E-Learning Environments: An Integrated View

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Abstract

The contemporary technological evolution requires higher levels of education and new skills from the work-force making people more conscious of the importance of being better educated. At the same time information and communication technologies (ICT) and in particular the Internet has enabled a great amount of information to be widely available, bringing new opportunities for learning. Hence, nowadays it is possible to notice the attention given to the e-learning area and therefore its development. Many e-learning environments and tools have been developed and used. By the other hand, as developing high quality content is a complex, time-consuming and costly task, there is a great emphasis on reusability of content material and services. This need for reusability as well as the necessity for developing e-learning as a whole has led to the creation of partnerships among institutions. However, in order to enable this collaboration it is necessary to consider interoperability problems. This paper presents an integrated view of e-learning environments dealing with interoperability through four basic aspects: content, services, agents and rules. In the proposed solution, there is a centralized management of content metadata, services' definition, agents' roles and rules.

1. Introduction

Nowadays, there is a great interest on e-learning topics in business world and also in academic forums. It has led to the development of e-learning technology. Several educational environments have been implemented and used, and a variety of e-learning courses have been offered. Thus, there are now numerous different educational environments with different approaches for e-learning, providing different combinations of services. The existence of so many different environments embodies many interoperability problems. Aware of these problems, some organizations are working to develop technical standards, recommended best practices and guides for learning technology. Nevertheless the main focus of their work has been on enabling content reuse especially through the description of learning content (e.g., IMS [1], ADL SCORM [2] and IEEE LOM [3]).

Addressing systems architecture, there is a draft standard proposal, IEEE Learning Technology Systems Architecture (LTSA), which specifies a high level architecture for information technology-supported learning, education, and training systems. This draft standard identifies the objectives of human activities and computer processes and their involved categories of knowledge. Therefore LTSA proposal is human-computer oriented and it still lacks on providing a general overview of software components for an e-learning environment.

Other general architectural proposals focus on knowledge management [4], content navigation [5], project management [6], ways of learning [7], selection of material [8], enterprise learning management [9] and general aspects of e-learning [10].

Other proposals ([11] and [12]) consider the software development perspective. However, the first [11] considers e-learning from the perspective of Brokers, Educational Service and Content Providers while the second [12] is peer-to-peer oriented and it

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considers a personal learning assistant, an educational service provider and a rating/evaluation service provider.

All these works define interesting aspects related to e-learning, each one according to a specific view or approach. However, when dealing with heterogeneity and distribution of e-learning environments, it is necessary to consider the management of content, services, agents and rules.

The PGL partners have been involved on the development of e-learning content and also in the development of methodology and technology for e-learning. Each partner has developed and implemented its own e-learning infrastructure, with specific services, agents and contents according to its specific rules. However an integrated view of these e-learning environments for enabling sharing of resources and collaboration among the partners is highly desirable.

The work presented in this paper proposes an integrated view of e-learning environments according to the four basic aspects (content, services, agents and rules). Such a view can be useful to guide the integration of PGL partners' e-learning environments. It was found no other work providing a general overview of e-learning environments in an integrated approach.

The remainder of this paper is organized as follows: section 2 presents the organization of learning content, section 3 presents the learning services definition, section 4 introduces agents and rules to the previous definitions and section 5 presents some final remarks.

2. Organizing Learning Content

In order to provide education, it is necessary to develop learning content material. However, developing high quality material is expensive and time consuming. It has led to a demand for reusability and collaboration and therefore it is the first aspect to be considered in an integrated view of e-learning environments.

The initial approaches for sharing content have considered the course level, i.e., all course structures and definitions were replicated to all partners or there was defined a global centralized database to the integrated efforts. Then, course sharing was not so reusable and there was the need for a more granular level for learning content. Learning content material, then called learning objects, has been the new sharing level.

The use of well-structured descriptions of the content material (metadata) has contributed to a better search of the desired material, thus facilitating content reuse. However, as these descriptions are not unique it is necessary to provide ways to enable interoperability among metadata structures. As previously stated, to enable interoperability of learning content, organizations such as IEEE, IMS Global Learning Consortium and ADL have worked to develop technical standards, recommended practices and guides for learning technology. Some standards specifications such as IMS Learning Resource Meta-Data Information Model [1], ADL SCORM [2] and IEEE LOM [3] define metadata for learning content. Other specifications such as IMS Learning Design Information Model [18], IMS Simple Sequencing Information and Behavior Model [19] and IMS Content Packaging Information Model [15] are related to making semantically richer learning objects from other simpler learning objects.

The general approach consists on having already developed learning objects (i.e., learning content materials) and defining their metadata in order to allow their reuse and composition on different educational and training programs.

Up to now, each PGL partner has been developing its content according to its own metadata structures or according to a specific standard. However there is not yet a common defined PGL metadata structure or an adopted standard.

Besides choosing and adopting a metadata definition for PGL learning objects, it would be desirable to extend actual standard proposals. Sharing content in PGL could be even semantically richer. It would be interesting to consider the knowledge of each content material since from the beginning of its development according to underlying concepts of knowledge and learning. Representing such metadata would provide better-structured learning objects. In addition, learning material should be considered according to different aspects such as content, context, interaction, media presentation and sequencing.

3. Choosing the Services

PGL partners have being using different e-learning environments and tools. Each solution provides different functionality according to its specific architecture and development approach. However, from a greater collaboration perspective, it is not only content sharing that should be considered. It would be advisable to have a web services architecture in which would be possible to share services. Then, each PGL partner could choose the services that are more adequate to each specific course implementation creating more personalized environments that would be at same time sharable among the partners.

A Web service defines a collection of operations that are network-accessible through standardized XML messaging. Web services fulfill a specific task or a set of tasks. They can be used alone or with other web services to carry out a complex aggregation or a business transaction. For an application to take advantage of web services, three behaviors must take place: publication of service descriptions, lookup or finding of service descriptions, and binding or invoking of services based on the service description. Some proposals for web services description and architecture (such as [Kreg2001]) can be found on the specialized literature, but there is no yet consensus on which should be adopted by the community.

Among the e-learning services that should be developed and shared would be those related to content development (such as sequencing, media selection, authoring, composition and metadata edition), content access, groupware (communication, coordination and cooperation), visualization (interface, hypermedia navigation and personalization) and assessment and evaluation. Learning objects could also be defined as web services so that sharing services would imply not only sharing functionality but also content.

4. Considering Agents and Rules

In an e-learning environment several agents play roles: active learners, collaborative learners, passive learners, content developers, professors/facilitators, administrators etc. Although there are some proposals for describing learner, such as IEEE PAPI Learner [16],

it is necessary to define all the agents and respective roles in the PGL integrated e-learning environment as well as their respective metadata. The agents and roles should also be incorporated in the web services definitions.

Finally, in order to provide the automation of tasks related to a specific content under certain characteristics of specific agents, a rule mechanism should be provided. It would enrich the PGL integrated e-learning environment with active behavior and therefore facilitate the execution of the e-learning activities.

In the conceptual architecture for web services there is a service description layer. WSDL is the *de facto* standard for XML-based service description. WSDL defines the interface and mechanics of service interaction. Therefore, a WSDL document can be used to define e-learning services, learning objects and agents. These documents are posted on the Internet and its URL in addition with related metadata could be registered with an online web service registry. The contents of the registry could then be searched manually or programmatically to discover and select suitable components according to rules that would be extensions on web service actual architecture.

5. Conclusions

This paper presented an integrated view of e-learning environments according to four basic aspects: content, services, agents and rules. In order to accomplish such integrated view it is necessary to extend existing standard proposals for e-learning and web services architecture. Although web services seems to be a distributed approach for managing learning objects, the approach presented in this paper emphasizes the use of semantic richer schemas for content, services and agents as well as the definition of active rules. The idea of global definitions/schemas provides easier and better management of the resources. Although this approach seems to be adequate to the PGL project, further research is necessary to enable its full implementation.

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