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CUC054/2004

Designing e-learning materials with learning objects

Abstract

E-learning materials are inevitable part of today's educational environment. They have found applications in classical distance learning communities as well as in university and generally higher education courses. Advanced technology possibilities are driving force behind e-learning disseminations.

Under CARNet support there are more referral centers designed to give hand in different aspects of e-learning materials applications. This paper will present some of topics Referral Center for Development of Educational Materials is dealing.

In this Referral Center you will find a systematic approach to development and design of hypertext educational materials. The knowledge and skills presented in these materials will help to develop quality hypertext materials for different purposes, ranging from personal pages to university textbooks.

Special attention was paid to defining educational materials depending on the available teaching tools, and different aspects of their use were considered in different forms of teaching in higher education.

An overview of university instructional literature is presented and demonstrated some of the possibilities of its enrichment educational materials with hypertext links.

For those who participate in the class performance at a university study, an overview of different possibilities of the use of information and communication technologies in different forms of courses is presented. A separate section was dedicated to the ways and constraints of the use of programs and computer equipment as teaching tools in educational processes.

There is a whole new approach in hypertextual educational materials development based on learning objects. Hypertext technology materials are very naturally organized around elements of knowledge, presented on single page. As there are plenty of authors dealing with similar courses, one learning object could nicely fit into different curriculum and different textbooks.

Interchange possibilities of learning objects have very soon resulted in two activities, one in organizing communities of authors who are ready to freely interchange its products and one dealing with compatibility of learning objects.

Educational community has paid a great attention to standardization of learning objects. Here in a Referral Center an overview of a material considering different points of view and different results is presented.

There is a really problem in defining what is learning object. Some of the most popular materials available on the web in large numbers are different reference books, dictionaries and encyclopaedias. This group contains some very valuable materials from distinguished and authoritative sources. In most cases their content cannot be directly linked to only one higher education subject, so these are not higher education textbooks in the classical sense. And each article could be defined as an article, or learning object.

Definition such as learning object is "...digital resources, modular in nature, that are used to support learning" are proposed. Learning object could be be also further divided into smaller units, (pictures, simulations etc.), smaller objects - sharable content object (SCO).

Some of the most important work has been done under IEEE with its Learning Technology Standards Committee. As a first result IEEE-LTSC Learning Object Metadata Standard 1484.12.1 is delivered. One could find that any US standardization is no obligation to any other nation, but industry leaders as Microsoft or IBM will follow IEEE standards.

European emphasis considering standardization aims started around ARIADNE (**A**lliance of **R**emote **I**nstructional **A**uthoring and **D**istribution **N**etworks for **E**urope) project.

Maybe the most successful initiative is communities around freeware educational sharing objects idea, such as MERLOT. Here authors make contribution to learning objects freeware pool. We could only encourage authors to use its resources and hopefully take part into such communities.

From the small country point of view, we could only look for the most suitable standards and accept them. Here at our local level we could recommend to adopt one of internationally approved standards and try to organize educational community

Such approach have a chance to insure that learning objects developed in Croatia, especially those using Croatian language will be compatible and could be used as a building blocks for a e-learning materials.

Introduction

Some argue that learning objects will have the biggest impact on online learning in this decade. One of fellows in field, H. Wayne Hodgins from Worldwide Learning Strategies compares learning objects with creation of periodic table of elements:

"I believe we are on the verge of grand discovery in the areas of learning, content, knowledge, and objects. Just as revolutionary as our discovery of the atomic and molecular models will be our discovery of the equivalent of the periodic table for all content or data. Mendeleyev's 1870s creation of the periodic table laid out the basic building blocks of all physical matter and revolutionized our view of that world. Similarly, an equivalent understanding of our data and informational world will give us a fundamental understanding and ability to manipulate, create, and build any substance possible."

Even if impact of Wayne Hodgins "Periodic Table of Data" is overestimated, learning objects approach delivered radical change in development of educational materials.

Learning objects should have characteristics such as **reusability,** so that learning content is modularised into small units suitable for use into a variety course curriculum; **interoperability,** operate regardless of developer or learning management system; **durability,** designed so that could survive ever-changing information technologies; **accessibility,** learning objects should and could be accessed and reused across network.

Some will compare that approach with well-known Lego building blocks that could be assembled into almost whatever shapes your imagination could find. Learning object is an element of content that is smaller than course or lesson, should be stored electronically, reusable, and deployed in different formats.

However, there is a choice of definition offered from different sources. "Learning object" is a term that could be found under synonyms such as: reusable learning object (RLO), reusable information object, sharable content object (SCO), modular building block or even Lego.

The term "learning object" was introduced by Wayne Hodgins in 1994 when he named the CedMA (Computer Education Management Association) working group 'Learning Architectures, APIs and Learning Objects'".

According to the IEEE`s Standard for Learning Object Metadata "Learning object" is: " any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning." And technology-supported learning is: "… 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."

David Wiley proposed another definition: "...any digital resource that can be reused to support learning. ... The main idea of "learning objects" is to break educational content down into small chunks that can be reused in various learning environments, in the spirit of object-oriented programming."

US National Learning Infrastructure Initiative (NLII) characterized learning object as: "...digital resources, modular in nature, that are used to support learning. They include, but are not limited to, simulations, electronic calculators, animations, tutorials, text entries, Web sites, bibliographies, audio and video clips, quizzes, photographs, illustrations, diagrams, graphs, maps, charts, and assessments. They vary in size, scope, and level of granularity ranging from a small chunk of instruction to a series of resources combined to provide a more complex learning experience... uniquely identified and metatagged, that can be used to support learning. "

Standardization

To achieve functionality early into learning objects development attention is paid to its standardization.

First steps were done by aviation industry. The Aviation Industry CBT Committee, defined a specification for interoperability between Computer Based Training courses and computer-managed instruction systems. The AICC' CMI Guidelines for Interoperability presents a standard syntax for communication between courseware and CMI. This was first try too define standards in the field.

In Europe The Dublin Core Metadata Initiative (DCMI) was formed as an organization dedicated to promoting the widespread adoption of interoperable metadata standards and developing specialized metadata vocabularies for describing resources that enable more intelligent information discovery systems. The mission of DCMI is to make it easier to find and use resources using the Internet.

Document such as DCMI Metadata Terms, DCMI Type Vocabulary and DCMI Grammatical Principles have been delivered. The grammar presents the typology of DCMI metadata terms and describes the principles underlying their definition and use.

In US a IMS Global Learning Consortium defines a rules to describe learning contents in the IMS Meta-data Specification. Without such meta data description one would find difficult to build interoperability into learning objects. Here learning content is described into details such as a description of the content, the title, the author, location (URL), cost and payment structure, prerequisites, learning taxonomy and so on.

Advanced Distributed Learning (ADL) initiative was formed in 1997. As a result of its work the Sharable Content Object Reference Model (SCORM) was defined. SCORM is a model for defining, packaging, and managing learning objects. SCORM defines API for communication between SCORM and Learning Management System (LMS).

Another projects from Europe, ARIADNE (Alliance of Remote Instructional and Distribution Networks for Europe) and ARIADNE II are research and technology development (RTD) projects of the 4th Framework Program of the European Union. This large project (approximatively 100 man.years) ended in June 2000

ARIADNE Educational Metadata specification (the 'pedagogical header') was developed as educational standard, which was one of the ingredients in the creation of IEEE/LTSC LOM Standard.

The US Institute of Electrical and Electronics Engineers (IEEE) Learning Technology Standards Committee (LTSC) is developing technical standards, recommended practices, and guides for learning technology. As a first result Learning Object Metadata (LOM) 1484.12.1-2002 was delivered and further work is underway toward Architecture & Reference Model WG1 LTSA, Digital Rights Expression Lang. WG4 DREL Computer Managed Instruction WG11 CMI, Competency Definitions WG20 RCD standards.

The IEEE LTSC coordinates with other organizations that produce specifications and standards for similar purposes.

The Learning Object Metadata Standard is a multi-part standard that is focus on the minimal set of attributes needed to allow Learning Objects to be managed, located, and evaluated. Also the Standard accommodate the ability for locally extending the basic fields and entity types. Relevant attributes of Learning Objects, as defined before, are type of object, author, owner, terms of distribution, and format. Learning Object Metadata include pedagogical attributes such as; teaching or interaction style, grade level, mastery level, and prerequisites. It is possible for any given Learning Object to have more than one set of Learning Object Metadata.

The schema for meta-data definitions is based on hierarchical model called the "tree structure". At the base of the hierarchy is the "root" element that for instance .for learning object describes relevant characteristics of the learning object to which it applies. The root element contains many sub-elements. The data elements of LOM are group into 9 top-level categories called "branches": General, Life Cycle, Meta-Metadata, Technical, Educational, Rights, Relation, Annotation, and Classification. Each of these branches comprises several elements, some of which are leaves; others are sub-branches, which lead to leaves. Sub-elements that do not contain any sub-elements are called "leaves".

To improve accessibility to Web content and applications for persons with physical and cognitive disabilities Section 508 was delivered in 2001. Many organizations now specify that new courses must be developed to a learning object standard (SCORM) and an accessibility standard (Section 508).

International ISO has also give its contribution in a field with vocabulary and definitions terms and here are results are in ISO/IEC JTC1 SC36 (Information Technology for Learning, Education, and Training) and ISO/IEC JTC1 SC36 WG1 NO 041 (Vocabulary). In a standards technical terms related to information technologies and terms used in traditional education theory and practice are defined.

All the standards mentioned should be considered for today use and its durability is certainly of matter of concern, one should expect that they will be changed in only a few years, as technology changes.

Communities

Around sharing/reuse idea of learning objects different communities were organized. Most of them are supporting one or another approach to that is the nature of technological innovation in Internet time.

MERLOT (Multimedia Educational Resource for Learning and Online Teaching) is one of the most popular communities of people who are involved in education. It has a free and open resource designed primarily for faculty and students of higher education. Thanks to its peer/ review principle MERLOT ranks high on quality between online learning material collections.

MERLOT is also promotes standardization in a field adopting its IEEE LOM Standard as a working platform for online material development.

Beside MERLOT Discipline communities that are focused on specific disciplines and are subject areas in which MERLOT Editorial Boards conduct peer review of materials there are also MERLOT Special Interest Communities. One such community CATS (Community of Academic Technology Staff) deals with tools and methods for online materials development.

The ARIADNE Foundation for the European Knowledge Pool was created to exploit and further develop the results of the ARIADNE and ARIADNE II European Projects. The basic mission of ARIADNE is to enable better quality learning through the development of learning objects, tools and methodologies that enable a "share and reuse" approach for education and computer supported training.

As a goals of the Association:

- to improve the quality and efficiency of educational systems by the sharing and reuse of knowledge components,
- to foster the creation of new knowledge components and to make them easily accessible and reusable,
- to promote the appropriate use in education and training of information and communication technologies, and
- to promote and, if necessary, to defend multilingualism and multiculturalism, which characterise Europe's - and most of the world's - formation systems

are declared.

Users Community of ARIADNE Foundation provides maintenance and training in the use of ARIADNE's tools, as well as their further development. Non-commercial exploitation and validation of the tools and concepts took place in various academic and corporate sites across Europe.

IADIS (International Association for Development of the Information Society) is one among non-profit associations highly supporting Web based online learning communities.

There is a long list of communities organized around universities where attention is paid to promote online learning.

Small country point of view

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