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OVERCOMING THE PRESENTATION MOSAIC EFFECT OF MULTI-USE SHARABLE CONTENT OBJECTS

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Abstract

International standards for eLearning have been under development for more than a decade (Sonwaklar. 2002) but it is only since the advent of large scale deployment of web-based learning and the subsequent adoption of Learning Management Systems (LMS) across education, private enterprise and government that such standards have attracted broad interest. Part of the promise of these standards is that they will reduce the cost of eLearning by enabling the re-use and sharing of content between standards compliant LMS (CETIS, 2002). To facilitate such sharing the separation of content from its presentation is necessary. When content and its presentation are not separable an artefact known as "The Mosaic Effect" occurs when building a course by sequencing Shareable Content Objects (SCOs) from a variety of sources together with those created as part of a new course. SCOs originating from different courses have their own individual "look and feel". As a result, the learner is faced with a series of different presentation styles and interfaces, leading to a learning experience that is interrupted by continual changes in the format of learning content. This paper details a mechanism for SCORM Style-Sheet Support (SCORM-SSS) that has successfully been used to overcome this problem by enabling SCOs to assume the look and feel characteristics of the course or session within which they are located. SCORM-SSS has minimal impact on the courseware development process and enables content presentation and interface design control that can either be specified at a centralised organisational level or devolved to business units or individuals within organisations.

Keywords
*SCORM, Sharable Content Object, Style Sheet, Mosaic Effect,
Dynamic Appearance Model, Reusable Learning Object*

Acronyms used in this paper are explained in a glossary preceding the References.

Introduction

Each new communication technology has promised greater benefit at lower cost as part of the technology vendors' marketing. In reality, however, this has seldom been delivered (Cunningham et al., 1997; Lewis

et al., 1998). It is no surprise, therefore, that web-based technologies have been greeted with a familiar skepticism. The real difference in the current scenario is a range of international standards (AICC; IMS; ADL SCORM; IEEE etc.) that have been maturing over the past decade, independent of any single technology or individual vendor, that provide developers the potential to treat content separately to the development and delivery tools within the context of a known and stable framework of a standard.

The Sharable Content Object Reference Model (SCORM) is the most successful and widely accepted reference model of the IMS specifications for content packaging and AICC computer managed interface specification (also being part of the IEEE LTSC effort). The SCORM has been developed by the Advanced Distributed Learning initiative (ADL, http://www.adlnet.org/), of the Department of Defense, USA. Its development is informed by the IMS specifications (IMS, 2001), AICC specifications (AICC, 2003) and the IEEE standards setting process (IEEE, 2001). The major vendors of Learning Management Systems (LMS) for the enterprise training market are either currently supporting SCORM or at least have publicly announced their intention to fully support it and while those LMSs more targeted to the education sector have also signaled this intent, their progress has generally been somewhat slower. SCORM compliant content is intended to be fully deliverable, without modification, to any other SCORM conformant LMS under the principles of interoperability and reusability.

It is important to note, however, that the standards are in early stages. Implementation raises issues that demonstrate areas where the standards are either incomplete or have not fully addressed anticipated problems. This paper deals with an anticipated impediment to the sharing of content.

One problem holding back more widespread re-use of SCOs is the mosaic effect that arises when assembling a course using SCOs of different origins. SCOs (and any other type of re-usable learning object) are typically developed for a specific course and carry with them, a particular "look and feel" that is consistent throughout the original course. The mosaic effect arises when a new course is constructed from a sequence of SCOs from originally different courses with different "look and feel" characteristics. Hence, a "mosaic" of different visual styles and interface elements is observed in the new course. The mosaic effect causes an unacceptably disjointed learning experience to be delivered to the student.

If the elements contributing to page layout and appearance are intimately associated with the content in standard HTML pages (ie the HTML tags contain style properties), the "look and feel" of the original course for which the SCO was designed carries over with the content. To reuse these SCOs for different courses (or clients in a private enterprise context), or in combination with SCOs from other providers, the courseware developer must edit the HTML tags to change the appearance of the SCO to suit the new context. This re-work severely compromises a key promise of the SCORM initiative: "the flexibility to incorporate instructional components into multiple applications and contexts" (Dodds, 2001) and undermines the principle of separating content from its presentation. Unless content re-use can be achieved with no intervention or recoding of a SCO, there is little hope of it being successfully promoted.

There are substantial benefits to be had from solving this problem. They include:
- Reduced re-work of SCOs being re-used in new sequences and courses;
- Greater ease of devising adaptive support for different learners based on alternative courses using different combinations of SCOs; and
- Facilitation of courses with identical content and presented with customised look and feel, including branding for different student cohorts, as required.

The solution proposed here enables re-use of SCOs from different courses whereby they acquire the look and feel of the course in which they are displayed with no intervention from the course developer. The solution has already been implemented by Open Learning Australia in all the SCOs making up over 60 course units. The work presented in this paper may be seen as part of a proposed extension to the IMS content packaging and CMI data model specifications to enable more economical re-use of SCOs from multiple courses.

Context and Rationale for the Solution

In 2001 Open Learning Australia (http://www.ola.edu.au/) commenced an aggressive schedule of development of the OLA Learning Portal. The Portal was launched in July 2002 and integrates the front-end user interfaces for accessing information and registering in units with the delivery of online units and support of off-line units. A key component of the model is that all content would support the SCORM specification in terms of development and that the LMS and LCMS would be tightly integrated.

In an earlier paper by Beck et al (2002), the value of implementing a SCORM model at OLA was described as follows.

> *For OLA, as a broker of education and training, the advantage of SCORM lies in two important areas. The first concerns building scalability into the authoring and update of materials. SCORM supports this goal by:*
> 1. *promoting a granular approach to the organisation of learning materials that favours formalised project management and quality assurance procedures and assists in the efficient location and update of content;*
> 2. *enabling development work to be organised and distributed across teams of collaborating content specialists and designers working with a range of development tools and delivery systems, and*
> 3. *cutting development effort and accelerating production by (a) encouraging the use of standard learning objects and (b) supporting the discovery and reuse of common learning objects.*
>
> *The second major benefit of SCORM to OLA's business derives from the advantage gained by adapting a common body of material to suit different end uses. This can be achieved by:*
> 1. *identifying and changing those elements of a course that relate to a particular market (say the different legislative regimes in international markets), and*
> 2. *revising the presentational interface to accommodate the branding of various client organisations.*

OLA has implemented a model that is based upon the standards. The full benefit of the SCORM, however, has not been delivered because of shortcomings in the standards. One such problem, the mosaic effect, arises from the standards failing to address the separation of content from presentation. By adopting the SCORM-SSS model, OLA found that there is no impact on the workflow for production of SCOs. The code needed to enable SCORM-SSS is added to the HTML file at the time it is converted into a SCO by adding the Minimum Run Time Initialisation code.

Figure 1: A demonstration of the same SCO embedded in two different "look and feel" templates. The colour schemes are different, the upper one being green and cream, the lower one blue and white. Different fonts are applied to the text of the content in the two examples and the tables of contents differ. Note that the branding is also slightly different in the two examples.

Technical Solutions

The Dynamic Appearance Model

A model to provide a solution to the mosaic effect has already been proposed, however its implementation will require a more substantial timeframe. The Dynamic Appearance Model (Canadian Department of National Defence, 2002) is a proposal to separate the appearance elements from content using XML and XSL. Implementation of the Dynamic Appearance Model requires that a SCO be written in XML rather than HTML. While substantial benefit may be gained by moving to an XML/XSL solution this would first require an agreed structure for describing the content and an appropriate set of tools for courseware developers that would make this model of courseware development as familiar as current HTML approaches. For an XML model to be deployed a standardised Learning Content DTD is required, the establishment of which can be linked to the IMS Learning Design Working Group which is looking into the EML (Open University of the Netherlands, 2001) as a potential foundation for an IMS Learning Design Specification. Though these are worthy developments, our immediate problem of delivering SCOs today requires a solution capable of immediate implementation. Nonetheless, the Dynamic Appearance Model and the SCORM-SSS model are not mutually exclusive and when needed, can be implemented in parallel.

The SCORM-SSS Model

Previous work on the support of collaborative learning within SCORM (Ip & Canale, 2003), proposed to extend the CMI data model to store values which provide course or session level information. It is further proposed that these same data elements should be available to course level templates without the

need to initialise a SCO. The proposed mechanism is to introduce data elements which will be available to a SCORM course template after calling `LMSPreInitialize()` similar to `LMSInitialize()`. The difference between these calls is that the first call does not imply the activation of any SCO. Although it is understood that the SCORM does not specify that the `LMSInitialize()` call signals the launching of a SCO, it is clear that in their implementation of SCORM, LMS vendors have interpreted `LMSInitialize()` in the context of the rule that only one SCO may be active at any one time and in the knowledge that the SCO is the unit of learning for the purpose of communication with the LMS and only a SCO can make the call. Therefore it is a safe assumption that a SCO is launched when the `LMSInitialize()` call is received. With this legacy, it becomes necessary to add the option of initialising SCORM communications specifically without launching a SCO. This would provide backwards compatibility with the current SCORM implementations in current LMS. After `LMSPreInitialize()` the course template may access the extended data elements using `LMSGetValue(dataElementName)`.

The usefulness of the `LMSPreInitialize()` command extends to situations where a SCO's asset may need to independently establish SCORM communications. An asset running in a separate browser window (from the rest of the SCO) would use `LMSPreInitialize()` to establish SCORM communications with the LMS. Similarly, an asset that has established a link to online services, such as collaboration services, would use the same technique to send results data to the LMS using SCORM communications.

This paper proposes to add the following data elements to provide the required course and session information. The course level or session level data elements become a logical location to store the required style sheets: *(The namespace to hold the new elements is subject to community discussion and is just indicated as [namespace] for the purposes of this paper)*

LMS Support
To support SCORM-SSS, the LMS needs to make the data elements in the [namespace].course.style category (or the [namespace].session.style category) available after either `LMSInitialize()` or `LMSPreInitialize()`.

SCO Support
Immediately after `LMSInitialize()` and before the rendering of any content, a SCO should query the LMS for [namespace].session.style.SCO for the style sheet to be applied and write the style information to the client browser.

Asset Support
For assets developed for a course, and when the look and feel of the asset needs to match the overall look and feel of the course, the asset needs to send `LMSPreInitialize()` prior to rendering any content. Then the asset should query the LMS for [namespace].session.style.ASSET for the style sheet to be applied and write the style information to the client browser.

Sample Client Script
```
var CSSValue=API.LMSGetValue("[namespace].session.style.SCO");
document.write (CSSValue);
```

Browser Compatibility
Since this is a client side implementation, different browsers running on different platforms may vary in the degree of support for dynamically rendering HTML pages based on a style sheet. During testing, we found that in all cases SCORM-SSS degrades gracefully. For those browsers that do not support dynamic re-rendering, a plain HTML is returned.

SCORM Style-Sheet Specification
All SCOs should be developed conforming to the HTML 3.2 specification without any style information

in the HTML tags. All tags would be overridden by the appropriate style sheet as supplied by the LMS within the context of the course.

Conclusion

The presentation mosaic effect caused by inter-mixing of SCOs from differing original contexts is a serious impediment to their re-usability. To solve this problem the content of the SCO needs to be separated from the presentation elements at the course level. With the SCORM-SSS proposed here, SCOs continue to be coded as HTML and the style-sheet may be applied at the course level or the session level and remain under the design control of individual academics. The additional effort needed for SCORM-SSS is minimal and the technique is fully consistent with the general methodology for implementing the SCORM communication framework. The SCORM-SSS approach has been fully implemented by Open Learning Australia to access the benefits of content re-usability based on their SCORM implementation. We seek to propose SCORM-SSS as part of the SCORM specification so that the technique may be more widely adopted.

Institutional support for pedagogical diversity is arguably a cornerstone for innovation and quality in teaching and learning in higher education and the central role played by academics is an essential feature. As long as the current emphasis on innovation and individuality continues, a single Learning Content DTD is unlikely to be agreed upon within higher education. This presents a major impediment to a XML/XSL solution to the Mosaic Effect.

The need for an implementation that delivered the system objectives of the OLA Learning Portal development, for which the Mosaic Effect became a key issue, provided a useful opportunity to apply previous work on extensions to the SCORM data model designed to provide support for structured collaborative learning within SCORM (Ip & Canale 2003). Taking these developments together, the authors believe the proposed extensions substantially enhance the potential for SCORM within higher education.

Glossary

ADL   Advanced Distributed Learning, http://www.adlnet.org/ an initiative sponsored by the Office of the Secretary of Defense (USA). It is a collaborative effort between government, industry and academia to establish a new distributed learning environment that permits the interoperability of learning tools and course content on a global scale.

AICC   Aviation Industries CBT Committee is an international association of technology-based training professionals. The AICC develops guidelines for aviation industry in the development, delivery, and evaluation of CBT and related training technologies.

DTD   Document Type Definition. A DTD is a specific definition that follows the rules of the Standard Generalized Markup Language (SGML). A DTD is a specification that accompanies a document and identifies what the funny little codes (or markup) are that separate paragraphs, identify topic headings, and so forth and how each is to be processed. Web pages are coded in a particular DTD called HTML

EML   Educational Modelling Language. EML attempts to describe both the materials of learning and the methods (activities) used, as well as the roles of learners and instructors. Unlike IMS Content Packaging or SCORM specifications, EML is concerned with the activities of the learner as much as the structure of the learning materials they use, and attempts to encode the learning methods used.

IEEE   Institute of Electrical and Electronic Engineers. The IEEE (Eye-triple-E) is a non-profit, technical professional association of more than 380,000 individual members in 150 countries. It has approved nearly 900 currently active standards with 700 under development.

LCMS   Learning Content Management System. An LCMS enables the efficient collection, discovery, management and sharing of learning materials used in the delivery of online courses.

LMS   Learning Management System. A LMS is used to plan, implement, and assess the learning

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process. Typically, a learning management system provides a teacher with a way to create and deliver content, run educational activities, monitor student participation, and assess student performance.

LTSC Learning Technology Standards Committee. The LTSC is chartered by the IEEE Computer Society Standards Activity Board to develop accredited technical standards, recommended practices and guides for learning technology. The LTSC coordinates formally and informally with other organizations that produce specifications and standards for similar purposes.

SCO Sharable Content Object is the smallest unit of content that can be tracked by SCORM compliant LMS . It is the smallest complete unit that can be used in another course, it contains useful content on its own, does not depend on any other SCO and is designed to be used with a SCORM-compliant LMS.

SCORM Sharable Content Object Reference Model. The SCORM is a set of interrelated technical specifications built upon the work of the AICC, IMS and IEEE to create one unified 'content model'. These specifications enable the reuse of Web-based learning content across multiple environments and products.

XML Extensible Mark-up Language is a simple, very flexible text format derived from SGML. Originally designed to meet the challenges of large-scale electronic publishing, XML is also playing an increasingly important role in the exchange of a wide variety of data on the Web and elsewhere.

XSL Extensible Style-sheet Language is a language for expressing style sheets. An XSL style sheet is a file that describes how to display an XML document of a given type.

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