A STRATEGY FOR THE DEVELOPMENT OF REUSABLE LEARNING OBJECTS IN THE BOSTON AREA ADVANCED TECHNOLOGICAL EDUCATION CONNECTIONS PARTNERSHIP

Oscar Gutierrez, University of Massachusetts Boston, oscar.gutierrez@umb.edu

ABSTRACT

Online learning is quickly becoming a viable delivery approach to education and training. This paper addresses the development strategy of reusable learning objects applied by several educational institutions in the Boston area. This strategy is designed to address the demand for Information Technology workers in four distinct areas of knowledge: Database development, network administration, enterprise applications and web development. The paper discusses the overall development strategy and touches upon some critical implementation issues.

Keywords: Reusable learning objects, Learning Management Systems, Online curriculum, eLearning.

INTRODUCTION

The Boston Area Advanced Technological Education Connections (BATEC) partnership is a regional Information Technology (IT) center sponsored by the National Science Foundation (NSF). It is designed, among other things, to develop IT education connections to encourage and facilitate multiple entry and exit points for current and future IT workers. A main goal of the BATEC center is to align IT education with industry needs and ensure consistent, current, and flexible IT training. The BATEC partnership includes The University of Massachusetts Boston; Bunker Hill Community College; Roxbury Community College; TechBoston, a technology-focused program of study in some Boston Public Schools; and the Metropolitan School to Career Partnership, an IT training initiative encompassing 10 secondary schools north of Boston.

It is commonly recognized that the continuing professional education of adults is the number one growth industry in the next thirty years, but not in the traditional form (2). Online content delivery programs that focus on both education and training are beginning to be offered through the use of dynamic Learning Management Systems (LMS) and Learning Content Management Systems (LCMS) (1) that require different models for curriculum program development and delivery. One promising method for supporting the implementation of flexible, current and consistent IT programs results through the use of Reusable Learning Objects (RLOs). This approach is also promising in helping reduce the entry barriers that prospective IT workers often experience under current requirements.

The sections that follow describe BATEC's strategy concerning the development and implementation of RLOs. The two main sections of the paper cover technical and policy considerations. The section on structure and development strategy begins by summarizing what Reusable Learning Objects are in the context of the BATEC project, as well as their architecture and common format. This section focuses on the identification of the fundamental technical

standards of the BATEC RLO. The overall development strategy and content linkage of RLOs is also discussed.

The section on implementation issues discusses the types of mechanisms that partner organizations will use to determine RLO applicability and effectiveness in specific situations. Issues concerning outcome assessments are also addressed.

There are many challenges in bringing multiple organizations to share and employ RLOs. The last section of the paper outlines some of the most challenging policy decisions that the BATEC group will be addressing in the next three years. The conclusions presented in the end are designed to offer specific recommendations for the development of an integrated RLO deployment strategy.

REUSABLE LEARNING OBJECTS IN BATEC

Architecture and format of BATEC RLOs

The last several years have seen the emergence of numerous prescriptions for what a learning object should be. Most notable are Cisco's reusable learning object strategy, the U.S. Department of Defense Advanced Distributed Learning (ADL) initiative, and IEEE Learning Technology Standards Committee. Similarly, numerous authors, both academic and commercial (4,7,8), have contributed to this body of knowledge. But despite the differences that are found with regards to platform, scope and size, there is a common understanding of what learning objects are. Based on the analysis of existing initiatives, the BATEC definition is as follows:

> *A learning object is a stand-alone content module that supports and enforces the learning experience of a topic.*

RLO Format

A BATEC learning object contains four basic components: Purpose, Content, Practice and Assessment (PCPA). This structure is based on the framework developed by Heins and Hines (3). The PCPA composition of a BATEC learning module ensures the use of two integrating elements that imperatively must be found in a dynamic learning platform. One is technical and has to do with accessibility to the object, while the other is pedagogical and has to do with mechanisms for assuring that competencies have been acquired by the learner. These two mechanisms are found in the extremes of the RLO and are identified as Purpose and Assessment. Following is a brief description of each of the four components.

Purpose contains the necessary identifiers and parameters for its location and use. It complies with the mechanism for cataloging, searching and adaptation.

Content includes the topic's subject matter. The content repository of a learning object is encapsulated and may contain several different resources such as digital images, video or audio clips, animations and text. The content component of a learning object may include numerous screens.

Practice contains the prescriptive guidelines for the application of the topic's concepts. Some learning objects may include applications with complex algorithms and data access.

Assessment includes the mechanisms to assure that competencies have been met. These mechanisms can be explicit or implicit. Explicit mechanisms are in the form of tests or self-assessments. Implicit mechanisms are tied to the practice module if it exists. And competencies can be determined when the practice session is successfully completed.

STRUCTURE AND DEVELOPMENT STRATEGY

The three components of the overall RLO strategy: development, architecture and delivery, are summarized in Figure 1.

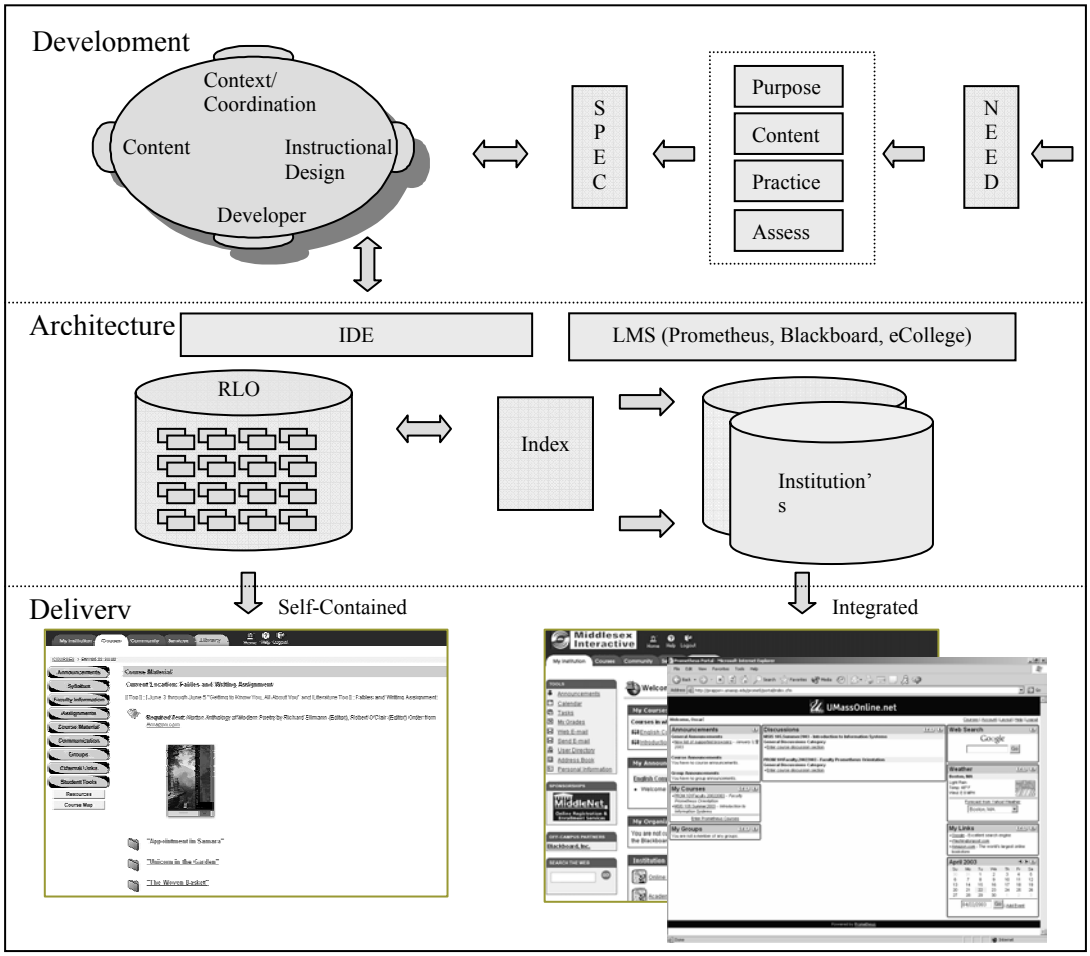

Figure 1. Architecture and format of BATEC's RLOs

Development Model

The development model is based on role differentiation. Within this model teams are comprised of a content expert, who is usually an instructor, an online instruction designer, and an IT

developer. All collaborate in the production process. Note that at the top of Figure 1 there is a fourth role identified as "context and coordination." This critical role ensures that two main development objectives are met. The first objective is to guarantee that any new RLO initiative fits within the broader curriculum collaboration efforts. The second objective is to make certain that no duplication occurs in RLO curriculum development (5)

The BATEC project curriculum development plan addresses four IT cluster areas: Database Development and Administration, Enterprise Systems Analysis and Integration, Network Design and Administration, and Web Development and Administration. The selection of these four IT cluster areas is not arbitrary. These are areas for which national skills standards exist (6) and will be used as a unifying reference in this effort.

The process for developing RLOs is summarized in the top layer of Figure 1. It begins with the formulation of an RLO requirement in any of the four areas mentioned above. For example, "Normalization" may be an RLO topic request in the Database cluster. The development team, after validating context, coordination and integration requirements, works together in the formulation of one identification and usage template and three different types of script. The template will be used to populate the purpose component of the learning object. The scripts describe the object's behavior and correspond to the three other object components. In the Normalization topic example these are content (e.g. rationale, modification anomalies, normal forms), practice (e.g. application of first, second, third normal forms to practical scenarios) and assessment (e.g. tests, or assessment practices). These products represent the specifications which are taken by developers to iteratively integrate the developed resources into the learning object.

Architecture

The architecture is summarized in the middle layer of Figure 1. The major components are: an integrated development environment comprised mainly of Macromedia development resources; existing Learning Management Systems at each participating institution; an RLO repository with search and indexing mechanisms; and each participating institution's online courseware. Of particular importance is the Metadata structure found in the Purpose component of the RLO.

The Metadata is comprised of three structures that support RLO identification and usage. These structures are: Identification, Technical Knowledge, and Object Configuration. Following is a brief description of each structure.

The Identification structure is comprised of relevant tags that serve the object's location and search. Sample tags include name, description, objectives, keywords, outcomes and glossary.

The technical knowledge structure includes descriptions of the technical skills and abilities that the reusable learning object is designed to instruct. Also included under this structure are descriptions of any tools and techniques that the learning object is designed to instruct.
The object configuration structure comprises parameters to arrange content, practice and assessment behaviors. For example, depending on the level of technical knowledge displayed by

the user or chosen by the instructor, the learning object can trigger the practice of more complex scenarios or assessments appropriate to the exposed or desired ability.

Delivery Model

In order to achieve maximum flexibility in the application of RLOs, the BATEC project will prepare and enforce policies and operating procedures for two delivery models. The two different types of model are self-contained and integrated. This is represented in the bottom layer of Figure 1.

The self-contained delivery model is designed to support the partial fulfillment of academic requirements. This applies to those individuals who have achieved mastery in certain aspects of a course through past academic or work experience, but lack achievement in other areas. This model also applies to concept enforcement. This applies to individuals who may be experiencing difficulty in the mastery of a specific topic through conventional ground or online courses. In such cases, the RLO experience of the topic in question may be required by the instructor as additional enforcement for the student. A third mode of application for the self-contained delivery model is in the design of short-term highly focused workshops.

The integrated model assumes the incorporation of distinct RLOs within the sequence of a given course. In such cases the RLO provides the content and may also provide the topic's practice and assessment, if the instructor so desires. The challenges facing the design team today are found within the integration of RLO's graphical interfaces with heterogeneous Learning Management Systems with the objective of providing a standard interactive experience through a course.

IMPLEMENTATION ISSUES

Deployment Strategy

The deployment strategy involves two distinct considerations: implementation process and deployment policies.

The deployment methodology follows an experimental paradigm to systems implementation. In this approach completed steps inform further implementation actions. This is because learning is an integral part of the deployment process. The course of action follows a two-phase piloting process. The first phase focuses on one-dimensional pilot tests meaning by this that the original pilot test of a learning object is performed on a single location, a single level within an IT cluster area, and a single Learning Management System. Experience from this scenario informs the second pilot process, which is multi-dimensional.

Beyond the process considerations mentioned above, much of the deployment strategy involves policy decisions. The most significant initiatives involve policy considerations regarding integration with current delivery models, incorporation of localized standards for integrating content into existing curricula, and policies regarding ownership and accessibility to the library of reusable learning objects.

Determining Applicability and Outcome Assessment

A critical implementation issue for determining the usefulness of reusable learning objects is the availability of mechanisms to help instructors in defining when and how these objects may be applicable. Equally important is the availability of mechanisms for assessing outcomes. The front and back ends of the BATEC's RLO structure contribute to these two implementation effectiveness issues.

Usage of the RLO's Purpose component through indexing, searching and configuration mechanisms will provide course developers and instructors with sufficient information to determine such issues as suitability, level of desired expertise or complexity, and behaviors that the learning object must expose in specific course or training packages.

As far as outcome assessments are concerned, the RLO's Assessment component will provide enough flexibility and rigor to help determine whether an individual has actually achieved a desired level of competency in the topic under study. Instructors will have the ability to determine the level at which an RLO should operate. For example, these levels can be categorized and configured by an instructor as basic, intermediate and expert. The RLO can then perform its operations of content, practice and assessment at the set level for the particular course or training package. It must be recognized that this level of flexibility is necessary in order to address the varied needs of the different BATEC partners.

Other Policy Challenges Facing Participating Organizations

The challenges facing the BATEC partners are many, particularly those relating to collaboration and enforcement policies. In the next three years guidelines will be necessary to address the following challenges: curriculum coordination across institutional boundaries, articulation agreements among participating stakeholders, and content sequencing and coverage across the various institutional levels. The overall reach of these guidelines within BATEC are currently impacting initiatives that are well beyond the scope of the RLO project. However, such guidelines are a necessary foundation and constitute a framework under which the RLO initiative should operate.

CONCLUSION

This paper has described the Boston Area Advanced Technological Education Connection's (BATEC) strategy concerning the development and implementation of reusable learning objects. This is part of a broader strategy to bring Information Technology education and training opportunities to non-traditional students at all levels within the regional workplace. The paper shows the elements of the development strategy and points to the most challenging system implementation issues.

The following points derived from the BATEC experience serve as recommendations for the development of an integrated RLO deployment strategy.

- RLO Architecture. Define standard components and generic functionality of the unit of content delivery (i.e. RLO). Agree on grain size, interface standards and media and other development resources to be used.

- Role differentiation. Current technology favors the use of interdisciplinary groups for scripting, designing and developing RLOs.

- Platform independence. Effective and flexible RLO development will most likely be done outside any specific Learning Management System. Approach the overall design from a platform independent perspective.

- Defining the framework for content and usage. An RLO strategy cannot function without a proper framework that outlines and addresses curriculum coordination issues, content integration and substitution, and topic sequencing.

- Selection of an implementation approach. An iterative process of scripting content, practice and assessment protocols followed by piloting techniques seems to be an appropriate methodological approach to deployment.

REFERENCES

1. Chapman, B. and Hall, B. (2002). Learning Content Management Systems: Comparative Analysis of Systems Used to Construct, Organize and Re-use Learning Objects, http://www.brandon-hall.com
2. Drucker, P.F. (2002). Managing in the Next Society. Truman Talley Books, St. Martin's Press, NY.
3. Heins, T. and Hines, F. (2002). Macromedia MX: Strategies and Architectures for eLearning Content, White Paper. http://www.macromedia.com
4. L'Allier, J.J. (1997). Frame of Reference: NETg's Map to the Products, Their Structure and Core Beliefs. http://www.netg.com/research/whitepapers/frameref.asp.
5. Longmire, W. (2000). Content and Context: Designing and Developing Learning Objects, Learning Without Limits, Vol. 3, Informania.
6. Northwest Center for Emerging Technologies (1999). Building a Foundation for Tomorrow. Skills Standards for Information Technology. http://www.newcet.org.
7. Wagner, E.D., (2002). The New Frontier of Learning Object Design. The eLearning Developer's Journal, June, 18.
8. Wiley, D. A. (2002). Connecting Learning Objects to Instructional Design Theory: A Definition, a Metaphor, and a Taxonomy. The Instructional Use of Learning Objects, Bloomington, IN, Agency for Instructional Technology.