AN OPEN LEARNING ENVIRONMENT BASED ON GENERIC COURSE

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Abstract: This work is part of a large research project aiming at implementing of a distant learning platform, based on the Web. The goal of this article is to present the methodology adopted in the architecture of this system. Our architecture aims at offering a flexibility of options input, in order to be independent and adaptive with respect to all education systems. By the adoption of LTSA standards and the use of the 3 – tier architecture of the Web, our system ensures a maximum of interoperability with the other platforms. While following the nature even of the process of education, we adopted a hierarchical and generic structure for the platform elements.

1 INTRODUCTION

The pedagogical revolution and the fast development of the distant learning, often concentrated on courses production, and the definition of this production rules (Alg, 2000). Other research works are interested in the interoperability of the diffusion platforms (Bousbia, 2007).

Most of the distant learning platforms are developed around specific topics, of an owned pedagogical method for the application editor, and of an education system suitable for the area of diffusion of the platform. An education system represents the whole of coherent services given by a distant learning platform (Brusilovsky, 2006). Thus, such products are intended for a limited applying domains and target population. That poses the problem of applying to geographically distributed populations, having generally different educational approaches.

Having benefited from the technological development, the majority of the distant learning platforms, in the trade and in academic world, adopted the Web for their development. They insure thus the criterion of mobility of the training actors (learner, teacher, trainer, administrator), since those actors needs to have just one browser and the Internet to follow their distant activity.

However, and in terms of architecture, these platforms respect rarely the standards dealing with the course structure levels and the teaching objectives.

To implement a distant learning platform with a broad diffusion, within various teaching frameworks, it is important to focus on some vital aspects. The system structure must be flexible and self-adapting regarding the training environment. It must use the specific vocabulary – communication language - to the learning actors, in their particular context. It must also apply to various education systems. The standards adoption like (LTSA, 2000) and their extension will be able to guarantee a higher interoperability between different platforms.

In this paper, we first focus our work on the identification of the architecture parameters, which characterize a distant learning platform (Brusilovsky, 2006). Theses parameters will allow using the platform by a broad spectrum of actors, with large geography and cultural distribution. We then develop, the Taalim system architecture, which aims to setup a virtual university.

The targets of our system are the basic and the continuous training. These systems try to face the needs for learning, according to users educational contexts (Balla, 2007).

Several research works developed original aspects of Taalim platform (Balla, 2009a)(Bousbia, 2007), such as asynchronous mode training, the co-operation and the adaptability of courses to learners. This paper focuses on the architecture of this

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platform. We will use elearning word instead of "distant learning" term.

2 THE ARCHITECTURE IN THE DISTANT LEARNING SYSTEMS

Most of the elearning platforms integrate the asynchronous mode of training. Thus they bring to learners, an entrance without space-time constraints.

However, the users have to stick to a specific methodology owned by the platform editor. Whatever the originality and the interest of those methodologies, learner will be disturbed. For example, the lecture is part of a degree cursus comprising other lectures taught in traditional mode (presential) or on other platforms. Thus, the platform diffusion may be highly limited by the lack of adaptation to the pedagogical learning environment. In the following we will introduce, fundamental concepts of elearning platforms architecture, and their conformity with the standards.

Characteristics of a Universal Architecture

Most of the emerging standards in elearning do not treat the standardization of the methodological approach of the teaching, nor the co-operation aspects between the actors (learners, teachers, trainers, administrators). However these elements are fundamental in the act of training. They ensure an open platform to be used in various contexts.

The standardization of on line learning faces the combined need for a better economic profitability of the investments in elearning and an improvement of the pedagogy effectiveness of its products.

The motivations of implementation of platform with broad diffusion were developed in work (Auf, 2002).

In this paper we will complete these and reinforce them.

Accessibility

A training system must be able to propose its services in a dynamic way. Learners should have access to updated information, in a flexible and effective way. The system must allow in a distributed network, the activities of searching, identifying to the platform, the access and the delivery of the elearning contents and components. It should ensure the independence of the users with respect to the communication support (networks) and its environment (Windows, Unix, etc).

Internet is used today as a standard, for distributed data transport.

Mobility

The actors of the elearning must have a large degree of freedom, to reach the platform resources.

Indeed, the learner and the teacher need often, to change work place, or environment (Linux, Windows, etc). The use of the Web ensures this mobility, since the used resources are preserved on the server, and the user can reach them from any Internet access point.

To increase the functionalities offered to the users, most of the platforms put plug-in components on the browser. Although these plug-in are automatically downloaded at the first use, the excess of them could obstruct the learner mobility.

Interoperability

It allows the use of contents and components developed by other organizations on other platforms. That supposes a high compatibility of the platforms to the standards, at the structural level.

Main actual work of development deals with the contents identification (metadata), the contents structuring, the systems architecture and the learner's information. SCORM is the main model for this purpose (Auf, 2002). This model integrates the most important basic specifications.

The products available in the elearning trade are often designed and developed according to an owner approach. The processing under another system or integration in a different training environment seems to be almost impossible. In fact, certain platforms do not support any education system. They propose courses focused on a given matter, without pedagogical objective (do not correspond to a cursus).

Interconnections between Education Systems

The access to a course, which is part of a cursus, needs some pre-requires. Pre-requires can be a diploma, a module, a chapter or even a section of course. The difference in organization, in structures and in terminology, in various education systems, makes difficult to identify pre-requires between different systems. Thus, it is important to manage equivalences on several aspects, from the course to the finest entities considered as prerequire (Balla, 2007).

This problem is rarely dealt with in the actual platforms.

Adaptability

It allows the adequate formulation of the contents and the components. The adaptability acts on several levels of the architecture.

It concerns the adaptation of the training process to the learner profile. Thus, according to its knowledge level and training progress, the system

should modify the studied matter itinerary (Balla, 2007) (Balla, 2009b).

Usually Learners have various objectives, and are interconnected through diverse environments. Thus, according to the pedagogical environment of the learners, the platform must adapt its interfaces with their educational system. For example, in the Canadian system, the diploma is associated to units of value, whereas the French system associates a diploma to an academic year.

A flexible platform, must thus adapt itself to users requirements and needs. Every learner should have access to a lecture, which can be adapted to his/her aptitudes, his/her training objectives and also to the socio-cultural and computer environment characteristics.

Users (learner and teachers) should be able to use the system whatever their education system or their training pedagogy.

Durability

It allows the contents and components to face the technological developments without Re-engineering nor Re-development. Durability can be developed in terms of evolution of the educational system or its extension. By structuring the architecture in an open and evolutive way, and having the options flexibility, we will offer to the elearning platform large possibilities of durability.

Re- utilisability

It allows re-using the contents and components for various needs, applications, products, contexts and access modes.

This could be obtained by the distinction between the structures of the platform and the environment of training provided to the users.

At the current time, large efforts are made, to ensure the reuse of teaching contents. That supposes conformity to the standards. This is rarely the case of the platforms with owner architecture.

3 CONTRIBUTIONS OF TAALIM ARCHITECTURE

Taalim, by its architecture, tries to respond a broadest range of universality and generic criteria, discussed before.

In order to make a training environment, convivial and fully usable by learners, Taalim has flexible and adjustable structures for various education systems.

3.1 A Generic Structure

To give a maximum of abstraction towards the specificity of the training environment and of learner, we operate a significant remark. Indeed, any education system fits well within a hierarchical organization.

An education system is seen as a coherent entirely structure, carrying out training objectives. According to the place and the framework of use, the objective can be a training course, a diploma, a degree, etc. It is composed of training entities. The entities can be one school year, one semester period, a module, a unit of value, etc.

Each training entities are made up of training elements, such as the lecture, the chapter, the exercise, etc.

The decomposition can follow up to the smallest level of granularity of training contents. At this level we can find elementary training information, such as a paragraph of text, an image, a slide, or other Elements Medias (sounds, animation, etc). Thus, independently of the adopted education system, and the vocabulary used to name its components, we are directed towards arborescence in the system structuring (Balla, 2009a).

On this basis, we proposed an abstract structure representing the training contents as a generic arborescence. We named this structure, “Knowledge Unit”. The generics enable us to represent a variable number of hierarchical levels, and to have a flexibility of representation, according to the selected education system.

To realize this concept, we have to set up an association between the specific terminology of each education system, and the corresponding elements in the arborescence. That will provide an interface that permit Taalim to be adapted to various systems specificity.

The principles, which governed the development of our system, are summarized by (Bousbia, 2007):

- **Independence:** This principle defines the needs and the interests of a generic model independent from any education system and any training method;
- **The Opening:** allows the model to be appropriate for any discipline and to deal with the courses established in other systems;
- **Approach of Structuring:** allows producing adaptive generic courses as well as the level of granularity of the training objects (To separate the structure of the course from the matter of training and To annotate the various Knowledge Units);

- **Approach of Follow-up:** it implements the sequencing relationship of a course objects according to training and educational principles. It model learners training follow-up in order to satisfy on line adaptability.

In our model, we propose an organization, which facilitates at the same time the definition of the training contents generic structures, and guarantees the coherence of the contents with a good adaptability.

Our generic model is valid for any educational system. It tries to satisfy the guiding principles specified further, with the training objectives.

Thus, Taalim treats in a simple way any component of the educational system, whatever its complexity, like a whole of Knowledge Units.

Knowledge Units are organized in arborescence on several levels (Balla, 2009a). On the lowest level, we find entities named Elementary Knowledge Unit (KUe). KUe corresponds to the weakest and atomic granularity. The sheets of this arborescence correspond to the media elements (ME) of the training contents (cf figure 1).

Each element of the arborescence in entities to be taught is identified then with a node in the Knowledge Unit.

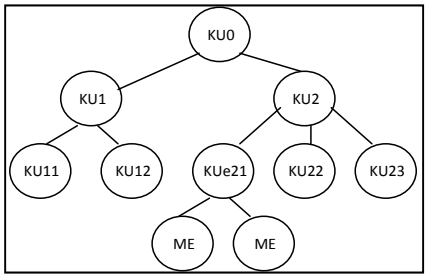

Figure 1: A generic course structure.

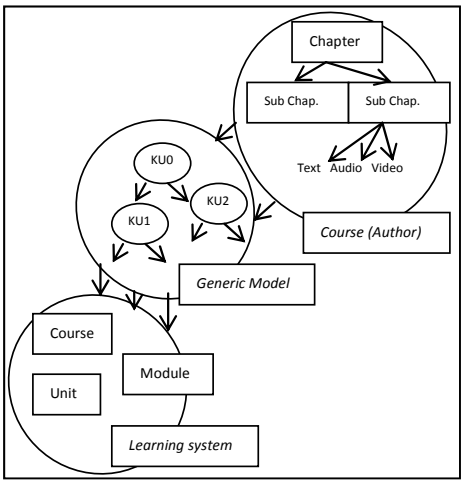

Figure 2: Taalim Generic Model.

Figure 2 shows this association. Our internal structure is thus, independent of the vocabulary used in the real entities. A Knowledge Unit can be a module, a unit or a course as shown by figure 2 of the correspondences.

3.2 Independence Towards the Education System

The educational models are developed according to the socio-cultural constraints of the local and regional environment.

Thus, the educational and training structures change according to the learning context.

The existing platforms of elearning are developed in two cases:

- Some platforms stick to a specific education system. They are not able to satisfy users of different education systems.
- Most of the commercial platforms do not worry about the belonging to an education system, nor to a common training approach for all their courses. They focus on the technical contents training, and do not pay attention to a global framework (course, module, etc).

These platforms are not suitable for users adopting a different educational model. However we should note that the contents are often comparable in different education systems. The difference lies mainly in the decomposition of the course elements (module, chapter, paragraph, etc.), and especially in the vocabulary used to name them.

By preventing these situations, it is possible to encourage the actor (learners, author, and monitors) to use more and more the elearning systems. This will give to learners the flexibility to remain in their education system, while having access to the information produced by other systems.

It proves, that with judicious choices in terms of the platform structuring, we can obtain a system, which can adapt to the majority of training organizations types.

This flexibility permits to the administrator to establish a general parameter input of the platform, according to the general choices. For example, he can choose the French education system. Then he defines as training objectives an engineers training cycle allowing a diploma. For entities he chooses modules, and for sub-entities he chooses courses.

The author actor can define the structure of his training entities, by defining his decomposition, for example, in sections, chapters, paragraphs, etc.

He then, interfaces the system by associating the structures and the vocabulary used in the learners' education system, with the components (Knowledge Unit for example) of the platform structure.

To ensure these objectives of independence, Taalim uses the concepts of Pedagogical objectives, and Knowledge Units supported by the generics.

3.3 Software and Hardware Architecture

To make our choices, we adopted the principle of mobility.

The strategic choice is then the adoption of Internet like support of exchanges between the platform and the actor.

That automatically responds to all the criteria, for user's environment. The client is thus, a browser to access to Internet.

Learner's access is done via internet (chat, Web explorer, videoconference kits, etc).

Thus, learner is not constrained to remain connected to the same PC or to the same operating system, to follow his distant courses.

The client activity is limited to displaying functions and to sending queries towards the server, without local treatment. The results of its queries are then displayed on his screen.

Now we must choose the web server, which supports all the platform activity. Since the elearning activity, requires lot of treatments, and uses database to store all training materials, we chose an architecture that gives good technological performances. Thus, we base our platform on the 3 – tier architecture (Bousbia, 2007).

In this architecture, the first tier is the client. The second tier is an applications server (a web server). This server has an engine for the treatment of the queries emitted by the browser (for example an engine of servlets), and returns the results. The applications server transmits requests towards other additional servers (DBMS for example) that represent the third tier. They are codified in an open source and portable language (Java for example). They manage and treat access to database.

3.4 Implementation of Adaptive Course

The Taalim system having the objective to provide an adaptive course, a need for a good structuring of the course documents is obvious for a comprehension of this structure by the system in order to extract some information targeted to provide a course adapted to each learner profile. Another need is that to be able to handle these documents, either to create others or only to modify them.

In the search for a solution to our needs, our choice was made on XML (eXtensible Markup Language) to describe the structure of the Taalim course. Indeed the automatic generation of the course as facilitated by the use of XML parsers likes XT of James Clarck, Xalan of Apache, etc.

The adaptation of the course according to the user profile is made possible using XSLT (eXtensible Stylesheet Language Transformations). It will first of all be necessary to adopt a structure defining the relationship between the course and the profile as in the case of Taalim.

XSLT can transform an XML document into another XML document according to present selection criteria (educational, localization, etc.). Thus, a generic course, containing all the possibilities, will be transformed into a specific course thanks to an XSLT document which includes specificities of the learner profile (figure 3). In fact, the general transformation parameters contained in the generic XSLT document are transformed using the profile values.

As figure 3 shows it, once that our Taalim course is well structured and written in accordance with the DTD of the Taalim course, it is stored and constitutes the generic course. It is starting from this generic course that specific courses will be generated with the need to satisfy the learner pedagogical objectives.

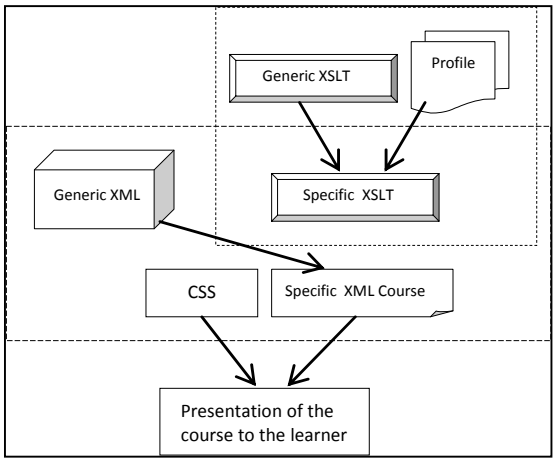

Figure 3: Generation Implementation.

This phase breaks up into three sub-phases which are:

- on the one hand the generation of the specific XSLT (starting from a Generic XSLT) according to the learner profile which will be used as filter for;

- the generation of specific XML course;
- After the generation of specific XML course, the following phase is that of the presentation of the course to the learner. The use of style sheet will make it possible to personalize the presentation of the course according to preferences of each learner. Its role will be to format XML specific files in a posting format (HTML, SMIL format, etc.) recognized by the web browser (Bousbia, 2007).

3.5 Accordance with the Standards

In order to ensure independence and modularity, Taalim architecture is conform to the LTSA standards (LTSA, 2000). The main goal of LTSA is to provide a framework to support interoperability and portability (deployment in multi-platforms) of the elearning systems. In this order Taalim supports the description in an abstracted way, of the principal components of the system architecture.

To provide multimedia elearning architecture, based on the Web, Taalim is based on the integration of standard and open tools such as XML, XSL, DOM, Servlet and Java programming.

However lot of work has to be done in terms of standardization. No standard was recognized officially by the ISO, and in spite of significant developments, several questions remain without answers.

4 CONCLUSIONS

This article, after the identification of the specific problems to the adaptability of remote teaching on Internet, exposes the total knowledge inherent to the production and the diffusion of adaptive courses on the web. We consequently detailed the various knowledge used in our system namely the generic course and the element of the learner profile.

And finally we showed how all these concepts are orchestrated to set up the adaptability in Taalim. To validate this work, a prototype was installed and tested to offer a High speed network course for different pedagogical objectives and different levels.

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