LEARNER AND COURSE INTEROPERABILITY IN A WEB BASED TRAINING MODEL

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Abstract: Learning Management Systems (LMS) are widely used by educational institutions. Their drawback is the lack of flexibility in sharing and exchanging learning resources and learner data. In this paper, a new Web Based Training/Education (WBT/E) Model based on the Learning Technology Systems Architecture (LTSA) standard and on the WBT Model of the Enhance Project will be presented. It is hoped that this model overcomes the reusability and interoperability problems at the learner and course level. For illustration, a scenario of collaborative learning stakeholders perspective will be presented. In this scenario, WebCT will be used as the distance-learning platform, RealNetworks family for manipulating synchronized multimedia courses integrated in WebCT, and Microsoft NetMeeting for providing audio/video/sharing of application between users.

Key words: Web based training, e-learning, e-learning standard, WebCT

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1. INTRODUCTION

Nowadays, learning Management Systems (LMS) have gained interest for their wide use by educational institutions. Moreover, the future framework of LMS will provide interchange with legacy systems via e-commerce transaction. Therefore, these systems must meet requirements such as accessibility, flexibility, extensibility, reusability, interoperability, scalability, and security (Harvi 2000). However, reusability and interoperability has not been well addressed by many of these systems. For example, learner information on an LMS cannot be re-used on another LMS due to the absence of standards. In recent years, an effort was made to develop e-learning standards by several organizations such as IEEE (Institute of Electrical and Electronic Engineers) Learning Technology Standards Committee (LTSC), IMS and others. (An exhaustive list of these can be found in ISO 2002; Robson 2000; and Babu 2001).

In this paper, a new Web Based Training/Education (WBT/E) Model will be presented. This model is mainly based on the Learning Technology Systems Architecture (LTSA) standard IEEE and on the WBT Model of the Enhance Project (Enhance, Benzekri et al. 2002). It identifies the requirements and components of e-learning systems, and we believe it overcomes the reusability and interoperability problems at the learner and course level. This is done by incorporating in this model the standards developed by the IEEE 1484 LTSC. This includes the IEEE PAPI for learner profiles and IEEE CMI (Course Management Interchange) for the developed course. Moreover, this model leads to a reduced course production cost, quality improvement, larger potential market, and life long learning improvement.

For illustration, a scenario of collaborative learning stakeholder's perspective will be presented. In this scenario, WebCT will be used as the distance-learning platform, RealNetworks family for manipulating synchronized multimedia courses integrated in WebCT. Microsoft NetMeeting will be embedded into WebCT to facilitate audio/video/sharing of applications between users.

In this paper, The LTSA framework and the Enhance model are presented in section 2. The new model is introduced in section 3 and illustrated in section 4. Concluding remarks are given in section 5.

2. THE LTSA FRAMEWORK AND THE ENHANCE MODEL

The IEEE LTSA framework is the standard for learning technology systems architecture, developed by IEEE LTSC. This framework consists of five layers (IEEE)

1. The first layer (highest) represents the learner/environment interaction. It provides a one-way flow of information from the environment to the learner entity.
2. Layer 2 is the learner related design feature. It is used to identify learners' influence on the design of the architecture, which helps in the selection of the needed lower layer components.
3. Layer 3 identifies the LTSA system components that include four processes, two stores, and thirteen data and control information flows.
4. Layer 4 identifies the LTSA components subsets that will be emphasized and de-emphasized according to the learning technology stakeholder's perspectives.
5. Layer 5 provides all the interoperable components such as Application Program Interface (APIs), Coding, and Protocols, as identified in the upper layer. This allows application portability, data portability, and wide area end-to-end interoperability.

"Enhance" is a European Aeronautical Industry whose objective is the increase of awareness in concurrent engineering techniques, and the improvement of training processes and methods in the aeronautical industry. The Enhance WBT/E Model is organized in eight concepts:

1. The Organization concept discusses the general organization and various structure of the platform. Moreover, it discusses the personalized training, the objectivist and constructivist type of learning with the various interactions. It also identifies the various roles, administration, and databases in a WBT/E platform.
2. The user interface concept provides the various tools to the role player depending on the task.
3. The communication concept identifies the communication between platform users using different synchronous/asynchronous audio/video/textual/graphical tools in public/private. It discusses also the communication between users and the platform itself.
4. The tracking concept specifies the user and course tracking features.
5. The evaluation concept identifies the methods for grading, testing, certification, and final examination.
6. The course structure concept is defined to guarantee an easy integration and re-use of course documents. Hence, it identified a hierarchical course

structure that is composed of modules. A module consists of a set of learning units, and each learning unit consists of didactic objects.

7. The course development concept provides a common methodology of five steps that takes into consideration the knowledge level to enhance the reusability of resources at the various steps.
8. The network concept identifies the security features such as integrity, confidentiality and authentication. In addition, it presents the various platform access principles, access technology, and the network QoS etc.

These eight concepts map to the components of Layer 3 while adding additional details. It follows that LTSA embraces the Enhance model at a high level without providing a high degree of details. The Enhance model can therefore be considered as a WBT/E illustration of implementation that conforms to and map to the LTSA architecture.

3. THE IMPROVED MODEL

The future framework of LMS will become the central part of a Global system that will provide quick and cost effective integration with legacy systems for the exchange of interoperable learner information and developed courses. Therefore, it will allow the knowledge capitalization of high quality developed courses integrated in KMS and remote repositories over the Internet. In addition, it will provide the management of human resources in ERP applications that include the acquired competences and qualifications by the learner through a follow up of his entire path over the curriculum. Hence, any other learner will get the same expertise if he/she follows the same path over the courses of the curriculum. Moreover, it will be used for worldwide recruitment since it will provide information on the most competent expert in any field.

In this section, a new Web Based Training/Learning model for LMS will be presented. This model is based on the LTSA architecture. It includes all Enhance model concepts and adds interoperability at the learner and course level. This is achieved by standardizing database design and data structures. This model has components, it adds requirements for an open system, and provides interoperability:

- **Model Components:** The model components are the same as LTSA architecture layer 3 components: processes, stores, data, and control flow components. The details of their implementation are defined in the Enhance model.
- **Model Requirements:** The model describes an e-learning open system. This requires features such as accessibility, nomadicity, flexibility, extensibility, reusability, interoperability, scalability, availability, security,

e-commerce (Harvi 2000). It also supports personalized, collaborative, objectivist, and constructivist learning synchronously with a multicasting media delivery or asynchronously with a unicasting media delivery while using the cross platform Internet browser.

- Interoperability: Three interoperability components are defined in LTSA. These components are API, protocols, and codings. It is suggested in this model the addition of database design and data structures.

Interoperability and Reusability at the learner level are possible by adding standard learner profiles that contain the major information to be interchanged between e-learning systems. The IEEE 1484.1 Learner Model could be used. It is composed of six categories of information that can be grouped together in one database or separated in six databases linked together with a standard learner identifier. These categories of information are the learner Personal information, learners' relations information, learner security information, learner performance, and learner portfolio information. This information will have several advantages such as providing the necessary details for a personalized training. Moreover, we suggest the use of a local standard learner identifier that points to a global standard learner identifier (Benzekri et al. 2001). In this way, learner data can be exchanged by various LMS.

Interoperability and Reusability at the course level is possible by using a standard database with standard course structure. We suggest the use of the IEEE 1484.11 CMI standard (IEEE) that also applies to LMS. This will define a standard course structure that is based on a hierarchical data structure. Each course is composed of a grouping of Assignable Units (AU) and other blocks in an order implied in a list or explicit using the prerequisite. Each AU may include course introduction, tests, lessons, course summary etc. Each level in the hierarchy can be indexed by standard metadata. The separation between the course structure from the course content is conceptually very important for the reusability of independent learning content. In addition, the LMS will be responsible for controlling the sequencing of the course content which is defined in the IEEE CMI course structure. The course content will be composed of instructional elements that are based on common templates and hierarchical object models (Abdallah et al. 2002c). This hierarchical objects Model will be based on the IMS-QTI in the case of test AU (Abdallah et al. 2002b) and on the MPEG-4 (2002) in the case of media AU (Abdallah et al. 2002c). Moreover, the MPEG-7 Media content description MPEG-7 (2002) will be used to describe the media object and AU (Abdallah et al. 2002c).

Our objective is to populate the LMS with interoperable courseware and use of interoperable learner profile to exchange the information with other remote legacy and operational systems. LMS should have complete and

detailed tracking, together with the information (such as competencies, certifications) stored in the learner model, which will provide the pedagogical baseline for building adaptive and intelligent type of learning. Hence, it will determine what the student should next experience. For this, LMS should track all user interaction, activities, performance, and monitor the progress and performance over the content. This will require a standard communication model of the information being exchanged between learning resources and LMS. For example this will inform the instructor that the student has really passed over all the steps at least once which is not possible to be detected with any standard classroom. As a result, all event/time object based tracking are needed.

4. ILLUSTRATIVE EXAMPLE

In this part, an implementation of the new developed Model will be presented using the collaboration and asynchronous learning stakeholder perspective. It emphasizes the collaboration among the learners that represent the collective learner entity, the development and delivery of a multimedia presentation, the protocols, and format of multimedia flow component etc. E-learning platform WebCT (WebCT) committed to IMS and Sharable Content Object Reference Model (SCORM) standard will be used. This platform contains a learner database, course database, evaluation, delivery, multimedia, learner entity, coach, and flows. It does not support multimedia development, synchronization, and audio/video synchronous communication. To overcome these problems (Abdallah et al. 2001, Abdallah et al. 2002a), the following tools were used:

RealNetworks: RealProducer and RealPresenter were used to develop multimedia presentations. RealServer was also used to host, synchronize, and stream the multimedia presentation. Finally, the RealPlayer plug-in is integrated in WebCT courses to play the media file (Abdallah et al. 2002).

Netmeeting: H.323 Microsoft Netmeeting was embedded in WebCT courses to allow audio/video synchronous communication among the learners.

LTSA collaborative/asynchronous stakeholder's perspective emphasis is on the development, format, protocol and delivery of multimedia within WebCT. This has been achieved as follows:

- **Development:** The RealNetworks family allows users to bundle several media clips, synchronize them in time and space using the SMIL XML(W3) based language. It specifies the bit rate, and the RealMedia clip information such as author, description, and keywords. However, these media clips, and their corresponding information are not searchable.

- Format: The multimedia clips developed using RealNetworks have a proprietary codec: RealAudio and RealVideo.
- Protocol and delivery: The RTSP (Real Time Streaming Protocols) is used to control the delivery of data with real time properties. The RTSP data packet format used is the RTP delivered over the UDP. The RTSP control connection is the TCP to send instruction and command such as rewind, fast forward, pause and resume.

Figure 10-1. Netmeeting integrated in WebCT

Moreover, this stakeholder perspective emphasizes also the collaboration in the Learner entity. WebCT provides several low bandwidth Synchronous/Asynchronous communication tools such as discussion, whiteboard, mail, and chat. In addition, the integration of Microsoft Netmeeting in WebCT (Figure 10-1) provides audio/video/sharing of application among the learners.

Reusability of learner data is possible using API provided by WebCT. It allows the direct access and manipulation of the two separate databases via a command or web-based interface. These databases are the global database and student database. They have built-in fields that cannot be renamed or deleted and other fields that can be added. The global database contains a

listing of all users in the WebCT server. A WebCT ID, password, first name, last name, courses, and registered courses describe each user. Moreover, the user data can be imported to the global database in a text file format, and exported in an Excel format. The global database could comply with a standard learner profiles in order to enhance the reusability. The student database is a collection of databases that are specific to each course. This database contains the User ID, password, first name, and last name. For every course, the User ID (in student database) is usually linked to the WebCT ID (in global database).

The reusability between WebCT's platforms at the course level is possible by backup/restore or using the course as a template for other courses with the course structure defined depending on the designer preference. Moreover, there is no easy reuse of modules, lessons, and multimedia presentations from within the same platform, since the library concept is not supported in WebCT and modules must be duplicated in each course. To overcome this problem, a Meta file or a pointer was used to link to these modules stored outside the platform. In addition, The WebCT COBALT will overcome these problems, provide a course and section hierarchy to improve the content sharing. The reusability of WebCT courses in any IMS compliant e-learning system is possible using the IMS Extensible Markup language (XML) importer/exporter utility. This utility allows us to recreate the course structure with the corresponding course content.

5. CONCLUSION

In this paper, we have presented a new WBT/E that it appears to overcome the reusability and interoperability problems at the learner and course level. It is mainly based on the LTSA, includes the Enhance Model concept that provides the necessary details to the LTSA components, and adds interoperability and reusability at the course and content level. Moreover, this model leads to a reduced course production cost, larger potential market, and life long learning improvement. To illustrate this model, a scenario of collaborative learning stakeholder's perspective was presented. In this scenario, WebCT was used as the distance-learning platform, RealNetworks family for manipulating synchronized multimedia courses integrated in WebCT, and Microsoft NetMeeting for providing audio/video/sharing of application among the collaborators.

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