Cooperative Learning Centre:
concepts, standardization issues and commercial approaches

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Abstract

This paper presents the general concepts of the current implementation of a cooperative learning centre, being developed as a set of facilities of the digital library of the Faculty of Engineering of University of Porto. The standardization efforts in the area of computer based learning facilities are also covered, as they present important guidelines for the project.

Introduction

In the new information society era, knowledge and innovation are certainly the basis of the added value and competitiveness of most successful corporations. The vital question to each corporation is then: how to continously develop, refine and use knowledge? Successful corporations strategically promote a knowledge exchange culture. The organizations of the future will certainly rely on a set of virtual technical communities, exchanging corporate database information and communicating through mail, bulletin board and conferencing systems.

In a knowledge era economy, the learning enterprise is strategically crucial. Too much crucial to be left to conventional schools. What is needed is learning on demand, when and where desired. Corporations must improve knowledge as the single institutional and economical security base. The best organizations of the XXIst century will merge intelectual power wherever it exists and not where it can be institutionalised. They aim to develop an intelectual republic, open to everybody, where the natural electorate will be those who stay intellectually informed all over their lives.

The role of Digital Libraries

Digital libraries may play an important role in the organization and management of information flow and cooperative work. Libraries may act as the interface between the research community and the commercial and industrial worlds, by means of the dissemination of scientific and research work and of the learning and collaboration facilities supplied [1]. Digital libraries are learning centers, the nodes of knowledge in the world-wide information society networks.

The technological evolution of storage and representation of different media made possible the developement of digital multimedia libraries, integrating in a single support text, image, audio, video, and also interactive content,

like simulations and presentations. Meanwhile, the standardization of catalogue and classification procedures leaded to flexible and open networked search and retrieval systems.
Nowadays, other promising new technologies are also being applied to digital libraries, introducing radical changes in the intellectual practices and in the social and economic organisation. Transparent world-wide interaction is aimed at distributed systems and component software technologies, while automatic content description, object oriented and agent technologies enhance the collaborative and productive work.

The functionalities of a digital library service should satisfy the needs of such different users as students, teachers, researchers or teleworkers, and make them collaborative and interdependent in the search of the relevant knowledge for their activities.
Administrative support and security procedures are key system facilities for the correct management and maintenance of the databases, the access control and the protection of intellectual property rights. Powerful and relevant document search and flexible browsing methodologies are needed for an efficient use of the digital database resources available, in particular when distributed services and large multimedia contents are available.
Content creation and cooperative work facilities should be available to users, so that everyone can contribute as a content provider and digital library access can be considered as a learning experience. Finally, commercial exploration of the digital library resources must be considered, requiring accounting and billing mechanisms, for electronic publishing purposes.

The Faculty of Engineering of Porto University, is following an operational plan for the development of a digital library since 1996. The Library wants to constitute a reference, in the access to information resources in the scientifical and technical areas of Engineering and related fields, in the Northern Region.
Besides providing the traditional library services at a high level, the plan has a great component related to information technologies, both by the service enhancement they provide and by the new habits of access, production and dissemination of knowledge they will produce in the future. Thus, a learning centre philosophy is followed in the plan, regarding the cooperative production, open access and international dissemination of scientific and technological information.

The installed Library Management System, ALEPH [2], commits with all the relevant standards in the cataloging area. In particular, it supports UNIMARC records, integrates CCL (Common Command Language) and Web OPAC (Online Public Access Catalogs) search capabilities, and supplies a Z39.50 Information Retrieval gateway. The ALEPH system is based on open, standard RDBMS (Oracle), and supports multimedia contents and URL links from bibliographic information, through field 856 of UNIMARC record.

The Cooperative Learning Centre

The massive multimedia information currently available on the Internet for search and retrieval offers exciting new opportunities for learning and research. However, the search of relevant and useful information, as well as the navigation functionalities, are still not very efficient, asking for new methodologies to format and organize the multimedia information in a coherent and controlled way.

A possible model for the development of distributed databases of learning content considers multimedia information entities, the learning objects, cross-connected in tematic subject paths, allowing for the representation of several associations of ideas, or annotations, on the primary contents [3]. In an operational view, the model is divided in four different levels of structured information: the assets pool, which are monomedia elements refernced in the cataloging system, the learning objects database, where documents that group objective elements are stored, the subject path connection service and the annotation facilities at each node. The combination of these four levels creates a dynamic and evolutive system: the hypermedium.

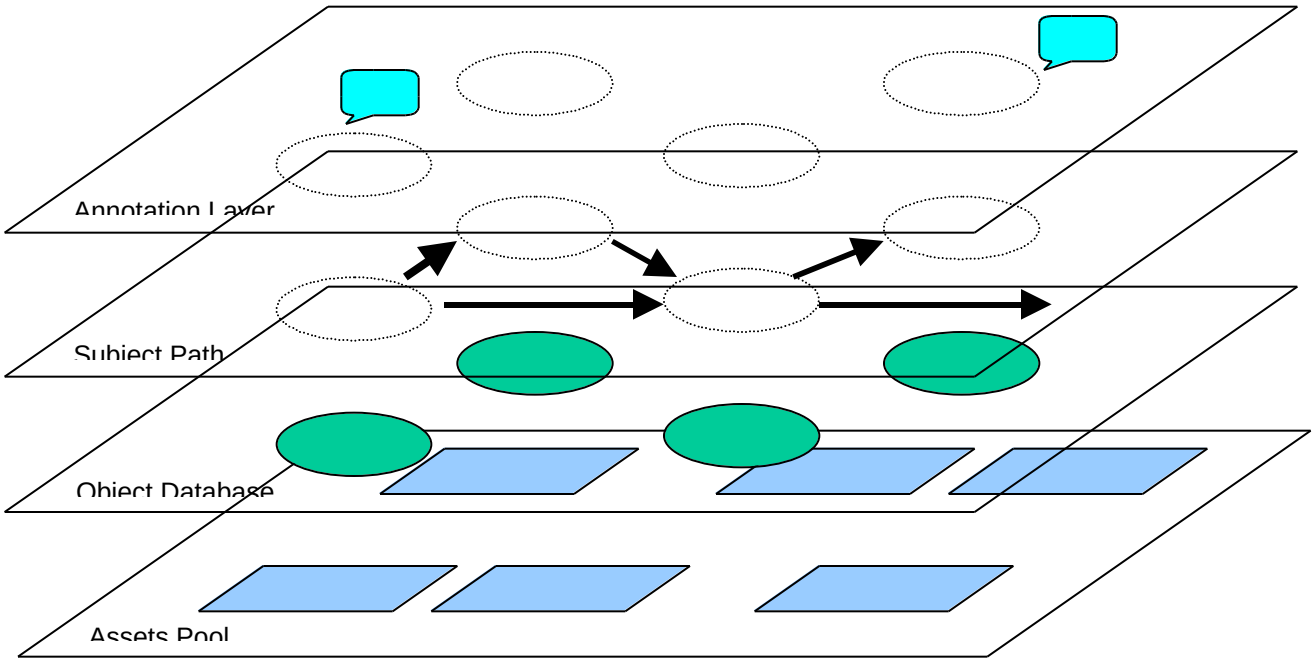

Fig. 1: The cooperative learning hypermedium model

The mediabase is supported in a conventional relational database, where the contents are multimedia entities, self-described and objective, and that can even be interactive (eg. a lab simulation). An entity acquires significant relevance in the context of an argumentation, described as a tematic subject path connecting several entities. A reader should be allowed to query an entity about the referencing paths, and move orthogonally on any one of those alternative paths.

The proposed model does not demand too much performance from terminal equipment and communication networks, as it is basically divided in a remote query (the subject path) and the download or streaming of self-described entities (the mediabase objects) [4].

The long term success of this model depends on the massive involvement of active users in the system, multiplying the entities and the subject paths defined on them. Intellectual property rights related with the annotations inscribed on the subject paths are protected by the nature of the hypermedium, as any copied entity

from the system looses the most important quality, which is the relational information inscribed in the subject paths [5].

Mediabase objects can include any kind of multimedia standards and formats. The initial content will be based in the large number of monographies, thesis and papers available in digital support (eg. PDF format). Video cassettes can also be converted to any suitable digital video format (eg. MPEG2) for distribution all over the campus.
More elaborated multimedia objects, such as, presentations (eg. Microsoft Powerpoint), application demos (eg. Lotus Screencam) or interactive simulations (eg. Macromedia Flash or Sun Java) can also be developed. A team including experts in multimedia production, interface design and pedagogic aspects will assist teachers and researchers in their development, providing also training courses and on-line support.

The Knowledge Centre will be available from a single web interface application, supporting the bibliographic and serials searching tools provided by the ALEPH library services, the access to external databases and contents (eg. Dialog, Engineering Information Village) and to the mediabase, in an object-oriented manner.
Annotation functionalities will provide for the user creation of subject paths connecting those entities, which can then be exported, if desired, to a restrict group of users or to all the research and learning communities inside the campus or in the Internet. Agent technologies will allow the development of pro-active and user configurable information services, providing a better exploitation of the available resources. Accounting and billing mechanisms will provide the needed security procedures for searching, editing or distributing the contents, and for statistical analysis of the users behaviour and taxation of commercial services.

Standardization activities

Computer-based training materials are largely developed on a proprietary, company-by-company basis, resulting in high development costs and limited re-sale value. The development of guidelines and standards fastens the creation of new markets for training materials, reduce the cost of development, and increase the potential return on investment. Some international efforts are now arriving to a consensus, in the field of computer based learning, and the most relevant initiatives that play a role in the standardization are listed below.

IEEE LTSC

The mission of IEEE LTSC - Learning Technology Standards Committee working groups [6] is to develop technical Standards, Recommended Practices, and Guides for software components, tools, technologies and design methods that facilitate the development, deployment, maintenance and interoperation of computer implementations of education and training components and systems.

The Learning Technology Systems Architecture (LTSA) 4.00 was accepted as a base document for IEEE 1484.1 (LTSC, Architecture and Reference Model Working Group). The LTSA specification covers a wide range of systems, commonly known as learning technology, computer-based training, electronic performance support systems, computer assisted instruction, intelligent tutoring, education and training technology, metadata, etc.

The LTSA specification is pedagogically neutral, content-neutral, and platform-neutral, providing a framework for understanding existing and future systems, promoting the interoperability and portability by identifying critical system interfaces. Five refinement layers of architecture are proposed. They are applicable to a broad range of learning scenarios. These refinement layers are called, from highest to lowest levels: *Learner and environment interactions*, *Human-centered features*, *System components*, *Stakeholder perspectives* and *Operational components*.

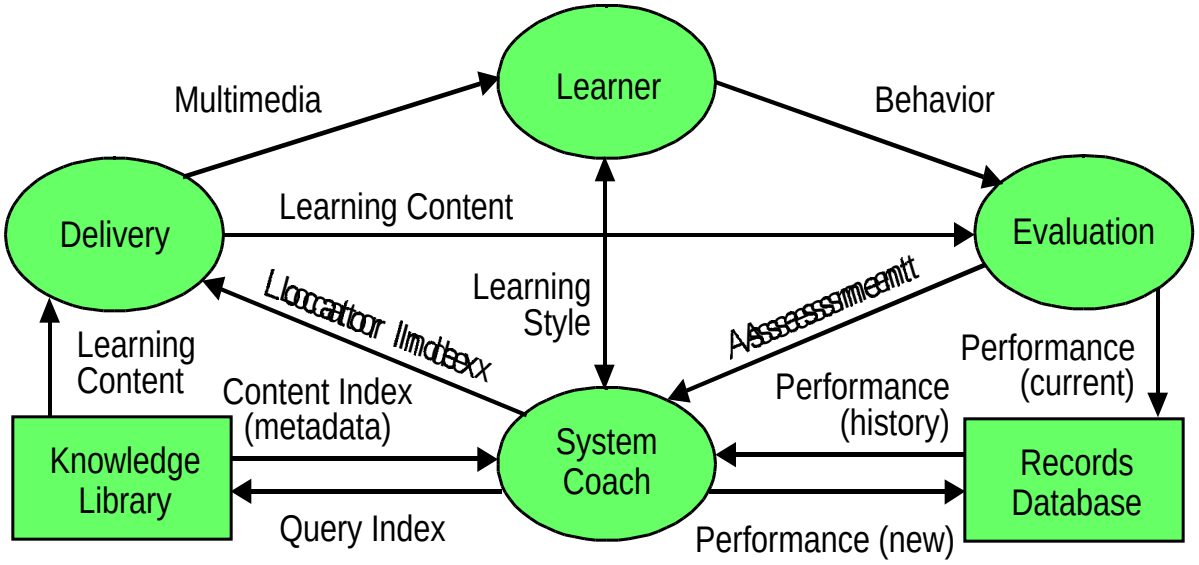

Fig. 2 : IEEE LTSC - Learning Technology Standards Committee / Edutool – System components

AICC -Aviation Industry CBT Committee

This committee recommendations are considered the *de facto* standards in computer based learning, and several commercial products comply with the Computer-Managed Instruction guidelines for interoperability (AICC document CMI-001) [7]. Interoperability means the ability of a given CMI system to manage CBT lessons from different origins. It also means the ability for a given CBT lesson to exchange data with different CMI systems. AICC-compatibility of courseware and CMI systems can be verified by the AICC-sponsored Independent Testing Laboratory.

The CMI document defines the standard and includes guidelines for: launching a CBT lesson from a CMI system, communication between a CMI system and a CBT lesson, moving a course between different CMI systems and generating and storing lesson evaluation data.

DoD ADL - Advanced Distributed Learning

The purpose of the ADL initiative [8] is to ensure access to high-quality education and training materials that can be tailored to individual learner needs and can be made available whenever and wherever they are required.

This initiative is designed to accelerate large-scale development of dynamic and cost-effective learning software and to stimulate an efficient market for these products. It will do this through the development of a common

technical framework for computer and net-based learning that will foster the creation of re-usable learning content as "instructional objects."
The main objectives of the ADL initiative: are then: to develop the guidelines for the implementation of efficient distributed learning systems, to identify business models, promoting the establishement of a networked community of consumers, and to stimulate collaborative developments identifying technical challenges still open.

EDUCAUSE IMS - Instructional Management Systems

This initiative, initially called the National Learning Infrastructure Initiative, identified a common need among educational institutions for non-proprietary, Internet-based strategies for customizing and managing the instructional process and for integrating content from multiple publishers in distributed or virtual learning environments. Toward this end the IMS [9] was formed as a catalyst for the development of a substantial body of instuctional software, the creation of an online infrastructure for managing access to learning materials and environments, the facilitation of collaborative and authentic learning activities, and the certification of acquired skills and knowledge.

The development of instructional software and its integration into the learning environment, have been impeded by a lack of standards that would permit sharing across institutions and across a wide range of technical environments. The current Internet-based solution has improved access to learning materials, but this access is limited at best. Finding relevant, valuable, and interesting information on the Web is a difficult process because there is no inherent structure or standards for describing available content. Furthermore, the Web tends to be primarily used as an information repository rather than an interactive space supporting the collaborative and dynamic nature of learning. Interactive technologies are developing to augment standard HTML, but translating the resulting content across sites requires a significant amount of expertise and time. Finally, the development of online learning environments has also been hampered by the lack of electronic commerce solutions for compensating the production and distribution of content or programs.

The IMS is a set of standards and tools that address three obstacles for providing effective online materials and learning environments: locating and operating interactive platform-independent materials, support for the collaborative and dynamic nature of learning and incentives and structure for developing and sharing content.
The IMS technical specification will provide the general guidelines and requirements developers must write to in order to create interoperable content and management systems, and five main areas were identified in which specifications are being developed and prototype code is being built: *metadata*, *content*, *management functions*, *human profiles* and *external interfaces* (eg. Databases).
ARIADNE (Alliance of Remote Instructional Authoring and Distribution Networks for Europe) [10] is an european project that focuses on the development of tools and methodologies for producing, managing and reusing computer-based pedagogical elements and telematics supported training curricula, and has liasons with IMS, in particular in the field of metadata description.

The current standardization activities in the area of computer based learning are the result of the concertation of the efforts of these and other organizations, as the next figure tries to illustrate.

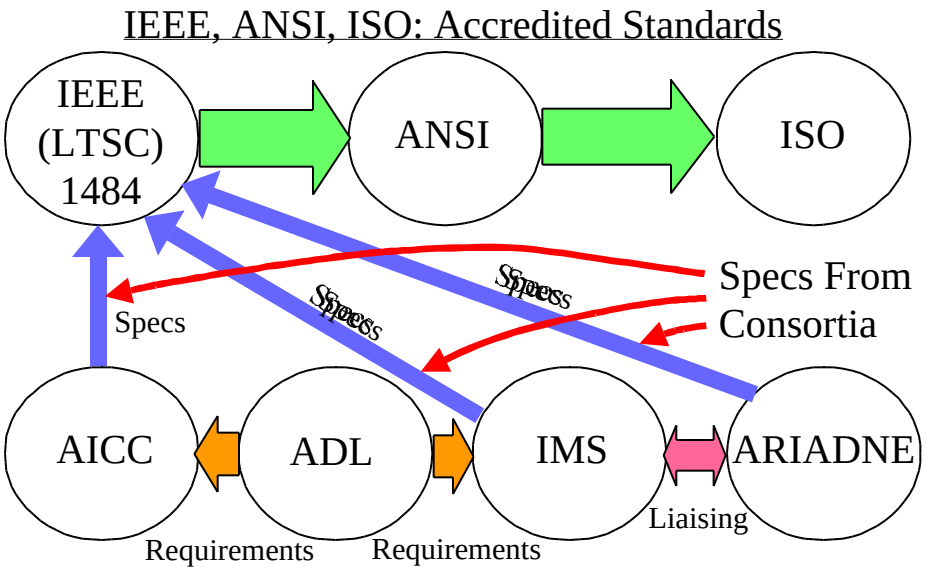

Fig. 3 : Standards and specification development organizations

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