# 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 LMSs (CETIS, 2002). To facilitate such sharing the separation of content from its presentation is necessary. When content and its presentation are not separable an artifact 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.

Common acronyms used in this paper

| | |
|---|---|
| ADL | Advanced Distributed Learning |
| AICC | Aviation Industries CBT Committee |
| DTD | Document Type Definition |
| EML | Educational Modelling Language |
| IEEE | Institute of Electrical and Electronic Engineers |
| LCMS | Learning Content Management System |
| LMS | Learning Management System |
| LTSC | Learning Technology Standards Committee |
| SCO | Sharable Content Object |
| SCORM | Sharable Content Object Reference Model |
| XML | Extensible Mark-up Language |
| XSL | Extensible Style-sheet Language |

 

## *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 and their implementations are in early stages. Thus it is common for points of stress to become evident. 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 from sequences of SCOs that are from a different origin. This can be characterized as SCOs that are developed specifically for a course being combined with SCOs originating from different courses, each with their own individual "look and feel". 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 sharing can be achieved with no intervention or recoding of a SCO, there is little hope of it being successfully promoted.

There are substantial benefits 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,
- 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 partly implemented by Open Learning Australia and its effectiveness can be demonstrated. 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.

## 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.

## Open Learning Australia's experience with re-usable SCOs

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, we found that there is no impact on the workflow of our 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.

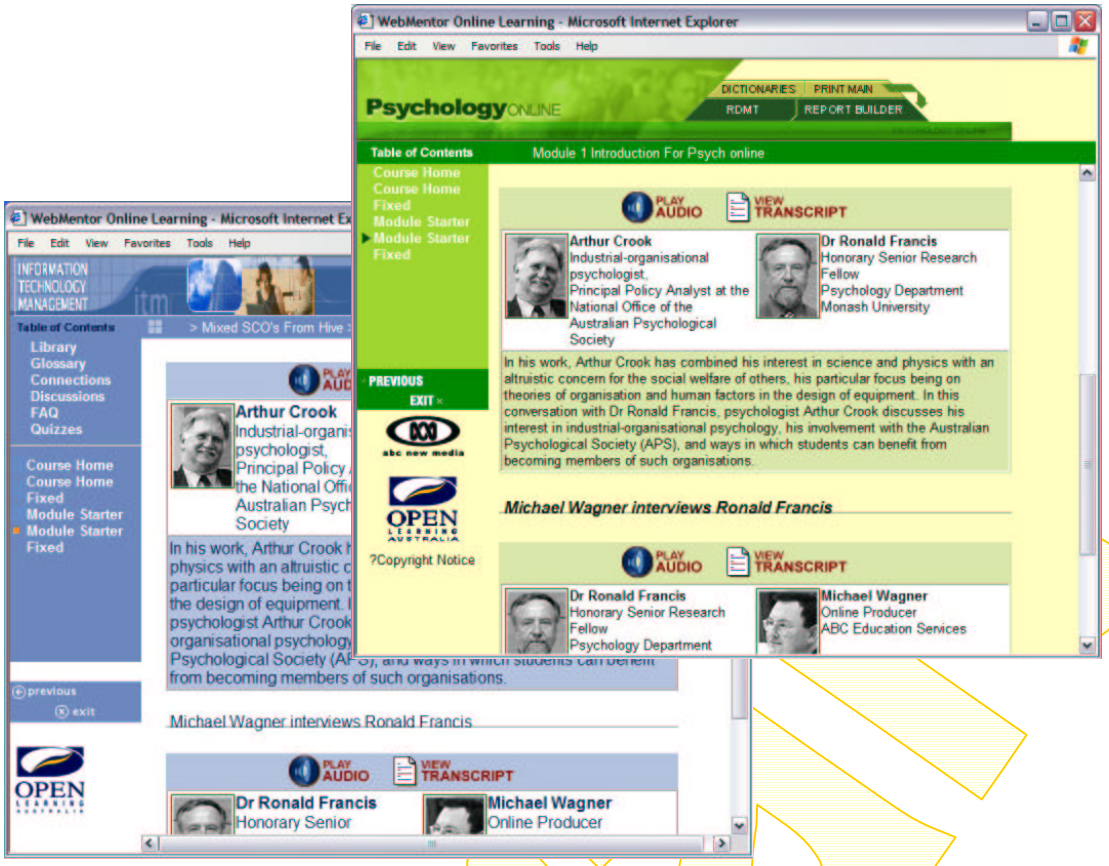


Figure 1: A demonstration of the same SCO embedded in two different "look and feel" templates.

## *Course Level Data Elements for SCORM Style Sheet Support (SCORM-SSS)*

In a previous paper putting forward a proposal for the support of collaborative learning within SCORM, (Ip & Canale, to be presented 2003) proposed to extend the CMI data model to store values which may be useful in a course or session level. It is further proposed that these 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 LMSPreInitialise() similar to LMSInitialise(). [The difference between these calls is that the first call does not imply the activation of any SCO and only data elements which are non-specific to any SCO will be available.] Hereafter, the course template may get the extended data element using LMSGetValue(dataElementName).

The namespace to hold the new elements is subject to community discussion. We have left it open and just indicated it as [namespace] in this paper.

This paper proposes to add the following data elements at the course and session level:

| **Element Name** | **Description** |
|---|---|
| **Course level elements** | |
| *Look and feel* | |
| [namespace].course.template | the name of the template being used by the course |
| [namespace].course.style._count | The number of styles defined |
| [namespace].course.style.n.id | Name of the style |

| | |
|---|---|
| | The following are pre-defined:<br>0 for SCO<br>1 for asset<br>2 for TOC<br>Users are free to define other elements matching their local need.<br>A shorthand mapping is also defined:<br>[namespace].course.style.sco.[…] is mapped to [namespace].course.style.0.[…]<br>[namespace].course.style.asset.[…] is mapped to [namespace].course.style.1.[…] |
| [namespace].course.style.n.format | specify the format of the style elements:<br>css = the style elements store the cascading style sheet<br>url = the style elements store the URL of the cascading style sheet |
| [namespace].course.style.n.value | store the style elements |
| **Session level elements:** When a course is run multiple times, each run is referred to as a session of the course. The value of the following elements, when not defined, will take the value of the elements with similar name in the course level elements. | |
| *Look and feel* | |
| [namespace].session.template | the name of the template being used by the session |
| [namespace].session.style._count | The number of styles defined |
| [namespace].session.style.n.id | Name of the style<br>The following are pre-defined:<br>0 for SCO<br>1 for asset<br>2 for TOC<br>Users are free to define other elements matching their local need.<br>A shorthand mapping is also defined:<br>[namespace].session.style.sco.[…] is mapped to [namespace].session.style.0.[…]<br>[namespace].session.style.asset.[…] is mapped to [namespace].session.style.1.[…] |
| [namespace].session.style.n.format | specify the format of the style elements:<br>css = the style elements store the cascading style sheet<br>url = the style elements store the URL of the cascading style sheet |
| [namespace].session.style.n.value | store the style elements |
| | |

## LMS Support

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

## SCO Support

Immediately after LMSInitialise() 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 asset 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 LMSPreInitialise() 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.

"Non functional Visual Enhancements" is also supported for Internet Explorer Browsers.

### 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 will be overridden by the appropriate style sheet as supplied by the LMS within the context of the course.

### Non-functional Visual Enhancements (Eye Candy)

An additional component of presentation, while not dealt with as part of this paper, does at least need to be mentioned here. It is common for courseware developers and web designers to add non-functional design elements to improve the visual appeal of course content. These elements are typically designed to be displayed within a particular course template, therefore, they will ultimately contribute to the complexity of shareable content. The solution for the visual elements is currently at an advanced stage and will be dealt with in a later paper.

## *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 can be implemented immediately. 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.

This proposal is built on previous work (Ip & Canale, to be presented 2003) on extensions to the SCORM data model to provide support for structured collaborative learning within SCORM and the work undertaken in implementation at Open Learning Australia. Taken together, the authors believe the proposed extensions substantially enhance the potential for SCORM within higher education.

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