Inclusion of the Sharable State Persistence Model in the SCORM 2.0 Core Standard Would Improve Extensibility

Jesse Hostetler, Leen-Kiat Soh, and Ashok Samal

Computer Science and Engineering Department

University of Nebraska-Lincoln

256 Avery Hall, Lincoln, NE, 68588-0115 USA

{jhostetl, lksoh, samal}@cse.unl.edu

TEL: 402-472-6738 FAX: 402-472-7767

1. Problem Definition

The SCORM standard represents an electronic instruction model based around a centralized Learning Management System (LMS). Developing a compliant Learning Object (LO) and hosting it in a LMS is more labor-intensive than authoring the same content as a web page or a Power Point presentation. The principal reason to put forth the effort is to gain the ability to authenticate a learner's identity, monitor his or her interactions with an LO, and store the data for later use. Frequently, the LO designer is only interested in verifying completion of an activity or recording answers to assessment questions, tasks which can be accomplished by storing data in the corresponding elements of the SCORM 2004 data model[1]. Sometimes, though, an application needs to store specialized data for which there is no equivalence in the data model, such as detailed user demographics or a record of the learner's mouse movements. It is not practical to add named elements to the data model to accommodate such seldom-needed data. A better approach would be for SCORM to specify a mechanism for storing non-standard data and require that all compliant LMSs implement it. Using such a mechanism, content developers could extend the data model to support new use cases and be confident that their extensions will work properly in any environment, without the need to alter the SCORM standard.

The Sharable State Persistence (SSP)[2] model introduced as an optional extension in SCORM 2004 is well-suited to this purpose. SSP allows an LO to store arbitrary data in named "buckets" which reside on the LMS, and retrieve it at a later time, possibly during a different learner attempt or in the context of a different LO. Because the format and semantics of the data are determined by the LO and not by the LMS, SSP can be used to store any data for which there is no suitable analog in the SCORM data model. However, because SSP is *not* a part of the "core" standard in SCORM 2004, a LMS can be fully SCORM 2004-compliant and yet not implement SSP. An LO which makes use of SSP thus cannot claim to be interoperable with "any SCORM 2004-compliant LMS," making SSP unsuitable for use in LOs that will be distributed on many different LMS platforms. Without the assurance of SSP support, it is difficult to implement features that require persistent storage of non-standard data in an interoperable manner under SCORM 2004.

2. Proposed Solution

The SSP extension as specified in SCORM 2004 should be made part of the SCORM 2.0 core standard. As part of the core standard, SSP support would be mandatory for all compliant LMS implementations, allowing LO developers to exploit its features without fear that their LOs will not be portable. SSP would allow developers to effectively extend the data storage capabilities of SCORM to suit their own needs, making it possible to implement features that are currently unsupported without changing the core standard. The greater extensibility provided by SSP would thus increase both the flexibility and stability of the standard.

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[1] Using the "cmi.completion_status" and "cmi.interactions" data model elements, respectively. See: *SCORM Run-Time Environment* (2004). pp. 79-195. Retrieved from: http://www.adlnet.gov/downloads/DownloadPage.aspx?ID=237

[2] *IMS Sharable State Persistence SCORM Application Profile* (2004). Retrieved from: http://www.imsglobal.org/ssp/sspv1p0/imsssp_prflv1p0.html#1634661

2.1 Existing Implementation

The sample SCORM 2004 Run-Time Environment created by the Advanced Distributed Learning Initiative contains an example implementation of SSP[3]. This example demonstrates the feasibility of adding SSP support to a LMS, and could serve as a basis for other implementations.

3. Use Cases

3.1 Learner Profiles

A learner profile is a collection of data that describes some interesting traits of a particular learner. While learner profiles alone are of limited use, they are required in a variety of applications. E-learning research using LOs, for example, frequently involves looking for relationships between learner traits and different aspects of learner performance. Persistent learner profiles can facilitate such research by allowing performance data to be connected to the specific learner who produced it. Machine-readable learner profiles can also be used by learning software that adapts to the particular learner using it. One such application (adaptive content presentation) is further described in Section 3.2.

There are three requirements for implementing a customized learner profile. First, since the contents of a learner profile will vary greatly depending on its intended use, there must be no restrictions on what data can be stored in it. Second, the profile must persist for as long as the learner exists within a particular LMS. Third, it must be possible for many different LOs to access the profile in order to obtain or update information stored in it. SSP satisfies all of these requirements, making it an ideal means of implementing learner profiles customized for any application. The implementation of customized learner profiles is likely to be a common use of SSP.

3.2 Adaptive Content Presentation

Some learners perform better when content is presented to them in the manner that they prefer. Some may find diagrams of a concept to be easier to understand, while others would rather read a text description of the same concept. Adaptive content presentation is the process of selecting the content presentation that is best for a particular learner by analyzing data collected from the learner in the past. LOs utilizing adaptive content presentation can offer a truly personalized learning experience and improve the learning outcomes of the learners using them.

Because they require data about the learner from which to infer the best content presentation strategy, some form of learner profile is a prerequisite for any adaptive presentation system. As discussed in Section 3.1, SSP is well-suited for the creation and storage of customized learner profiles. Adaptive content presentation is thus one example of an application that, while possibly not utilizing SSP *directly*, benefits from the capabilities that SSP provides.

3.3 Interactive Learning Activities

Interactive learning activities such as games and simulations can create an especially engaging learning experience. A complex simulation may need to store a large amount of state

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[3] *SCORM 2004 3rd Edition Sample Run-Time Environment Version 1.0.2* (2007). Retrieved from: http://www.adlnet.gov/downloads/downloadPage.aspx?id=280

information to support its operation. One group[4] has proposed hosting simulation activities in a LMS by using a SCORM-compliant LO as an intermediary between the LMS and the simulation, and storing the simulation's state data using SSP. This approach would allow learner progress through the simulation to be monitored by the LMS in a completely portable manner.

Innovative solutions like this one make the strongest case for including SSP support in SCORM 2.0. Support for simulations is a feature well outside the scope of the existing SCORM standard. Including such a feature in the standard would increase its size significantly, but *most* LOs would not take advantage of the additional functionality. SSP, by providing a foundation on which to build specialized extensions, can help keep the SCORM standard small yet flexible, reducing the burden on LMS implementers while increasing the productivity of content developers.

4. Summary and Recommendations

Persistent storage of data outside the scope of the SCORM data model is a core requirement for a variety of e-learning applications. Including SSP support in SCORM 2.0 would give the standard the extensibility required to accommodate new applications without further changing the standard itself. The SCORM standardization process is slow relative to the blistering pace of innovation in the e-learning field. The combination of stability and flexibility granted by the inclusion of SSP could help make SCORM 2.0 the platform of choice for the development of innovative e-learning systems that are interoperable between many different LMSs. It is our recommendation that *Sharable State Persistence be included in the set of core SCORM 2.0 features*.

5. Acknowledgements

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[4] Alfaro, Z. M. & Antonio, A. (2005). Possibilities for inclusion of simulations in current standards for e-learning. *Learning Technology, 7*(3), pp. 49 – 52. Retrieved from: http://lttf.ieee.org/learn_tech/issues/july2005/learn_tech_july2005.pdf