CREATING LEARNING OBJECTS IN COLLABORATIVE E-LEARNING SETTINGS

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ABSTRACT

Learning objects are break-down of digital content into smaller "chunks" of information that can be shared and reused in various instructional contexts. This paper presents a systematic approach to creating LOs for the purpose of reusability in collaborative e-learning settings.

Keywords: Learning Objects, Reusability, SCORM, E-Learning, Collaboration, Metadata, Granularity, Accessibility, Interoperability

INTRODUCTION

E-learning, especially in the form of web-based or online coursework, is changing the complexion of education and training in academia, business, and government. The promise of on-line education and training is hard to deny; it offers education and training delivered anywhere anytime. And the market is responding enthusiastically. For example, Adkins [1], projected that U.S. e-learning industry revenues will total $83.1 billion by 2006.

It is obvious that e-learning is here to stay. Perhaps, even more obvious are the on-going efforts of e-learning instructional designers, scholars, and theorists that are focused on enhancing and optimizing learning. Included in these efforts are appropriate learning models for designing e-learning materials [6, 4, 3]; the key learning elements that influence learning within e-learning environments [11, 9, 12]; and the importance of constructing e-learning usability into the e-learning instructional design process for sound e-learning user interface [8, 7].

Learning Object (LO) is the recent entrant in the e-learning environment in which content is created and broken down into smaller parts or "chunks" that can be effectively shared and reused.

Learning Object – Definitions

The term Learning Object (LO) is a blend of learning concepts and the computer science's object-orientation that defines an object as self-describing. It includes all the information about itself and can be located anytime. An object can be used in various settings.

Wiley [16] defines learning object as "any digital resource that can be reused to support learning. This definition includes anything that can be delivered across the network on demand, be it large or small. Examples of smaller reusable digital resources include digital images or photos, live data feeds (like stock tickers), live or prerecorded video or audio snippets, small bits of text, animations, and smaller web-delivered applications, like a Java calculator. Examples of larger reusable digital resources include entire web pages that combine text, images and other media or applications to deliver complete experiences, such as a complete instructional event"

IEEE [5] defines Learning Objects "as any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning. Examples of technology supported learning include computer-based training systems, interactive learning environments, intelligent computer-aided instruction systems, distance learning systems, and collaborative learning environments. Examples of Learning Objects include multimedia content, instructional content, learning objectives, instructional software and software tools, and persons, organizations, or events referenced during technology supported learning."

Wisconsin Online Resource Center [13] defines LOs as "a new way of thinking about learning content -- Learning objects are much smaller chunks of learning than courses, modules, or units. Interactive objects typically require from 2 to 15 minutes for completion. Learning objects are small, independent chunks of knowledge or interactions stored in a database – can be presented as components of instruction or as reference information." Learning objects are based on a clear instructional strategy. They are self-contained, interactive, reusable, and able to be aggregated.

The most valuable application of LOs is reusability of digital content within various disciplines. Once a learning object is created it should be shared and reused in various instructional contexts. The term reusability is the utilization of existing LOs in various contexts and for diverse intentions [2]. It enhances productivity, cuts back on the cost, lessens the production effort, and improves the quality of instruction [2].

In a collaborative e-learning environment, LOs must be created for the purpose of sharing and reusability within and across disciplines. This paper presents a systematic approach to creating LOs for the purpose of reusability.

CREATING LEARNING OBJECTS

Learning Object Team

The approach requires the formation of a LO team responsible for creating, evaluating, and implementing the LOs. The LO team includes a content expert, e-learning instructional designer, user interface designer, database, XML, and multimedia experts. This team may include a maximum of 5 and a minimum of 3 persons. Often a person may possess 2 or more skills required of the team. For example, a professor as a content expert may also be an instructional and user interface designer.

The Architecture

Once the LO team is formed, it must embrace a LO architecture that follows a set of industry-standard principles that are essential to accessibility and interoperability that lead to reusability of LOs in a collaborative environment. The systematic approach requires a sound architecture that contributes to the overall success of creating, using, and reusing of LOs. Figure 1 presents the learning object architecture. It includes tools for authoring LOs, the server-side computing (with a database) and the client-side computing. The authoring tools are multimedia software

(capable of creating text, audio, still images, animated images, graphics images, and video images. Macromedia Flash is a vector-graphics based animation program that can adapt to different display sizes and resolutions for fast download), Web creation software (FrontPage or DreamWeaver) and/or HTML and XML editors. The server-side includes a database and is responsible for adaptive navigation which includes user background, user performance, user support, and user feedback. The database stores learning objects to be searched retrieved, used, and reused in various contexts. The client-side includes browser capable of recognizing XML, JavaScript, SVG, and various Plug-ins.

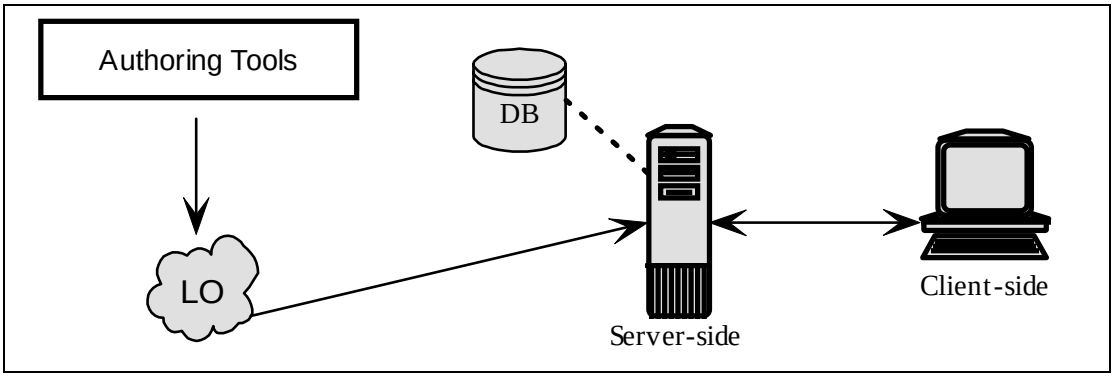

Figure 1: Learning Object Architecture

The LO team will make sure that the appropriate principles and standards are built into the architecture to allow for run-time environment, the metadata, and the content packaging of the LOs in various media.

Using the authoring tools, learning objects can be created, edited, and modified. The LO team understands that the purpose of creating LOs must be reusability of digital content in collaborative e-learning settings. Before creating LOs, the LO team takes into account the following: granularity, interoperability and accessibility.

Granularity

Webopedia [15] defines granularity as "the extent to which a system contains separate components (like granules). The more components in a system -- or the greater the granularity -- the more flexible it is." The most critical issue in production of learning objects is granularity [16, 17]. Granularity is the process of braking down the digital content into small pieces or "chunks". It deals directly with the size of the LO. The purpose of granularity is to combine LOs to be shared and reused in a variety of contexts. Wiley [17] believes that granularity is critical to the success of LO's reusability.

Figure 1 shows granularity process in which the digital content is broken down into six different LOs. These LOs can be reused within different contexts.

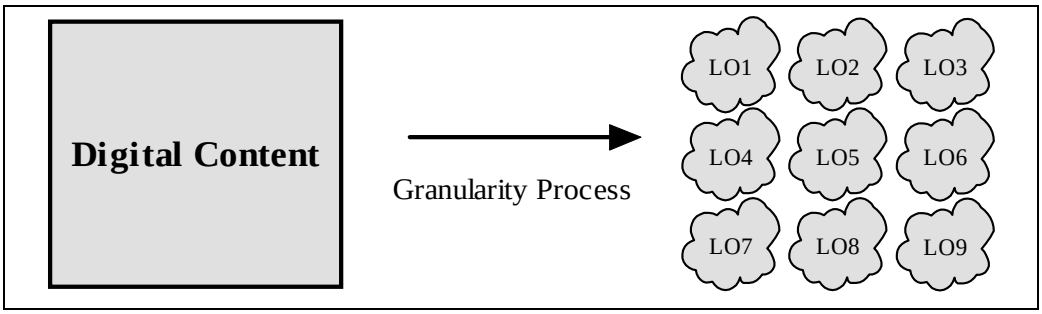

Figure 2: Granularity of Digital Content

Accessibility and Interoperability

To share and reuse LOs, they must be accessible and interoperable. Accessibility is the ability of the LO to be easily accessible by the user. Interoperability refers to transportation of LOs in different platforms. In placing emphasis on interoperability and accessibility of LOs for the purpose of reusability, careful attention must be given to Sharable Content Object Reference Model (SCORM). SCORM, introduced in 2000 by Advanced Distributed Learning (ADL), is a set of principles and specifications allowing accessibility and interoperability of LOs for the purpose of reusability. The concept of SCORM is central to learning objects which is adopted by the term object-oriented technology that produces quality software products that are timely, inexpensive, and flexible. The use of the SCORM principles and specifications will allow for 1) run-time environment, which trails the progress of the learner; 2) the metadata, which allows for consistency and accessibility of the LOs; and 3) the content packaging, which allows for interoperability and transportation of the LOs in various media [14].

Polsani [10] believes that in order to achieve interoperability the LO designers must select and use a language that focuses on the next generation technology. For this reason, the language of choice is XML. XML stands for Extensible Markup Language. It is being endorsed as the standard for all future applications because of its ability to separate structure, content, and presentation. The underlying logic of XML allows the flexibility that is essential for deploying and manipulating LOs.

The Paradigm

Figure 3 shows the process of creating LOs for a specific course. It begins by organizing the course into various major segments. Each segment is organized into various themes. Each theme includes at least one LO. A maximum set of LOs for each theme may be determined.

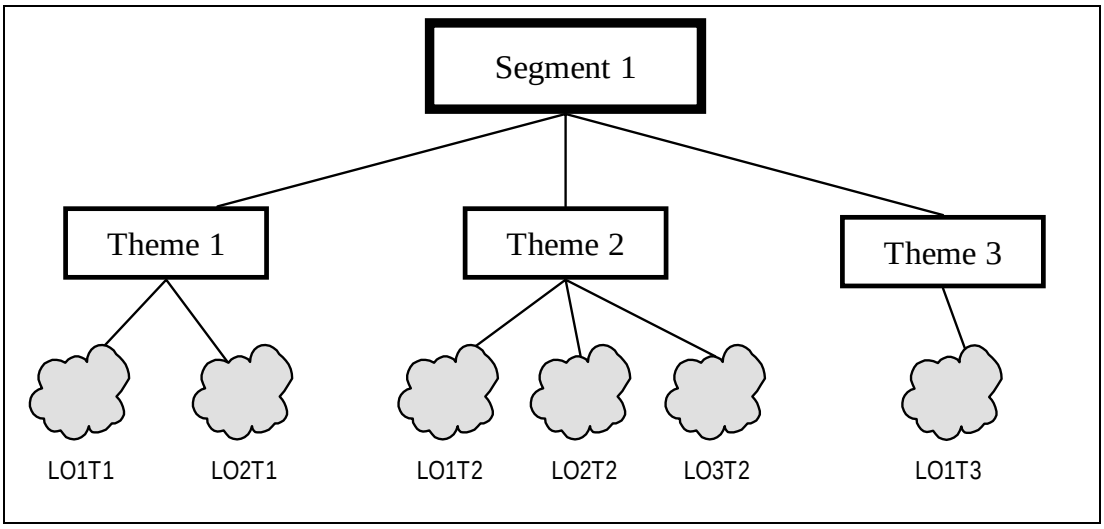

Figure 3: Process of Creating Learning Object for a Segment of a Course

For example, an undergraduate introductory course in an introductory systems analysis and design within the IS or MIS discipline can be granularized to create LOs that are shared and reused among various sections of the course taught by multiple instructors. The granularity process includes dividing the course into five different segments: planning, analysis, design, implementation, and support/operation. Each segment is divided into various themes. For example, in Figure 3 planning is segment 1 of the course and is divided into three themes: Theme 1 – IS planning overview, Theme 2 – evaluation, and Theme 3 – preliminary investigation.

Each theme will then be divided into various LOs. For example Theme 1 will have two LOs – strategic planning LO (LO1T1) and IS projects LO (LO2T1). The second theme will have three LOs – systems request LO (LO1T2), systems feasibility LO (LO2T2), and systems priority LO (LO3T2). The third theme consists of only one LO – systems preliminary investigation LO (LO1T3). Similar process continues with other segments of the course.

Each LO may have a precedent LO and a subsequent LO. A LO in a theme can become precedent to another LO within the same theme or a different theme. A precedent LO is a prerequisite knowledge. A subsequent LO is knowledge beyond the current LO.

These LOs may be reused as precedent/prerequisite LOs in a different context within the IS or MIS discipline such as a graduate course in systems analysis and design. The LOs may also be reused in undergraduate or graduate courses that require various *bits and pieces* of knowledge from systems analysis and design contents within the IS or MIS discipline. Various LOs within this course may also be reused across various disciplines.

A LO may include an activity to reinforce the learning of the content presented. Each LO may have a difficulty level, i.e., beginning, intermediate, and advanced. They may consist of one or more of the following knowledge forms: text, audio, video, graphics, and animation. Each form is responsible for a specific task and has a corresponding metadata file. Each LO could be

classified into various levels of complexity (lowest to the highest) based on its place within and across the disciplines.

Every individual has a unique way of learning. Individual learning styles can be auditory, visual, or kinesthetic. In creating LOs attention must be given to content adaptation to learning styles. Finally, consideration must be given to e-learning instructional design models and key elements that influence and optimize learning in the process of creating LOs. In addition, LOs must be created with sound user interface design for usability.

Once LOs are created, they must be tagged for consistency and accessibility. It is the LO team's responsibility to tag LOs. The metadata makes available information about the content and the digital object identifier makes available information about the object. The LOs will then be entered into a learning management system for use and reuse in collaborative e-learning settings. Before LOs are made available, the LO team tests and evaluates each LO for run-time environment, metadata, and content packaging. Run-time environment test trails the progress of the learner. Metadata test checks for consistency and accessibility of LOs. Content packaging test verifies interoperability and transportability of the LOs in various media.

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CONCLUSION

LOs are one of the most promising elements of e-learning. As the landscape of e-learning changes, LOs can and should contribute to learning and teaching within a collaborative e-learning environment. Quality LOs must be created to optimize and enhance learning. LOs must be combined and reused for maximum efficiency. LOs offer many advantages that are beneficial to both teaching and learning. They encourage collaborative teaching and learning within and across various disciplines.

This paper presented a systematic approach to creating LOs for the purpose of reusability. There are undoubtedly other methods that can be offered for creating LOs. A critical element in creating LOs is choosing a sound LO architecture that includes a set of industry-standard principles that are fundamental to run-time environment, metadata, and content packaging. In addition, instructional design models and user interface design that are critical issues in learning must be incorporated in the process of creating LOs.

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