# Designing and Implementing a Learning Object Repository: Issues of Complexity, Granularity, and User Sense-Making

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# Introduction

With funding from the Texas Higher Education Coordinating Board (THECB), the Texas Center for Digital Knowledge (TxCDK) at the University of North Texas is designing and implementing a DSpace/Manakin learning object repository (LOR). Under a mandate from the Texas Legislature, the THECB initiated the Texas Course Redesign Project (TCRP), which provides funding to redesign entry-level academic courses to improve student learning outcomes and lower costs. THECB is funding a two-phase LOR design, development, and implementation project to store and make accessible course content created by TCRP-funded projects. In Phase I, completed in December 2007, the THECB LOR project team developed a proof-of-concept repository application that used content from one redesigned course to demonstrate the functionality and potential of a LOR for reuse and repurposing of learning objects. Phase II is a two-year effort that is moving the proof-of-concept LOR to a production system. Background information and description of the THECB LOR versions can be found in Barnes, et al (2008) and on the project website <a href="http://thecblor.unt.edu">http://thecblor.unt.edu</a>. The current development version is at: <a href="http://txcdk1.unt.edu/THECBLOR/">http://txcdk1.unt.edu/THECBLOR/</a>

A number of challenges and issues have emerged in the design, development, and implementation the LOR, and this paper focuses on three key aspects and the solutions we are pursuing: 1) complexity of the course content and granularity; 2) submission of complex objects and metadata; and 3) user interface design to assist users in making sense of this repository and its contents.

#### Course Content in the THECB LOR

The content for the THECB LOR differs in significant ways from content stored in other well-known and evolving LORs such as MERLOT <a href="http://www.merlot.org">http://www.merlot.org</a>, WISC-ONLINE <a href="http://www.wisc-online.com/">http://www.wisc-online.com/</a> and the Orange Grove <a href="http://www.theorangegrove.org/">http://www.theorangegrove.org/</a>. The THECB's course redesign project is producing complete or partial content for large enrollment undergraduate courses. While this content can be represented as a single learning object (i.e., a complete course as one learning object), the THECB LOR is making not only the complete course content available as a learning object but is providing access to components of the courses' content as discrete learning objects for reuse and repurposing. Although definitions for the concept "learning object" exist (e.g., Wiley, 2000), the THECB LOR project defines a learning object is simply a digital resource (simple or complex) that can be used to support learning.

#### **Course Complexity**

The content of the redesigned courses was not created as learning objects; rather, the course content is really an aggregation of hundreds of files (in various formats). The LOR project team's strategy has been to decompose the content of the courses, using the course structure or other guidelines to determine usable chunks of course content, and then store and present chunks of content to users as discrete learning objects. An example can illustrate what this means. The first course the THECB LOR project team worked with was a complete, redesigned U.S. History I course (created by Kelly McMichael at the University of North Texas). The logical structure and components of this course include:

• Units, where each unit consists of two or more Lessons

- Lessons, where each lesson belongs to a unit, and each lesson has two or more topics, and may have associated assessments (self-tests)
- Topics, where each topic belongs to a lesson, and may be comprised of text, images, video,
- Supplementary or auxiliary course resources such as:
  - Case studies
  - Course-level assessments
  - o Teaching guides

While we could simply take some chunk of course content and designate it as a learning object, our strategy was to identify meaningful, logical, and related chunks of the course, treat those as learning objects, create metadata to represent the object, show its relationship to other course content, and then present a set of logical groups of content at various levels of granularity as shown in Table 1 (left column),

United States History I (main course content)	Elementary Spanish Grammar (main course content)
• Units	• Lessons
<ul> <li>Lessons</li> </ul>	• Topics
Topics	Assets
Assets	
United States History I (supplemental course	Elementary Spanish Grammar (supplemental course
content)	content)
Case Studies	Teaching Guides
Teaching Guides	Assessments
Assessments	Grammar Assignments

Table 1. Logical Structure of Courses at Various Level of Granularity

The project team also faced the challenge that no two courses may use the same logical structure or nomenclature to describe logical course components. For example, the Elementary Spanish Grammar course (created by Scott Gibby at Austin Community, see Table 1) has very different content and components than the U.S. History 1 course. The design goal of the LOR, however, is to overlay a standard structure and labels to represent the different sizes, or granularity, of learning objects contained in the repository. This in part is to address the need for users to make sense of what the repository holds, the levels of granularity, and other concerns.

#### Granularity

The literature on learning objects uses the term granularity to refer to the extent or size of a LO. Some writers suggest that the smaller (or more granular) the LO, the more likely it can be both reused and repurposed. In the LOR project, reuse means that a LO can be used in a similar context for which it was created and used without significant modification; repurposed suggests that a LO can be used outside the context for which it was created. Although reuse may be related to the granularity of LOs, we feel that relationship has not been empirically established, and suggest this as a research topic in its own right.

Although the target audience of this LOR comprises instructors and instructional designers at institutions of higher education (since the courses in the LOR are primarily for first-year undergraduate students), the project team couldn't anticipate the optimal level of granularity for these users. The LOR, therefore, provides the course content a several levels of granularity: from the entire course as a LO to the asset as a LO (e.g., an interactive map created in Flash). Since we are using DSpace, this requires us to store content redundantly through different groupings of the files that comprise the content at various levels of granularity. Matkin (2002) refers to this as the Russian doll approach where "separate learning objects

are created at all levels, course, lesson, topic, page, page element (media), with each level contained in the one above it." In Table 1, this means that Assets are contained in Topics, Topics, in Levels, etc.

#### **Metadata and Submission Processes**

To date, we have been creating metadata manually according to an application profile developed for the repository. The application profile contains about 40 elements drawn primarily from the Dublin Core Metadata Set, the IEEE Learning Object Metadata, and the Gateway to Educational Materials Metadata Set. Additionally, the project team receives content from the THECB-funded course redesign projects. The files comprising the course are typically not bundled together in a manner that allows easy ingest into DSpace as LOs. We submit the files associated with each learning object through the DSpace workflow for submission. Metadata creation and submission of files (where some LOs in the U.S. History I course consist of 50 or more separate files) are time-consuming processes. To address the metadata creation and the bundling of files challenges, we are building a web-based tool that should assist the course designers and the project team in submitting learning objects. We are also investigating automatic metadata generation as a solution (Coursey, Mihalcea, and Moen, 2008).

The LOs for a particular course will have common data values for various elements no matter the granularity of the object, and the tool will provide a metadata template approach that allows entry of the data values appearing in multiple, related metadata records. For each LO in the course, common data values will be inherited as one moves from the largest LO (least granular, e.g. entire course) to the smallest LO (most granular, e.g., asset), saving hundreds of keystrokes. The tool will also allow the submitter to easily drag and drop files associated with a LO into a folder for processing. Upon completion of a metadata record and bundling the associated files, the tool will create a DSpace's simple archive format file. Batch loading of these files can then be executed. We are also investigating the use of the SWORD protocol for submitting into the repository. We anticipate that through this tool, we will also be able to produce content package (SCORM and IMS Content Packages) for submission as well.

Because the LOs within a course are related in terms of belonging to one or more logical components of the course, we are using the Dublin Core Relation element to record the relationships. In the case of the U.S. History I course, for example, a topic-level LO belongs to one lesson, and a lesson-level LO belongs to one unit. Helping users make sense of the course content, and the related LOs, is a challenge we are addressing in part through the Manakin tool for DSpace interface customization.

# **User Sense-Making Challenges**

The adage "systems fail because people don't use them" has been constantly on the minds of the team members. In the design for the LOR, we have been addressing complexity of the content, the various levels of granularity, and the relatedness of the LOs, by exploring the power of Manakin, graphic design, and metadata. The following indicate the solution paths we continue to explore.

In helping users to understand the chunk or size of a LO, we implemented a "puzzle" icon that appears the simple item display. (See Figure 1 and 2 below.) The white spaces in the puzzle indicate the granularity level, and clicking on the icon will provide the user the overall structure of the course in which this LO appears. The puzzle icon is powered by the data value in the LOM Aggregation Level element.

We are also examining how we can display the related LOs for any given LO the user is reviewing by exploiting the data in the Dublin Core Relation element. We are trying to minimize the number of clicks to get the user from the metadata record to the actual LO, whether to view it or download it. These solutions are being assessed through usability testing with representatives of the target user group. To date, we

have conducted one round of testing to inform the next version of the LOR, and especially the interface design. Two more rounds of usability are built into the development plan prior to the final deliverable to the THECB in August 2009.



Figure 1. Simple Item Display with Granularity Level Puzzle Piece

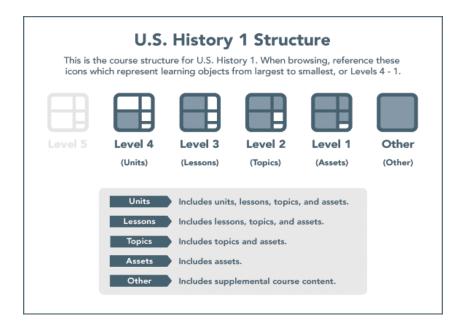


Figure 2. Course Structure Map for Levels of Granularity

# **Summary and Conclusion**

Discussions among developers and implementors of LORs have identified a range of issues and challenges (e.g., granularity, metadata, etc.). The THECB LOR project has faced issues common to other LOR design and implementation projects, and additionally faced challenges specific to the content intended for this LOR. Some constraints for solving certain problems are based on the selection of DSpace as a platform. However, using Manakin is providing potential solution paths, primarily through the customization of the user interface. The complexity of Manakin, however, has presented its own set of challenges. We are making progress towards the implementation of a robust LOR that will present to the target user groups a positive experience in finding and using the high quality course materials being developed through the THECB's Texas Course Redesign Project.

# References

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