Encapsulating learning objects for learning flexibility: A case study

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The case study described in this paper illustrates problems experienced in the transition from a traditional learning material specification, to a learning template model. The new model encapsulates a Learning Object Model approach.

The adoption within an educational organisation to provide flexible delivery and online learning, required a fundamental paradigm shift within a discipline. This paradigm shift caused the discipline not only to struggle with the concepts of learning objects but to discover ways of implementing them to support the subject's individual outcomes.

The paper discusses outcomes and presents findings in the context of learning objects for learning flexibility. It explores the context of learning objects and how these should be considered in the design and development of both undergraduate courses, online, and distant learning.

Introduction

Before the introduction of the Information Technology, Systems, Multimedia Discipline (ITSM) Learning Template, a model for subject delivery was in current use. This model was ‘The Learning Material Specification’ adopted by Swinburne University of Technology, Lilydale campus consisting of subjects, modules, and topics.

In Semester One, 2002 the ITSM discipline at Swinburne University, Lilydale, adopted a new instructional design model to deliver course materials. From that time, ITSM has been and continues to be engaged in a transitional process of subject development and delivery.

This new instructional design by Dr. Bruce Calway, Discipline Leader, ITSM is known as the ‘ITSM Learning Template’ model. This model was designed in parallel but not in cohesion with the Shareable Content Object Reference Model (SCORM) initiated by the Department of Defence, USA in 1997 (Letts, 2002).

The ITSM Learning Template model draws on the concept of learning objects as does SCORM, however the Learning Template is structured with a ‘Lesson’ overlay that presents the learning and understanding of the objects.

All subjects offered by ITSM undergraduate subjects for Semesters One and Two 2002, and Study Period One 2002 in Open Learning Australia have undertaken this transition process. The Discipline is now in its second year utilising the ITSM Learning Template model.

Like the SCORM reference model, the ITSM Learning Template model borrows from the object-oriented paradigm that strongly promotes re-use, encapsulation, inheritance, and aggregation techniques. This is where the concept of ‘learning objects’ were developed.
The ITSM Learning Template model describes the structure, and models for aggregation of content as well as the environment via web browser for presentation to students.

The transitional process was completed in two phases.

The first phase involved subjects running in Semester One, 2002 through the University’s ITSM Discipline, Lilydale campus, and Study Period One, 2002 through Open Learning Australia (OLA). These subjects were converted over by identifying relevant and appropriate learning objects and the incorporation of an umbrella structure called a ‘Lesson’ to tie learning objects together and provide informative and knowledge creation activities through abstraction.

The second phase which was implemented at the University in Semester Two, 2002 and in OLA Study Period Three, 2002, involved the incorporation of case studies and key terms into the lesson areas. The case studies were incorporated to afford knowledge creation through abstraction in a workshop environment. The key terms were to allow for hyper linking to relevant information contained in the learning objects. As yet this linking has not been implemented.

Discussion

The Learning Material Specification model

The theory behind this methodology required that every subject (apart from the necessary introduction and overview) had lesson objectives outlined in broad terms. Within the subject were a list of the modules and topics to be covered during the subject, as well as the subject delivery showing weekly lecturer and tutorial content.

The module included an introduction as well as Learning Objectives that were more specific to the module being delivered. More importantly the module contains several topics, these topics had a common theme that ran through the particular module. Each module required a reference to the previous module, and at the end of the module a cross reference to material covered in the next module of the subject.

Finally the topic included very specific Learning Objective outcomes that students were expected to achieve. The content of the topic included important ideas that were directly relevant to the subject, but the material in each topic was quite specific to an attribute within the subject.

Learning objects

There were many issues to consider in developing and adopting the Learning Object approach. What should be a relevant and an appropriate Learning Object? To what degree do you break something down (granularity)? When does a Learning Object become appropriate? How do you manage the reusability of learning objects?

learning objects were to be self describing and self contained that can stand alone if need be. In essence, a Learning Object’s pedagogical role was to be a complete piece of knowledge (Eduworks Corporation, n.d.). Therefore careful consideration in the construction of each Learning Object had to be undertaken.

Within the ITSM discipline, there was confusion over the definition of a Learning Object. The Literature also confirms that confusion over the definition of a Learning Object was not something new (Muzio, Heins, & Mundell, 2002; Letts, 2002; Wiley 2001). It was not surprising to find that individual ITSM team members interpreted a Learning Object differently. For example, was a Learning Object an entire web page or an image – it could be either or an aggregation of both.
Conceptualising the ITSM Learning Template model proved more difficult. Within the ITSM discipline there was much discourse between colleagues about the concepts, understanding and definitions of a Learning Object. After much discussion and deliberation, team members still followed their own interpretations, particularly during the early stages of development in Semester One and Study Period One, 2002.

Another level of complexity that existed in the model was that learning objects need to be designed with the intent of reusability incorporated into them (Calverley, 2002). Two main issues present themselves. One is the transparency of learning objects between the ITSM team members, and the other is the ability to actually locate the learning objects within the discipline.

**Transparency**

Within the ITSM department, five conveners manage three streams, information technology, information systems, and interactive multimedia, that comprise twenty-one subjects. The three streams form effectively three “silos”. The current thinking between these conveners is that a subject may be delivered across each silo and certainly there are subjects exclusive to a silo.

Problems currently exist within the discipline where learning objects are delivered in one subject and may be duplicated in another subject or different stream. This occurs because of the lack of transparency across subject content, awareness of learning objects used in each subject, and collaboration between conveners.

Working within this silo mentality reduces the awareness of what is available not only within other convener’s subjects but across the subjects delivered in every silo. For example, a convener accesses their own instructional material and reduces this material into its basic component parts, then reconstitutes this material to support their subjects’ individual outcomes. This practice was identified by Wiley (2001), and adds to the management complexity as there can be many versions of the same learning object.

The problem is further complicated when the two learning objects (with the same name), may not have the same assets within them, and have a different interpretation applied to them or support a different outcome (Downes, 2001).

There is also the issue of content ownership within the discipline. This can be attributed because of the initial work and time invested in constructing the learning object by the convener and the historical ownership inherited from the previous instructional design format. To exemplify this a second year level subject may contain a learning object that is best delivered at the first year level. This would require the convener of the second year level subject to relinquish ownership of that particular object to the first year level subject.

Conveners whose subjects have lost a learning object may feel that a void has been created in their subject. This void may have to be filled with another learning object (new or existing), or the convener may choose to apply a higher conceptual level through the lesson structure that overlays the learning objects.

This development should be undertaken in collaboration with other subject conveners within the same stream and certainly in consultation with conveners from other streams as appropriate.

One solution to developing transparency across all subjects in all streams, is to have a repository of learning objects in a database. This repository or library of learning objects would then be available to all conveners. This would facilitate access to all learning objects and their assets.
Repository

The current repository for containing subjects, lessons, and learning objects is WebCT, a course management technology. WebCT facilitates the management of subject content including lessons and learning objects to be displayed as Web pages under each subject heading. Under WebCT, a learning object used in a specific lesson or subject is only available to that lesson or subject and not available to others. This creates the problem of duplicating the same learning object for each lesson where it is required in the different subjects.

If the repository were to accommodate the objects in one central location and not segregated by subject, then the issue of transparency will be partially addressed. When an object is required by more than one subject, it can be picked from the general repository (central location) of learning objects. If it is required in another subject lesson, then the same one can be selected from this general repository. Thus ensuring that the same learning object will be used creating some consistency across the entire subjects range. Further, when a learning object requires some modification, this would only need to occur once, instead of many times. The object would still be subject to configuration management but the upgrade of the one object would be consistent across all subjects.

A convener of a number of subjects can easily integrate or reuse learning objects that they have explicit knowledge of. Under current practices, a convener would not know of the existence of a learning object in other subjects unless they expressly asked other subject conveners/developers if they had a matching or similar learning object.

Learning objects and metadata

A key benefit of learning objects is their ability to lend themselves to reusability (Oakes & Rengarajan, 2002). Downes (2001) refers to the economic viability of resource sharing and states that it “makes no economic sense” to have duplicate versions of similar learning materials. We can see that similar learning materials are naturally shared across subject areas, as indeed discipline areas. For example, learning materials on report writing and referencing.

There are different interpretations on the structure of a learning object and the metadata that it should contain. These interpretations range from the metadata kept about learning objects through to the actual content itself.

Jacobson (2002) refers specifically to ‘objective data’ which includes file types and file sizes, and ‘subjective data’ which utilizes key words and descriptions. Muzio et al. (2001) also indicates the use of key words, as defined by the users, to tag an object. Oakes et al. (2002) argue for metadata to include a description of the learning object itself that would include information on the type of content, the learning objectives, author, language, version number and the creation date for the actual content. Eduworks Corporation (n.d.) suggests the inclusion of technical requirements and educational context and intent as part of the metadata for learning objects. Downes (2001) refers to authoring and metadata of learning objects and states “The type of object determines the content of the metadata.”

Management of learning objects

All learning objects and their assets currently within ITSM are stored in a dedicated directory file structure within the Windows Explorer environment. This repository is a mirror image of the file structure in WebCT.

Windows Explorer will only give some basic information about the html file, such as file type (e.g. .htm), or the file size (e.g. KB), or the date created or modified.
The metadata provided in each of the html templates in the management technology WebCT has little information about the contents of the learning object and is limited to the content type which only describes the text type, and language type of the default metadata found in all html pages.

A system of management and control of learning objects is required that will allow any convener of subjects to access the metadata of any object, and from the information obtained in the header of the html page, be able to not only find the object but be able to obtain complete information about the assets of the object.

File type and size are important, so this information should be included in the html metadata section. As the literature suggests key words included in the metadata section would be appropriate to enable a convener to use a key word/s search to locate a learning object. This method is supported by Jacobsen (2002).

The learning objectives should be included in the metadata so the convener can establish the immediate objectives of the learning object and its specific use. Other fundamental descriptions should contain information about the author, the language used and any other language available, as well as details about configuration management, which would include the original creation date for actual content and version control, also supported by Jacobsen (2002).

Configuration management as suggested above is a real way of controlling the development of objects and versions in current use. Controlling and tracking learning objects requires standards, particularly in the information that is contained in metadata of an html page.

The transition process:

Initially the transition process undertaken ITSM was one of analysing the current learning material content for likely candidate learning objects. As the current material was already packaged into neat topic areas, the initial interpretation by some team members was to simply call these topics, 'learning objects'. This however proved to be problematic. Not all topics are a complete piece of knowledge and not all were 'self describing' as was the requirement of the ITSM Learning Template model.

Further issues arose as to the new model’s requirement of reusability. It is fair to state that the original topic areas were tailored and groomed to be ‘fit for purpose’ to the subject in which they belonged. Needless to say, some subject conveners may have followed the path of simply renaming topics as learning objects with minimal alteration if any to the content. This was a major issue. In the new model adopted by ITSM, the reusability requirement was mandatory.

Granularity of learning objects

To what degree do you break something down? Eduworks Corporation (n.d.) state that there is no standard size or granularity for a learning object, and reports that “the happy medium has been estimated as between five and fifteen minutes of learning material” from the literature of pedagogy.

Muzio et al. (2001) argues that the smaller a learning object, the easier it becomes to reuse it without having to make major changes to its content, if at all. The theory can be shown to be sound within the reusability context, however there is a price to pay for breaking down the instructional material into too many learning objects.

From the introduction of the learning objects concept, there was confusion over how far you would you reduce instructional material to individual components, or what is commonly referred to as granularity.
This is evident in a level one subject taught in the ITSM Discipline, where the convener reduced the instructional material into sixty three learning objects for the one subject. Perhaps the subject’s content justified so many objects, but further investigation revealed some of the learning objects were reduced to such a level that they could not be regarded as one complete piece of knowledge, and therefore would not stand alone, resulting in a weak object.

In subsequent development of the subject the number of learning objects was reduced to forty-three by combining weak objects together or providing further assets for the weak object.

This example illustrates the need to have a thorough understanding and full knowledge of the structure and content of a generic learning object that can be used across all subjects in a particular discipline, and understood by all conveners of the subjects.

In the case in question, is was only through trial and error and then refinement that the convener was able to establish a pseudo standard of learning object within those subjects delivered by that convener. This standard was not known or recognised across the discipline and not formally discussed with other conveners.

**Future Benefits for ITSM**

In the case study presented, the reader may well consider that the entire exercise of transition across to the new ITSM Learning Template model was conducted without formal structure or proper management. In undertaking this transition process many issues were revealed, and each issue had to be addressed by the conveners of the discipline.

With all of the issues discussed so far, it is important to highlight the benefits to the ITSM Discipline with regards to the new model.

The new Learning Template model potentially offers a truly flexible approach to learning for both educational facilitator and the student. This is evident in the model’s objectives of transparency, flexibility, and reusability. The potential for a fully transparent learning environment is now possible. This learning environment will ultimately allow for flexible delivery of learning materials through the learning objects themselves. Students who have relevant work experience and/or prior learning will be able to claim credits for learning objects thus reducing the time to complete their studies.

The impact of reusability on learning materials across subjects, subject streams and perhaps even in the future courses will have a major influence on the way the learning experience is played out. Learning facilitators will be able to concentrate more on the higher level conceptualisations and abstractions, rather than focus on building materials that already exist.

The asset of a library of learning materials that are available to all conveners. This library will allow conveners to add enhancement to their subject areas with minimal effort and will provide a major advantage for the Discipline.

**Conclusion**

The case study formally identifies the issues and the learning curve requirements the ITSM conveners have had to manage. While this case study reflects the views and analysis of two of the conveners, the concerns described in the paper highlights the requirements for a complete understanding and definition of a learning object. The paper further highlights the need for transparency across all subjects within the discipline and supports the notion of a repository for these learning objects so they are available to all conveners. The repository should contain information about the...
learning object that will enable any convenor to establish its identity and content immediately including relevant assets.

The transition process throughout the two implementation phases was extremely difficult. However having undertaken this process the ITSM Discipline conveners can now look forward to greater transparency between subjects and across silos. This will ultimately lead to greater learning flexibility for students and reusability of learning objects in the design and development of both undergraduate and distant learning courses.

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