Learning Objects and Learning Designs Reusable Learning Resources for Virtual Learning Environments

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ABSTRACT

The concept of learning object, at the center of a new instructional design paradigm for Web-based learning, emphasizes reuse as a quality feature of learning contents and activities. Standardized learning objects are reusable elements that can be utilized as part of *learning designs*. In learning design, activities are considered to be pieces of interaction among a number of specified *roles* –generally learners and tutors– inside a given environment. The activity-based paradigm of IMS Learning Design provides a good solution for the creation of virtual environments aimed at using and reusing learning objects to facilitate concrete learning outcomes.

INTRODUCTION: THE PARADIGM OF LEARNING OBJECTS

The evolution of Web-based learning has fostered the search for methods and technologies that enable a degree of reuse of learning contents and learning activity designs. Such attempt is intended to facilitate both the reuse of quality resources and the development of automated resource-search tools, and it may eventually reduce the cost of devising learning activities. The concept of *learning object* is at the center of a new instructional design paradigm for Web-based learning. This new paradigm emphasizes reuse as a quality characteristic of learning contents and activities. For example, the often-cited definition of learning object by Polsani (2003) explicitly includes reuse in his definition: "an independent and self-standing unit of learning content that is predisposed to reuse in multiple instructional contexts". In one of the most referenced articles on the field, Wiley (2001) also mentions the term reuse in his learning object definition: "any digital resource that can be reused to support learning". Nevertheless, the concept of learning object reusability as a key quality factor for content design is difficult to characterize and measure since it encompasses, not only the evaluation of the contents themselves (Vargo et al., 2003), but also a balance between their usability in specific contexts and the range of educational contexts it explicitly targets (Sicilia and Garcia, 2003).

In practical terms, a learning object is a piece of Web content of arbitrary type and structure that is described by a metadata record. This metadata record provides information about the object and its prospective educational usages. Learning object metadata is thus the key to reuse.

LEARNING OBJECT STANDARDS AND SPECIFICATIONS

In the last years, a number of specifications and standards that describe or make use of the learning object concept have evolved. However, even though an important effort of cooperation has been made, some confusion derived from the existence of numerous organizations that create, develop and implement these specifications still remains. The CEN/ISS Learning Technology Standards Observatory¹, a "web based repository that acts as a focal access point to projects, results, activities and organizations that are relevant to the development and adoption of e-learning technology standards" represents one of the most significant clarification efforts in the field.

Regarding metadata, the basic elements associated to learning objects have been described in the IEEE LOM standard (IEEE, 2002). This standard, based on the well-known Dublin Core Metadata Element Set (Dublin Core, 2003), organizes its conceptual metadata schema in nine categories: General, Lifecycle, Meta-Metadata, Technical, Educational, Rights, Relation, Annotation and Classification. General and Annotation cover basic description -title, coverage, etc.- and general purpose annotations. Lifecycle and *Rights*, contributors, change control and property matters. The category Technical, covers technical characteristics of the Web contents. Metametadata covers the description of the metadata record itself. Educational describes the envisioned educational characteristics of the object, including type of interactivity, typical educational context, typical age of the intended learners and the like. The Relation category describes relations between learning objects, which could be seen as a form of "linking" the described learning object to educational characteristics, e.g. related learning objects that constitute prerequisites or that cover semantically related elements

¹ http://www.cen-ltso.net

(Sicilia et al., 2004). Finally, the *Classification* category serves several different purposes, including stating the objectives of the learning object, the prerequisites of the learner and the overall classification of the contents inside taxonomical schemes or ontologies.

As a descriptive standard, LOM enables cataloguers to provide metadata values for the abovementioned categories. However, it is not mandatory for the annotator of a LOM conformant metadata record to specify a minimum number of values, because LOM is just committed to provide a conceptual model. The so-called *application profiles* provide useful guidelines for the implementation of practical subsets of LOM, addressing the requirements of particular user groups and recommending the use of certain LOM elements for local implementations. The most relevant examples of application profiles are the Canadian Core², UK LOM Core³, the Le@rning Federation metadata application profile⁴ and FAILTE metadata⁵.

On learning design, the recent IMS Learning Design specification (IMS, 2003), whose objective is "to provide a containment framework of elements that can describe any design of a teaching-learning process in a formal way", addresses the description of activity-based designs of learning activities. In each activity, several different roles are joined together and interact with learning objects and services (similar to chat services) to accomplish some

² http://www.cancore.ca

³ http://www.cetis.ac.uk/profiles/uklomcore

⁴ http://www.thelearningfederation.edu.au

⁵ http://failte.ac.uk

goals. Current IMS Learning Design implementations –like the *CopperCore⁶* engine– provide a coordination support needed to effectively deliver the activities to the specified learners in the order and under the conditions specified in the learning design.

Regarding the learners, a number of specifications have been developed to allow the exchange of learner information between systems. Among these, it is important to mention both the ISO SC36/WG3 Learner Information, an information model based on the earlier LTSC Public and Private Information (PAPI) specification, and the IMS Learner Information Package, an interoperability protocol for internet-based systems.

Another remarkable effort is the influential ADL Sharable Content Object Reference Model (SCORM). Regardless IEEE and IMS Learning Design, SCORM is not a different specification but "a model that reference a set of interrelated technical specifications and guidelines, designed to meet highlevel requirements for learning content and systems". As part of the specifications compiled by SCORM, IEEE LOM has been adopted as the metadata language for learning resources, but it also includes specifications oriented towards achieving a degree of interoperability in the functioning of *Learning Management Systems* (LMS). On the one hand, the SCORM content packaging specification determines an interoperable format for the interchange of learning contents structured as hierarchical units. On the other hand, the SCORM run-time specification states a common protocol and language for the Web browser-LMS communication, including the delivery of

⁶ http://coppercore.org

some kind of learning objects (called *Sharable Content Objects* in SCORM) and the recording and tracking of the activities of each user. Finally, the most recent sequencing and navigation specifications go further by providing a language in which complex navigational patterns can be devised, including learning paths that adapt to the accomplishment of some objectives by the learner.

IEEE LTSC, IMS and ADL, among other organizations, are currently active in the evolution and extension of the body of learning technology standards. Other areas currently covered and not discussed here for brevity include educational portfolios, learner descriptions, tests, digital repositories and competency specification.

LEARNING DESIGNS AS MODELS OF COMMUNITIES OF LEARNERS

Learning objects are considered as reusable elements that can be utilized as part of *learning designs*. IMS Learning Design provides a powerful language for the expression of learning designs targeted at the realization of activities. Here, an *activity* is considered as a piece of interaction among a number of specified *roles*, played by persons, that produce a tangible *outcome* by using a concrete environment. The so-called *environment* of a given role is made up of learning objects and services that are available at runtime. Activities can be further decomposed in sub-activities. They are also aggregated into *methods*, that specify the conditions for application of the learning design, along with the planned objectives that will eventually match the outcomes of the activities. Methods can be structured around concurrent *plays* and these in turn in sequential *acts*, the latter allowing the specification of execution conditions. This schematic description of IMS Learning Design gives an idea of the flexibility that this specification provides for describing activity-based learning programs. The practical use of Learning Design-based tools would then allow the definition of the activities resulting from a process of instructional design that takes, as point of departure, a concrete perspective about learning that drives the crafting of the activities.

Constructivism and socio-cultural approaches are two prominent and complementary ontologies (Packer and Goicoechea, 2000) that pervade current educational practice. Socio-cultural approaches view cognition as a complex social phenomenon, mediated by participation in social activities, in which the learner is, to some extent, guided. In such views, the concept of social context represents a specific instance of a learning community. Whenever these communities are mediated by Web-based learning tools, it opens the possibility of tracking social interactions and analyzing them using computer-based tools. Nevertheless, current learning technology specifications do not explicitly cover concepts like *social relationship*, *culture-specific norms and beliefs* or *identity* inside a group, which are determinant in the driving and assessment of sociocultural-based learning programs. Some recent work intends to overcome such limitations, e.g. Allert (2004) has provided the outline for a model that extends activity-based designs to include a notion of social context based on the Theory of Social Systems.

The resulting scenario for virtual learning communities is beneficial, as the activity-based paradigm of IMS Learning Design provides the appropriate technological solution for the creation of virtual environments aimed at (re-)using learning objects and services to facilitate concrete learning outcomes. Even though such framework still requires extension to integrate social relationship and culture-related elements as part of the technological, standardized solution, it provides a rich platform for the development of advanced tools that help in crafting and understanding learning communities on the Web.

CONCLUSIONS

The concept of learning object is at the center of an evolving framework of learning technology that focuses on reuse and automation of searching, selection and composition of educational contents and activities. Learning object metadata is the critical element for the development of such infrastructure, since it provides a shared schema for learning objects of diverse kind.

Learning designs are activity-based descriptions of on-line learning programs of arbitrary complexity that use learning objects as pieces inside activities played by roles. Activities in learning designs represent actual interactions of learners and tutors inside an environment prepared to facilitate learning through the use of communication services and activities. In consequence, learning designs are actually reusable patterns of potential social interaction that join together an educational design with learning objects.

Further research in the directions described by Koper (2004) is required to advance both in our understanding of learning patterns and in conceiving more ambitious models of learning communities that provide a prominent role to social interactions and relationship.

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Terms and Definitions

Learning Object: A digital entity described by a metadata record that facilitates its reuse in on-line learning.

Learning Design: The description of a program of activities, roles and learning objectives.

Learning Management System: A system that automates, totally or partially, the creation, management and execution of learning activities and their related processes of design, auditing and assessment.