Whose Learning Objects ?

Iain Morrison, Albert Ip
Alison Young

[1]Information Systems, University of Melbourne
[1, 3]UNITEC, Auckland
imorrison@unitec.ac.nz

[2]Digital Learning Systems

Proceedings of the 15th Annual NACCQ, Hamilton New Zealand July, 2002 www.naccq.ac.nz

ABSTRACT

There has been a recent surge of interest in so-called Learning Management Systems - generally Web-based technologies which facilitate student access to, and participation in, a course or program. Closer inspection show that although there are some useful learning aids in terms of information access, chat forums and review, the major emphasis is on management - of content, learner and learner progress. The paper looks beyond this to using technology to design and deliver, within a management framework, interactive and student/teacher selected learning events - which we call dynamic 'learning objects'. We provide a rationale for the approach and a technical framework for constructing complying prototypes. Some prospective applications for further learning analysis are discussed.

1. INTRODUCTION

Traditionally, digital learning content is developed for a complete course. However, driven by the push of learning technology standards and by teaching practice, we have seen more content developed specifically to be deployed as learning 'objects' - smaller content units capable of being reused in different courses and possibly contexts.

There are a number of academic arguments as to what comprises a learning 'object'. After reviewing the literature and analysing several different pedagogical paradigms which are likely to benefit from digital technology, we earlier argued (Ip and Morrison, 2001) that a distinction should be made between "learning resources" and "learning objects" and that in order for a digital entity to qualify as a "learning object", it needs more than just attaching appropriate 'learning object' metadata to the digital entity (that is the entity carries a description of itself) - it needs to acquire behaviour and be adaptive.

For the purpose of this paper, we define a learning object (LO) as 'A computer mediated or delivered module or unit, that stands by itself, that provides a meaningful learning experience in a planned learning context'. The emphasis on 'learning experience' is to acknowledge the different type of interaction a learner may have with the 'learning object'. There is also an explicit reference to the planned learning context as opposed to the spontaneous, accidental learning that occurs when one is engaged in other activity. The learning object is being used with an intention of learning.

Taking some lessons from the object oriented software paradigm, we argue that a 'learning object' should possess several interfaces, attributes and methods - that is it should provide several contracts for service and exhibit both state and behaviour. At a minimum, 'learning objects' should have the following three standard interfaces:

- A Management Interface with an underlying Learning and/or Content Management System (LMS or CMS) (or subject gateway) which support authorisation for access, accounting for use, learner progress tracking and so on;
- A Learning Interface (GUI interaction) which can render, present an appropriate interaction interface to the learner in a meaningful way integrated with the rest of the course in order to support the atomic learning experience; and
- An Instructional Design Interface which supports discovery of the resource, customisation, and assembly of learning objects into courses, possibly tailoring the use to meet different learning context or even different pedagogical design and requirement.

A Learning Object, as we shall see, should also support behavioural change - adapting itself to learner styles and choices. We will label such a Learning Object as dynamic.

2. PEDAGOGICAL LINKAGES

In an earlier set of papers (Ip and Morrison, 2001), we looked at the efforts to characterise LOs and at the educational contexts into which they may be put. In the context of this paper, we can ask which, of any, of the educational use scenarios might be better assisted by LOs with the extensibility and interactivity we briefly set out above. We should note that both static and dynamic LOs support re-use at some level, for example, so we focus only on the extensibility.

In noting the above comparison, the differences are those of timing and perspective/role. With foresight, the teacher/designer can edit/select and re-use other learning resources as appropriate to alter a standard lesson plan. The capability and capacity to do it while learning ('run-time') is one we are trying to elaborate in this paper. The difference corresponds to design time (static binding) or run-time (dynamic binding) composition of learning sequences/ experiences. The latter is harder but offers more choice and flexibility. This is especially important in education, where the choice of learning resources and process of engagement are part of the learning experience.

In a recent review of the application of Digital Learning Technologies in K-12, Bennet (1999) noted that there was, with the introduction of technology supported learning, a move in instructional strategies and practice to more constructivist-orientation (away from instructionist and behaviourist) and role changes evident. Students were becoming more independent and individually active. However, there were, as yet, few teaching and learning applications that supported this change.

3. LEARNING OBJECTS AND MANAGEMENT SYSTEMS

There are several recent developments in specifications for Digital Learning Systems that are

Use Scenario	Static Learning Object	Dynamic Learning Object
Tutorial, Drill and Practice	Yes	Improved via levels selection
CASE Study	Yes - Partial	Yes – Improved Discovery
Goal-based Learning	Yes - Partial	Yes – Improved Discovery
Learning by Designing	Yes - Partial	Yes – Improved artefact tracking
Role-Play Simulation (Web)	Yes - Partial	Yes -Partial
Problem-Based Learning	Yes	Yes – Improved Discovery
Incident-based Learning	Little	Little
Rule-based Simulation	Yes – Requires dynamic processing	Yes – requires dynamic processing
Exploratory Learning	Little	Yes – Improved Discovery
Cognitive Tools	Yes – requires processing	Yes – requires processing
Resource-Based Learning	Little	Yes – Improved Discovery

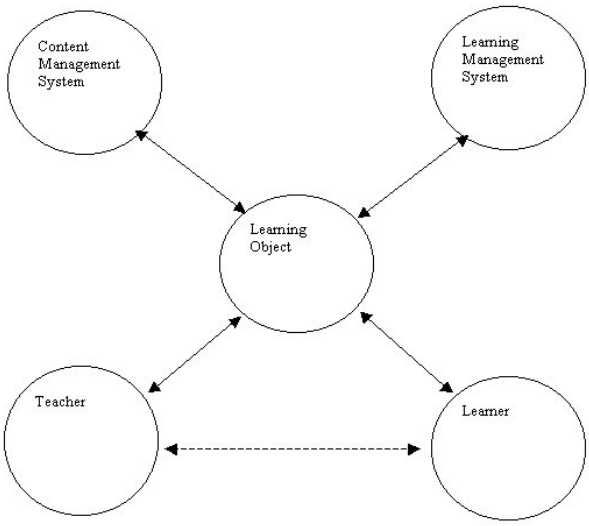
germane to our discussion. The Advanced Distributed Learning Network (ADL) brought together industry practitioners and international standards (IEEE) and specification bodies (IMS Project) to help define critical technical interface points and descriptors for online delivery of learning and training. The design and packaging of the learning resources to enable their deployment to and migration between different Learner Management Systems (LMS) led to the Shareable Content Object (SCO) Reference Model (SCORM). A SCORM SCO, at its basic, is a Learning Resource plus metadata descriptors plus 'hooks' into an LMS - it is able to be located/stored in a Content Management System and have its use recorded in an LMS.

The SCORM Model envisages three levels of component:

- SCORM 'Assets' are what we have called 'input', the basic building blocks (media elements, text etc)
- SCORM 'Resources' are collections of 'assets' that are searchable/retrievable as a single unit
- SCORM 'SCO's are 'assets' or 'resources' which provide tracking capability through the LMS.

The SCORM model has introduced a new workflow for courseware development. The model now calls for the creation of Sharable Content Objects (SCO) and then assembly of the SCOs into courses by using IMS content packaging specification. This assembling process represents a separation of content subject matter expertise and instructional design expertise. The Instructional Design interface of a learning object should expose the learning object's subject matter as metadata elements and allow instruction designer (or software agent 'on the fly') to assemble the learning objects into pedagogically effective courses.

Figure-1 Roles



Our 'learning object' remains consistent with the SCORM with the proviso that we are seeking to enhance current models to allow for more pedagogically sound and dynamic instructional content models. Our perspectives are set out in Figure-1. The roles that we see of increasing importance are those of teacher and learner. When we say 'Whose Learning Objects', we are alluding to our view that the focus should move to the teacher/ learner interfaces and away from the management interfaces. Our definitions of learning object, learning interface and learning design interface can be interpreted flexibly within the SCORM Model and, as will be seen later, can be largely reconciled through interpretation of aggregation points and having a 'dynamic' manifest.

4. ENHANCED CONTENT MODEL

In a report to the Curriculum Corporation in Australia titled "What to build and why", McRae (2001) noted the need for a similar change to a constructivist orientation and for online resources to be more open and offer challenging experiences. He further noted that "objects should support a range of learning activity... not assume self-contained self-assessment processes... offer flexible organisation and be adaptive to learners". A mental framework of 'objects' offering a 'concept' model, a 'schema' model and 'chunks' was advanced. The 'concept' held the context, goals and was based on prior knowledge - it helped learners conceptualise the learning experience in prospect. The 'schema' set out the organisation structure of the object and where points of flexibility and adaptability in learning activities/styles/ sequencing lay. The 'chunks' were the basic building blocks of resource. For our purposes, this framework is very similar to ours - chunks are atoms or simple learning resources; 'schemas' are dynamic LO sequences; and 'concepts' are what the teacher/ designer sets into the initial LO template.

We feel therefore that the construction of a dynamic LO is a useful advance on the current SCORM (see below) constructs and offers a number of advantages in a teaching & learning context consistent with emerging instructional design ideas and teaching practice. It also supports a higher level of student-centric learning activities. The simple content and interaction model of SCORM Version 1.2

supports our perspective in Figure-2, namely the learner interacts with the course elements and events are written to the LMS as appropriate. In Figure-3, we posit a dynamic model where learner behaviour (interactions) changes the path through a course (as expressed in its sequencing and use of learning resources) dynamically.

In Figure-2, our use scenario is that the teacher has expressed a lesson plan in the manifest and learning sequence, which the student works through, in sequence, using 'hard-wired' SCOs and having status/progression logged to the LMS. The sequence could include Question and Test elements at appropriate points. In Figure-3, our use scenario is that student starts with a 'base' sequence but can, at points allowed by the teacher, select from a palette of further resources (or more openly if allowed) for exploration prior to re-joining the main sequence. Figure-2 may be more representative of a 'training' scenario where there is a fixed curriculum with expected outcomes and behaviours. Figure-3 may be more representative of a 'learning' or 'knowledge construction' scenario where the educational outcomes are broader and behaviour less specifically directed.

It should be clear that the Learning Object in our model carries the centrality of our proposition - the LMS (or the LO itself based on implementation technology) dynamically constructs the LO from an initial template and modified based on the learner characteristics. The LO carries the state of the interaction and supports event reporting. Events can still be logged to the LMS as the learner acquires content (learning atoms or resources) from the CMS or completes milestones in the manifest description (albeit dynamic).

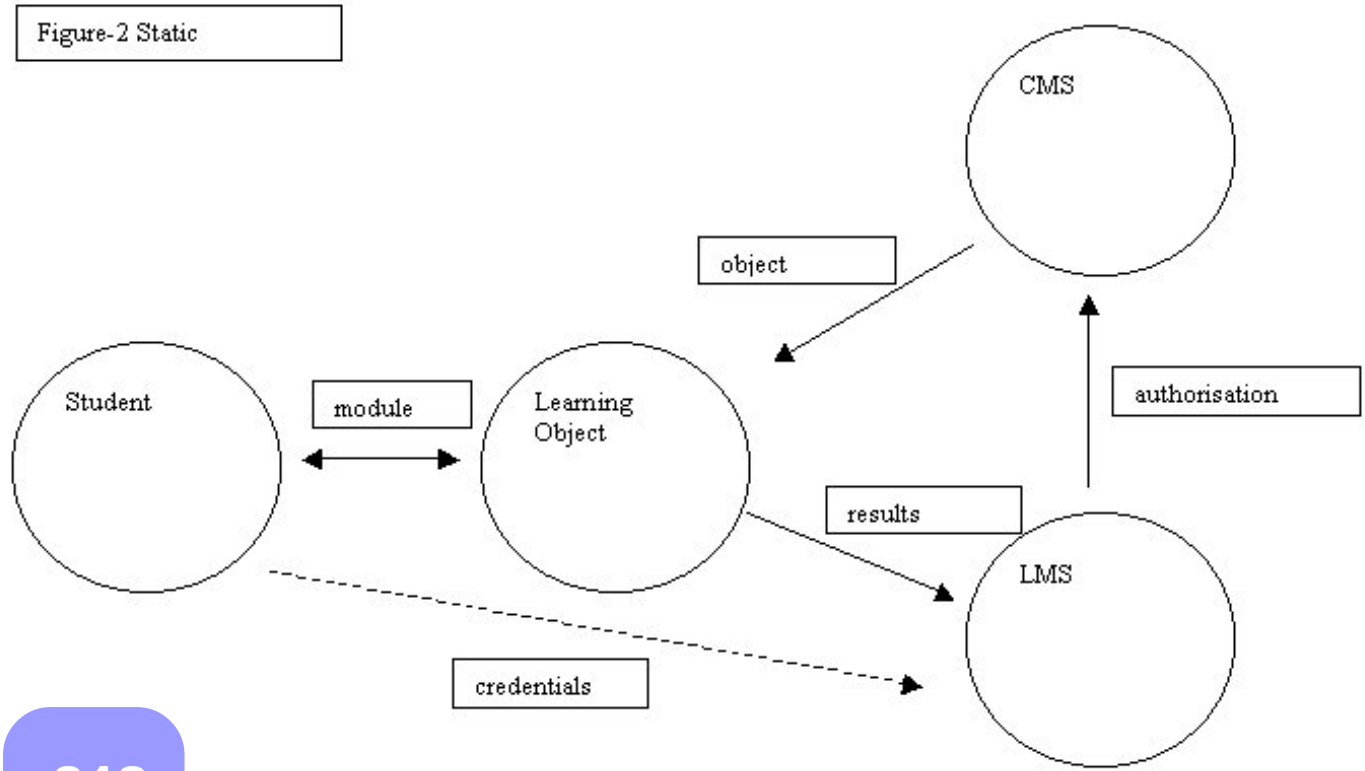
5. DEVELOPMENT MODEL

We have elaborated here a conceptual model for design and implementation of a dynamic Learning Object compatible with SCORM and current LMS. This model will also enable some of the issues associated with learning resource migration transparency and reuse to be addressed.

For purposes of demonstration, we articulate, at a high level, a model for creation and use of our 'learning resources' within the 'Document Object Model' (DOM). The DOM is useful for our purposes because:-

- it maps transparently the XML-based interfaces (packaging and content) proposed for the LMS, CMS and SCORM metadata
- it supports persistence and instantiation (save and restore from databases)
- its structure supports the development of hierarchical (and dynamic) content development from 'atoms' through complete lesson plans

Figure-2 Static



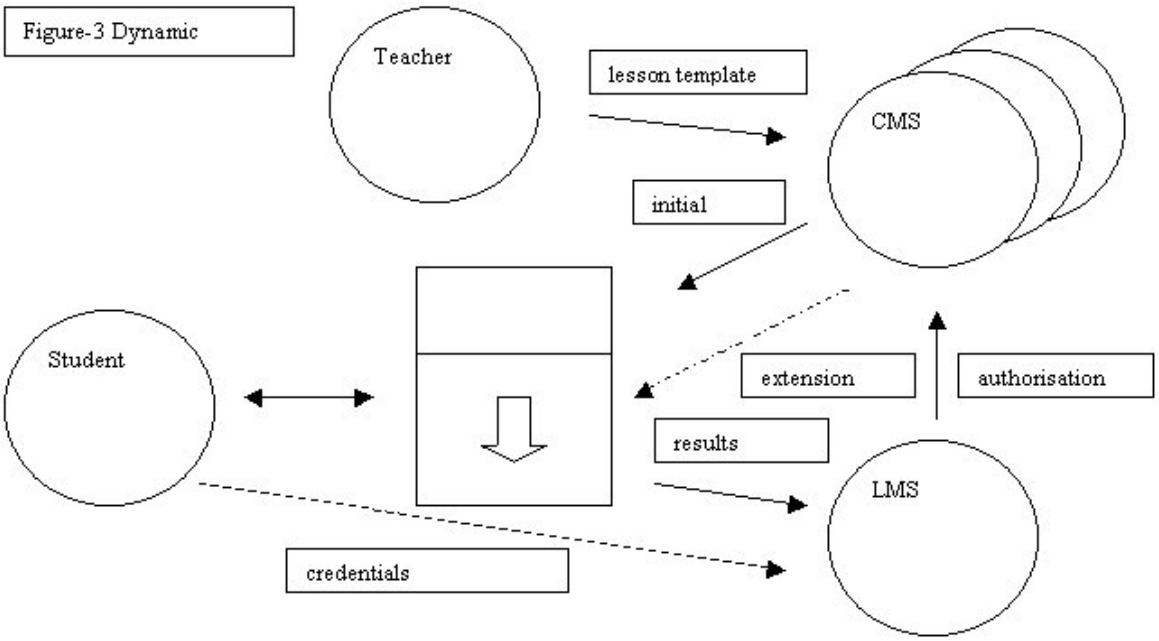
- it can bind resource processors (renderers) to elements or components of a learning resource
- it is extensible therefore capable of supporting a range of pedagogic and management styles
- it can accommodate both early (static) and late (dynamic) binding decisions.

We provide in Figure-4 a schematic of a DOM representation of a learner session and interaction with a learning object. The learner has decided to replace a sequence from the canonical LO (alternatively the LMS may trigger a new self-test module). The student would draw down the LO (as last instantiated - a previous session or the initial load) following login to the LMS. The CSF (course sequence) plus state would be transformed into a Document Object Model in the server - an in-memory representation of the Learning Object. As the student interacts with the LO, state is created and intermittently events would be triggered to the LMS as the student completes, for example, SCORM AUs, or Learning Resources. At various points, the student would have the option of re-sequencing or extending their study. These points would be set by the teacher/ designer and validated by the CSF DTD or Schema to preserve the integrity of the lesson plan (McRae). This would ensure that the new sequence maintained educational validity. The choice could be made from a draw-down palette or from the CMS with pre-selected metadata descriptors. The DOM would be updated dynamically to track resource sequence and progress. The 'dynamic' CSF would be learner specific but DTD compliant and interface with the LMS which would need to track resource use and learner progress. In order to preserve the 'look-and-feel', accessible Learning Resources (located by metadata search or menu pull-down) should be learning atoms or learning objects with separated content syntax and presentation syntax.

6. SUMMARY

In this paper, we have explored the interaction between the learner, the teacher-initiated lesson plan, and the associated management systems in an online learning environment.

Current systems are evolving to support simple information (learning atom) access or managed access (learner and content) to 'static' learning objects. To support a wider range of pedagogies, and in particular resource-based and learner-initiated learning patterns, we have articulated the need for a more open view of a learning object that allows for interactivity and extensibility of resource and the management of the learner session from a teaching & learning perspective.



We have provided a framework for the development of such 'dynamic learning objects' within a standard model (DOM) and compatible with current developments in learner and content management systems (SCORM, LMS and CMS).

We believe that the current SCORM can, with minimal changes, be adapted to allow the range and sequencing of learner activity to be flexible within an overall learning plan set by a teacher/designer, and for content use to be guided, but not necessarily prescriptive, in accord with good teaching practice.

It is our aim to build a few prototype lesson plans exhibiting this dynamic activity within the SCORM framework and to evaluate consequent student use in a moderated series of experiments.

REFERENCES

Advanced Distributed Learning Network. http://www.adlnet.org/index.cfm

Bennett and Lockyer (1999). Digital Learning Technologies and Teaching&Learning in K-12. Faculty of Education, The University of Wollongong

IEEE Learning Technologies Standards Committee. http://ltsc.ieee.org/

Instructional Management Systems Project. http://www.imsproject.org/metadata/

Ip, A. and R. Canale (1996). A model for authoring virtual experiments in web-based courses. ASCILITE 96.

Ip, A. and R. Canale (1997). Meeting the challenges with Web-based 'Virtual Apparatus'. Doing IT at Melbourne, an One-day symposium on the use of multimedia & educational technology in teaching and learning, The University of Melbourne.

Ip, A. and R. Canale (1997). "Supporting mainstream adoption of digital technology using the "virtual apparatus" Model for Courseware Development." Online Education(15th August, 1997).

Ip, A., R. Canale, *et al.* (1997). Enabling Re-usability of Courseware Components with Web-based Virtual Apparatus. ASCILITE 1997.

Ip, A., I. Morrison, *et al.* (2001). What is a learning object, technically? WebNet 2001, Orlando, Florida, AACE.

Ip, A., I. Morrison, *et al.* (2000). Managing Online Resources for Teaching and Learning. AusWeb2K, the Six Australian World Wide Web Conference.

Ip, A and Morrison I,. (2001). Learning Objects and Technical Frameworks (presented at ASCILITE 2001)

McRae (2001). What to Make and Why. Report to the Curriculum Corporation.

Roger St-Pierre. "Dynamic Appearance Model for the SCORM" http://www.online-learning.com/papers/SCORMModel.pdf)

The Education Network Australia (EdNA). http://www.edna.edu.au/

The Apache Foundation. "Cocoon. An XML-Publishing Framework." http://xml.apache.org/

W3C. "The Document Object Model". http://www.w3.org/DOM/

Figure-4 Document Object Model