Characterizing E-Learning Networked Environments

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INTRODUCTION

As computer networks evolve, the variety and quantity of machines available and the quantity of links used is increasing. In fact, each type of network has its own specific logical setting, switching mode, data format and level of quality of service (QoS). This explains, in part, the existence of heterogeneous environments for public and private networks of boundless dimensions giving rise to many problems of incompatibility (Stav & Tsalapatas, 2004). E-learning environments must address such problems.

Many problems remain to be solved before e-learning is widely adopted and deployed by organizations. Initial training in the public education sector, professional training, and personal training at home are merging. Any useful, computer-based training solution must provide flexible learning systems, outside and inside the education system, before, after and during office hours. In all sectors, simplistic or inefficient use of the Web has yet to be overcome in order to offer an interesting alternative to the eyes of the client organizations. Currently, most e-learning material is focused on transmitting information. While this is undoubtedly useful, a shift to knowledge-intensive learning/training environments has yet to be made in order to address knowledge and skill shortages in a rapidly changing economy.

To unleash the power of new learning technologies, new research-based solutions are needed to insure accessible, reusable and high-quality Web-based learning materials and activities. For this purpose, it is necessary to go beyond the simple reusability of material in repositories of learning objects and find solutions in order to build significant learning scenarios or programs which enable learners to achieve real competency gains while reinvesting small learning objects (Vossen & Westerkamp, 2004). Many enthusiastic predictions are also based on the use of broadband networks for full multimedia delivery of high-level three-dimensional/virtual reality simulations and real-time telepresence interactions. Such services are now available only through a small number of communication link types, but they will generalize rapidly through cable-modems, DSL telephone lines, satellites or non-wired terrestrial communication and their full potential for education has yet to be reached (Pierre & Paquette, 2006).

Knowledge management is essentially focused upon the concept of knowledge and, specifically concerns the competencies of those working for organizations (Davenport & Prusak, 1998). This chapter presents the basic concepts and main issues which characterize the e-learning networked environments from a knowledge management standpoint.

BACKGROUND

A learning object can be defined as any entity, digital or not, that can be used, reused or referenced during technology-supported learning activities. From an object-oriented programming standpoint, learning resources can be understood as objects in an object-oriented model, having methods and properties. These properties are generally described using metadata, i.e., structured data about data. Due to various methods, the learning objects can become interactive or adaptive (Paramythis & Loidl-Reisinger, 2004). In this chapter, the terms *learning object* and *learning resource* will be used as synonyms.

Learning objects or resources can be distributed over different servers. They can be of any size and type: text, audiovisual material, educational software, multimedia presentations, or simulations. They also carry information to be explicitly used by persons in order to acquire knowledge and competencies. They can be described and gathered in such a way that facilitates their storage, publication and retrieval. Such an organization is called a *learning object repository* (LOR).

A networked virtual environment can be defined as a software system within which multiple users, possibly located worldwide, interact with one another in real

time (Singhal & Zyda, 1999). Such an environment can be used for education and training, engineering and design, commerce and entertainment. When hardware, software and communication tools, as well as the teaching, coaching, assistance services offered to the users of the computer network are integrated together in a coherent way, they constitute an *e-learning networked environment*.

In large networked environments, learning takes place under a variety of technical constraints. It is important that each learning object be adapted to these constraints. Thus, the various computations carried out by a learning object must have an "anytime" flavour (Grass, 1998). For this reason, amongst others, learner modelling remains active, considering only the information available and computing only as deeply as time and space constraints permit. Instructional planning must also be sensitive to these time and resource limitations.

One of the advantages of a LOR is that it allows any instructional designer or any person acting as an editor to track down interesting learning objects created in a learning context in order to reuse them or adapt them for use in another environment. For this purpose, interoperability and metadata protocols are needed.

One of the main purposes of interoperable learning objects is that they can be aggregated and integrated into a knowledge management or learning environment. Such an environment sometimes emerges from peer-to-peer interaction and can be designed by a team of instructional engineers by creating and implementing a delivery model that depicts interactions between users and the learning system components, activity descriptions and learning objects (Paquette, 2004). The main challenge for the interoperability of learning objects consists of their design rather than the platform interoperability issues which initially motivated their development.

From a knowledge management standpoint, learning objects need to be encapsulated into abstract resources in order to provide designers with a scripting language to produce aggregations and launch resources in all different technical situations. Tools also need to be defined in order to associate knowledge models to resources, operations and actors' competencies, which would facilitate the integrated search for useful resources and ensure the design consistency of a learning management system.

Interoperability involves several degrees of focus:

- Digital packaging of the learning object itself, using the emerging metadata standards to catalogue it for local and global identification
- Providing different organizations with search tools
- Finding and interchanging information with one another
- Transporting objects for use in different contexts

Learning objects can embody both educational content and learning activities and the traditional approaches to labelling and transporting containers of digital content are being challenged by emerging abilities to express content, processes and metadata as semantically rich ontologies (Tsalapatas, Stav, & Kalantzis, 2004). This leads to the concept of semantic Web services. In the same vein, the emergence of autonomous agents allows for the creation of learning environments where learners interact with or deploy multiple agents to help define and navigate individualized learning paths that are dynamically created and interactively shaped.

Learning objects can be active and/or adaptive. In fact, they generally consist of raw material which can, ideally, be used in different ways, for different purposes and in different contexts. For these purposes, it is necessary for designers to be able to adapt original learning objects in order to reuse them properly in new contexts. However, it is difficult to make learning objects actively able to adapt to the context of their use, adapt to the pedagogical goals of the learner or learning environment to the nature and needs of the learners involved, to the level of detail needed to reach the pedagogical objectives and to the technical constraints. This time-consuming task constitutes a serious bottleneck in the development of e-learning materials. In fact, making learning objects readily adaptable to various contexts, various learner capabilities and various pedagogical needs would be a useful extension of their current capacities.

Learning objects can be of an advanced multimedia type including three dimensional (3D) or virtual reality components. *Multimedia* refers to objects that contain a combination of "media" such as audio, video, text,