

Digital Libraries in Education: State of the Art (Tutorial Abstract)

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In the competitive space of alternative information service suppliers surrounding any organization that undertakes an educational mission in the society the role of the traditional library as the primary aggregator of content to its community becomes less unique. Users (students and educators) want control of their own information environment. Another change in learning environments is that the quality of someone's teaching is no longer a personal or departmental matter. Education is considered as a service that is evaluated for its quality, just like other services. New requirements are imposed on the knowledge industry in partnership with librarians and educators to provide adequate changes in information infrastructures and education methods to support learning as a *lifetime activity, learning anytime and anywhere*.

Introducing Digital Libraries into the education process was well prepared by distance education that is being developed by years. With the Internet and the web distance education programs can mount sets of materials on web servers to support each course. New pedagogical methods should accompany Digital Libraries in Education (DLE) as an emerging technology for education to reach the compelling vision of the education: "Any individual can participate in on-line education programs regardless of geographic location, age, physical limitation, or personal schedule. Everyone can access repositories of educational materials, easily recalling past lessons, updating skills, or selecting from among different teaching methods in order to discover the most effective style for that individual. Educational programs can be customized to each individual's needs, so that our information revolution reaches everyone and no one gets left behind".

The digital library must not be seen as merely a digitized collection of information objects plus related management tools, but as an environment bringing together collections, services, and people to support the full cycle of creation, dissemination, use and preservation of data, information, and knowledge. DLE is considered as a *federation of library services and collections* that function together to create a digital learning community. The range of supported materials includes curricula and courseware materials, lectures, lesson plans, computer programs, modeling and simulation, intelligent tutoring systems, access to remote scientific instruments, project-based learning, tools, the results of educational research, scientific research reported both formally in journals and informally in web sites, raw data for student activities, and multimedia image banks. DLE will be much more than the sum of its parts, and will promote change and innovation in scientific and technical education at all levels.

Large programs being developed in the DLE area look quite impressive:

1) National Engineering Education Delivery System Project (NEEDS)

NEEDS is the distributed architecture developed by Synthesis: A National Engineering Education Coalition to enable *new pedagogical models* based on Internet-mediated learning environments. NEEDS catalogs courseware and other instructional software developed nationally and internationally to provide a resource where *both instructors and learners can search, access, and download* educational materials over the Web. NEEDS encompasses all U.S. engineering colleges. NEEDS develops a new vision of a digital library to serve the engineering education "community."

2) A National Digital Library for Science, Mathematics, Engineering, and Technology Education (NSDL)

To stimulate and sustain continual improvements in the quality of science, mathematics, engineering, and technology (SMET) education, the National Science Foundation (NSF) has launched the National Science, Mathematics, Engineering, and Technology Education Digital Library (NSDL) program. The resulting digital library is intended to serve the needs of learners belonging to a broad user audience – K-12 to undergraduate, graduate, and life-long learning. The NSDL program is an unusual program for NSF in that its projects are engaged in building an enterprise much larger than the object of any one grant. The SMETE Library is not a research project, but it will be greatly strengthened by a parallel program of research.

The SMETE Library should be *sustainable, reflect current best practices regarding standards, and be a cost-effective mechanism* for enhancing quality education in science, mathematics, engineering and technology for undergraduates on the national scale (*reaching all students*). NSDL is considered as the aggregated capabilities of numerous, more specialized digital libraries, focused collections, and other digital resources, referred to as NSDL Member Libraries/Collections.

3) The Digital Library for Earth System Education (DLESE)

DLESE is a community-owned and governed digital library for Earth system science. Collections, services, and tools will be developed and maintained by numerous partners rather than being housed in a single centralized facility. Fundamental to the design and construction effort is a commitment to building a library that responds to the needs of the Earth system education community. DLESE is one of the initial members of NSDL.

4) Scholnet and Cyclades: Extending the Role of Digital Libraries

Scholnet (IST-1000-20664) and Cyclades (IST-2000-25456) are two digital library projects funded by the EU 5th Framework Programme and coordinated scientifically by the IEI – CNR. Both projects aim at extending the role of a digital library by providing services that support *remote communication and collaboration among scholars*. In particular, the goal of Scholnet is to develop a digital library providing an enhanced set of specialised services, while Cyclades is focussed on the need to develop a service environment on top of large heterogeneous and multidisciplinary interoperable archives.

5) Instructional management systems project (IMS)

Designers and developers of online learning materials have an enormous variety of software tools at their disposal for creating learning resources. To cope with this diversity, IEEE Learning Object Meta-data (LOM) effort has been undertaken to define a metadata standard that can be used to describe learning resources. This standard specifies a conceptual data schema that defines the structure of a metadata instance for a learning object. For this standard, a learning object is defined as any entity, digital or non-digital, that may be used for learning, education or training.

Long range objectives for DLE as a *national treasure* include life-long learning and learning anytime, anywhere. The results of these developments eventually will have a significant impact on the humanity comparable to that of the Web. The digital libraries for education are being developed as *an environment bringing together collections, services, and people* to support the full cycle of creation, dissemination, use and preservation of data, information, and knowledge so that communities of research and education become more efficient and productive and the benefits of collaboration are maximised.

Immediate conclusion that can be drawn from preliminary analysis of possible DLE impact on educational environment is that to cope with the process of globalization in education as the natural outcome of DLE expansion and to preserve at the same time national identity of educational content in different countries, careful analysis of possible scenarios of development of education infrastructure under the influence of the new methodological and technological advancements is to be undertaken to provide for their timely, gradual and efficient merge with traditional practice.