

***Keywords*-SCORM, Content Aggregation Modeling, UML profile, Structural Diagram, Behavioural Diagram.**

I. Introduction

In a rapidly changing world, the life cycle of a didactic content is every day shorter and the traditional atomic view of courses, together with the the prolification of proprietary Learning Management Systems (LMS), imply that much of the effort put in the realization of a learning experience goes lost in obsolescence: standards are needed to allow content reusability and to lower the production cost and time for courses. Needless to say, documentation is the backbone of quality, and a standard and easy to interpret modeling language is essential for teachers to design and document courses prior to their publication in any LMS.

The Unified Modeling Language (UML) has been used to model different aspects of SCORM in many ways and contexts. In [1] standard and extended UML diagrams are applied to represent artifacts created during the development of SCORM-conformant contents; in [2] a SCORM course is divided into sequencing objects using modelling notation. In[3] a study is proposed to create a visualized online simple sequencing authoring tool (VOSSAT) that provides an easy-to-use and Web-based interface to help instructors edit existing SCORM-compliant content packages.

In this paper we propose the use of an extension of the UML to model both structure and navigation of a SCORM compliant course in the same diagram.

II. E-learning and modeling standards

The Shareable Content Object Reference Model [4] (SCORM) is a collection of specifications for web-based e-learning. It is a reference model, not a standard by itself, that means it is a collection of standards from various specialized organizations (for example IMS[1] and AICC[2]). The SCORM Content Aggregation Model[5](CAM) is the standard devoted to define how to aggregate content to form a SCORM package.

On the other side, the Unified Modeling Language is a general visual language for systems modeling, widely used for software design and documentation, whose specifications are published and updated regularly by a not-for-profit computer industry consortium called OMG[3]. In its current version it is defined as a metamodel, representing the abstract syntax of modeling languages in general: any element derived from the metamodel with a legitimate extension mechanism is a legitimate UML element.

Structural UML diagrams have been proposed to model a course content (in [6] a course may be seen as an aggregation of lectures, tutorials, assessments and additional resources), but without any information on the type of allowed navigation - that is on the behaviour of the system. Using SCORM 2004 as a reference, we modeled course structure, together with Flow and Choice routing options and skippable or not content.

III. Stereotypes for modeling SCORM content

A profile is a stereotype of a package containing a set of model elements appropriately tailored for a specific domain or purpose. Typically it is obtained by extending the metamodel using one or more of the allowed pre-defined mechanisms: stereotypes, tagged values and constraints.

The following profile defines a set of stereotypes used for the intuitive description of a course design and navigation.

Asset (Fig. 1a). An atomic fragment in a learning object.

SCO (Fig. 1b). A Shareable Content Object (SCO) is a launchable learning object (resource) that communicates with the Run Time Environment.

Content Aggregation (Fig. 1c). A conformant e-learning content packaged, deployed to, and delivered via any SCORM compliant LMS.

[1]IMS Global Learning Consortium, http://www.imsglobal.org/
[2]Aviation Industry CBT Committee, http://www.aicc.org/
[3]Object Management Group, http://www.uml.org

978-0-7695-4702-2/12 $26.00 © 2012 IEEE
DOI 10.1109/ICALT.2012.161

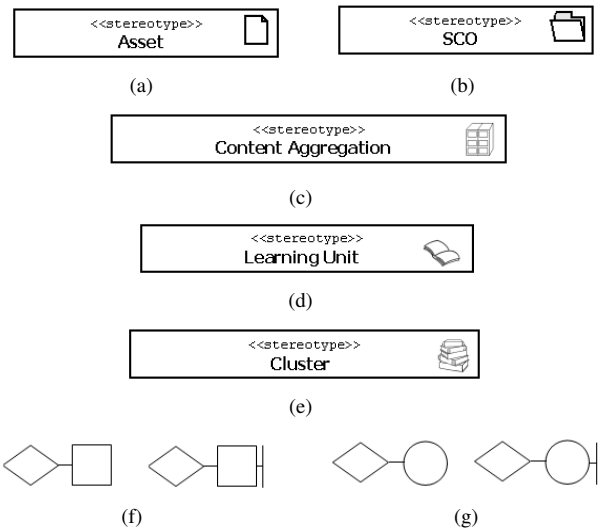

Figure 1. (a) Asset. (b) SCO. (c) Content Aggregation. (d) Learning Unit. (e) Cluster. (f) Free aggregation and skippable free aggregation. (g) Sorted aggregation and skippable sorted aggregation.

Learning Unit (Fig 1d). A learning unit may be seen as an aggregation of SCOs.

Cluster (in Fig 1e). A cluster is a specialized form of a learning activity that has sub-activities.

Free aggregation and skippable free aggregation (Fig. 1f). An aggregation in which the user can choose the order to follow in completion of activities.

Sorted aggregation and skippable sorted aggregation (in Fig. 1g). An aggregation in which the user is forced to follow a predefined order in completion of activities.

IV. Example Application

We show how the proposed profile is used to give an high level representation of the structure and sequencing behavior of the "Informatics with elements of Bioinformatics"course held in the Biology faculty of University of Naples "Parthenope". The course has two major sections: *Informatics* and *Elements of Bioinformatics*.

In the first section, each of the modules has his own assessment test. Modules building a lesson are strictly sequential and not-skippable, while lessons may be skipped, even if they must be accessed sequentially. Skipping of lessons was allowed because these were designed strongly self-contained and because most likely some students already know basic functionalities of a spreadsheet or a database. In the second section, lessons are by choice more independent and the user may choose freely its preferred path of learning. Test/assessments are given for each lesson as a whole, instead of each module.

A diagram representing the structure of the course can be seen in Fig.2.

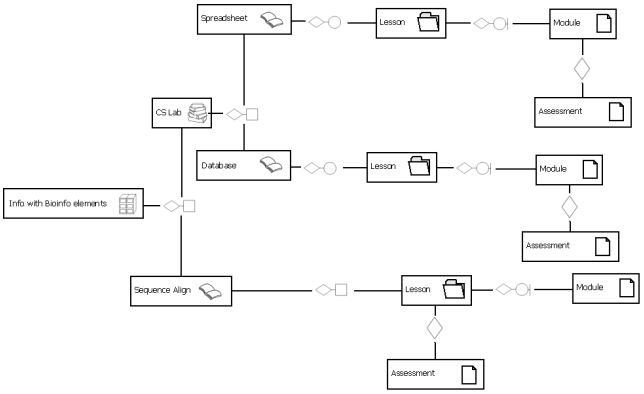

Figure 2. UML Profile

V. Conclusion

Easy to use, expressive and powerful visual languages are invaluable in all steps of design process, and the extensive use of standards is the only way to guarantee reusability and interoperability of learning content. We have proposed a diagram based on UML that allows the intuitive description of a course structure and navigation pattern, using an extension of the aggregation association. The integration with the well known SCORM reference model makes the diagram widely usable.

References

[1] S. C. Hu, *Application of the UML in modeling SCORM-conformant Contents*. Proceedings of 5^{th} International Conference on Advanced Learning Technologies, pp. 200–201, Kaohsiung, Taiwan, 5–8 July 2005.

[2] J. M. Su, S. S. Tseng, J. F. Weng, K. T. Chen, Y. L. Liu, Y. T. Tsai, *An Object Based Authoring Tool for Creating SCORM Compliant Course*. Proceedings of 19^{th} International Conference on Advanced Information Networking and Applications, pp. 209–214, vol. 1, Taipei, Taiwan, 28–30 March 2005.

[3] J. T. D. Yang, C H. Chiu, C. Y. Tsai, T. H. Wu, *Visualized Online Simple Sequencing Authoring Tool for SCORM-compliant Content Package*. Proceedings of 15^{th} IEEE International Conference on Advanced Learning Technologies, pp. 609–613, Joensuu, Finland, 30 August - 1 September 2004.

[4] O. Bohl, J. Schellhase, R. Sengler and U. Winand. *The Sharable Content Object Reference Model (SCORM) - A Critical Review*. Proceedings of the International Conference on Computers in Education (ICCE'02), pp. 950–951, vol. 2, Auckland, New Zealand, 3–6 Dec 2002.

[5] J. L. Lu and C. J. Hsieh. *A relation metadata extension for SCORM Content Aggregation Model*. Journal of Computer Standards and Interfaces, pp. 1028-1035, n. 31, September 2009.

[6] C. Chrysostomou, G. Papadopoulos. *Towards an Object-Oriented Model for the Design and Development of Learning Objects*. International Jl. on E-Learning, pp. 219-243, n. 7(2), 2008.