Building a Repository for Online Laboratory Learning Scenarios

Conference Paper *in* Proceedings - Frontiers in Education Conference · December 2006

DOI: 10.1109/FIE.2006.322603 · Source: IEEE Xplore

Hamadou Saliah-Hassane
Université du Québec

Building a Repository for Online Laboratory Learning Scenarios

Hamadou Saliah-Hassane, Senior IEEE Member
Télé-université/Université du Québec à Montréal,
LICEF Research Center
saliah@teluq.uqam.ca

Abdallah Kourri [1], I. De la TejaI[2]

Abstract - **In the framework of our work carried out with the LORNET Research Network, we present a model for online laboratory repositories of learning scenarios based on IMS-Learning Design. A number of considerations should be taken into account to achieve a composition of services related to a given scenario for the required ad hoc synchronous and collaborative learning environment built on the fly. This paper will also show how the concept was implemented within a telepresence learning environment with a group of students using remotely and collaboratively laboratory instruments.**

Index Terms: Telepresence, IMS-Learning Design**,** Distributed Instrumentation, remote laboratory, online laboratory.

INTRODUCTION

Remote laboratories are learning systems which allow users to learn by carrying out practical work over computer networks. This system integrates various types of resources which are generally found in telelearning systems such as learning objects and communication tools. However, remote laboratories can use dynamic learning objects to provide users with remote access to laboratory devices in real time. Moreover, the system resources can be integrated into a multi-environment platform: the environments of the learner, the tutor, the administrator and the instructional designer. These environments are designed especially with the user role in mind. The tasks to perform by each actor should seemlessly be associated with users' rights and priviledges required to access to the ressources needed. This paper will address the storage of learning systems for distributed remote laboratories. In terms of instructional design process, the MISA method was selected [1] to model learning scenarios according to the tasks completed by the various actors and the resources they require. Moreover, MOT+ (*Modélisation par Objets Typés*-Object-oriented modeling tool) [2], a tool designed specifically to depict MISA graphics, will be used to model learning scenarios.

Mot+ is software that helps to build representations of knowledge. MOT+ uses specific graphical forms to represent types of knowledge: concepts, procedures, principles and facts, and different of links between them (c.f. Figure 1). For example, the relation between knowledge is highlighted using links; the specificity is given by letters: *C* is a link of composition; the knowledge composed of another knowledge. The link *I/P* means input/product, according to the direction of the arrow; a procedure often has a concept input and product (c.f. Figure 2).

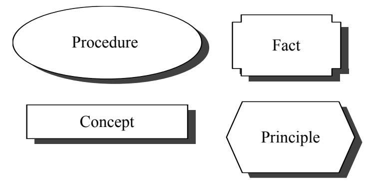

FIGURE 1 GRAPHICAL FORMS TO REPRESENT TYPES OF KNOWLEDGE UNITS: CONCEPTS, PROCEDURES, PRINCIPLES AND FACTS.

Furthermore, MOT+ allows the instructional system designer to transform the scenario graphic model into a model that meets IMS-Learning Design (IMS-LD) standards [3, 4]. Figure 2 illustrates a MOT+ remote laboratory model with the MISA method. In this model, two different activities are explored by team 1 and team 2. The first activity it makes it possible to *send information* and *determined the type of set up*. The second activity consist to *send signals* and *get feedback* about different environments *(Request analysis, Function generator and Oscilloscope).*

Our approach consists of exporting the IMS-LD compliant XML file for learning scenarios provided by MOT+. This file shows only Level A specifications which describe basic elements such as roles, activities and environments. To personalize, adapt and add resources and collaboration links, Level A specifications must be supplemented by Levels B and C. In this investigation, such complementarity is achieved by the editor RELOAD [5].

A strategy was then formulated to automate a procedure that will generate transparent associations of learning scenarios,

[1] Abdallah Kourri, LICEF, Télé-université/Université du Québec à Montréal, kourri.abdallah@courrier.uqam.ca
[2] De la TejaI, LICEF, Télé-université/Université du Québec à Montréal, idelatej@teluq.licef.teluq.ca

objects and resources (e.g., laboratories, tools, distrinuted user interfaces and documents).

DESIGN MODEL

The design of a remote laboratory environment, unlike that of a classical distance-learning system, requires planning, actor access as well as an emphasis on the concept of real time to efficiently manage various resources, including dynamic learning objects and communication tools. MISA is based on a design approach that respects the definitions of four models used to describe a learning scenario: content, learning strategy, media and delivery [6]. Figure 3 illustrates this pedagogical model, how the components are linked, as well as the interactions amongst them. Web services will be used to link these components. A web service architecture will thus be defined to ensure the most important operations allow for the publication of a Web service, as well as the research and links within the service. These Web services will be built from either the *Workflow* mechanism through WSFL (*Web Services Flow Language*) [7] or BPEL (*Business Process Execution Language)* [8] which defines the specifications of a business process based on the Web service.

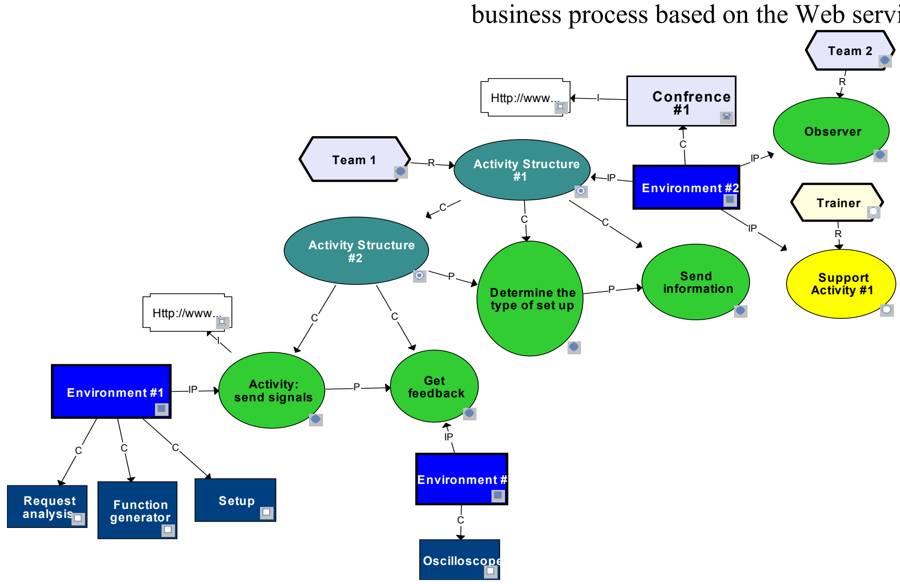

FIGURE 2. MODEL OF A LEARNING SCENARIO WITH MOT +

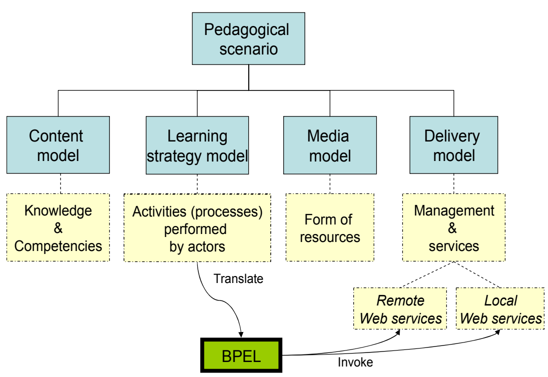

FIGURE 3. REMOTE LABORATORY PEDAGOGICAL MODEL

MSL-LD

The IMS-Learning Design specification (IMS-LD) was proposed by the IMS Consortium [3, 4]. When the final version was published in February 2003, it was composed of three documents:

- **IMS Learning Design Information Model:** this document describes the data structure, the behavioral model for delivery and the conceptual model.
- **IMS Learning Design Information Binding:** this document provides further details concerning the elements which link data.
- **IMS Learning Design Best Practice Guide:** this document indicates how the specification must be implemented. It offers examples of courses with IMS-LD specifications.

The specification of the conceptual model includes three implementation levels. Each one has a specific XML schema [3, 4]:

- **Level A**: contains all of the basic elements: roles, activities, environments and structure of the methodology.
- **Level B**: builds on Level A; adds proprieties and conditions required for personalization and adaptability.
- **Level C**: adds the concept of Notification to Level B in order to fulfill collaboration and feedback requirements.

The objective for providing designers with an instructional meta-model based on these specifications is to facilate in describing learning scenarios. According to Koper [9], this IMS-LD model will make it possible to describe, in an inter-operable manner first, all of the process, content and services used in the framework of a course. Second, it will also ensure assistance to personalize learning activities and reuse course components and multi-role instructional designs.

METADATA

This section addresses various metadata required to ensure granular and aggregative learning objects. In the case of distance-laboratories, learning objects are graphic interfaces and a set of metadata describing these objects and their level of granularity has been provided by the LOM Standard (Learning Object Metadata) [10]. LOM metadata will appear in a PALOMA-imported XML file [11]. Developed by the LICEF, PALOMA is a metadata manager that makes it possible to describe learning objects with all of the descriptors available with LOM. It is a learning object repository developed by various research teams involved with the LORNET network. The main feature of this manager is that it allows for the insertion and removal of all of the LOM descriptors using an interface that contains all of the descriptor fields for nine LOM categories (c.f. Figure 4). Moreover, it makes it possible to generate an XML file that contains all of the predefined learning object descriptors according to the LOM standard.

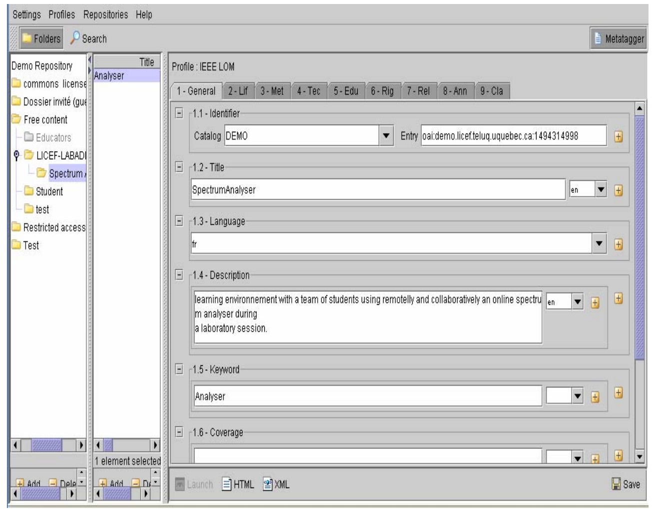

FIGURE 4. PALOMA MANAGER

TABLE 1 PROLEARN ONLINE EXPERIMENT LABORATORY DESCRIPTORS

Name	Meaning	Type
Description Extension	Online laboratories require long text descriptions. This attribute is used if the text exceeds the current maximum of 2,500 characters in the text field of the attribute "Description".	Extension of general description: [Text field]
Experiment Types	Three types of laboratories have been identified: local, remote and virtual laboratories. Aside from the attribute which indicates the type of laboratory, this attribute includes two sub-attributes: - Experiment ID: to identify a laboratory - Experiment Title: to explicitly identify a laboratory	Experiment component types contained : [Set of boxes to check] ➢ Virtual experiment components ➢ Remote experiment components ➢ Local experiment components
Internet-Based Experiments	Laboratories which require an Internet connection to allow users to carry on their activities. This attribute includes the following sub-attributes: Availability, Number of Setups, Interaction mode, Reservation, Guest access.	Internet-based experiments [Set of boxes to check]
Availability	This attribute is used to specify server availability and maintenance requirements. Online laboratories are available 24/7 during the year, or over a predetermined period, or triggered by a user request, or unavailable if the laboratory no longer exists or is temporarily unavailable.	Availability [List of radio buttons] ➢ Continuously ➢ Planned Time Interval ➢ Upon request ➢ Not available
Number of Setups	A laboratory requires configurations that enable the verification of certain information, such as the number of active users, for example. Active users are allowed to use equipment whereas passive users are denied such rights. Instead, the latter must watch the experiment and active users' interactions.	Number of setups: [Text field] Number of active users per setup: [Text field] Number of passive users per setup: [Text field] Allocation policy: [Text field]
Interaction Mode	In synchronous mode, users connect in order to take part in a laboratory that lasts for a certain period of time. In asynchronous mode, there is a single step where users send a request and await the result. At the end, the system returns to its initial state.	[Set of radio buttons] ➢ Synchronous ➢ Non-synchronous/Asynchronous?
Reservation	The number of users who can simultaneously access a laboratory in synchronous mode is limited. Four strategies are used for reservations: Online Reservation: a reservation is made online. Offline Reservation: a reservation is made by contacting the laboratory owner directly. Stand in Queue: queuing mechanism to process a large number of users Direct access: if no laboratories are available, users are informed via messages indicating that they should try again at another time.	[Set of radio buttons] ➢ Online Reservation ➢ Offline Reservation ➢ Stand in Queue ➢ Direct Access
Guest Access	For guests who would like to test a laboratory and assess its level of usefulness.	Guest access available [Box to check]
Associated Documents	Laboratory descriptions are presented in documents whose target audience may be learners, instructors, developers or guests.	Information for each type of documents: Abbreviation: [Text field] Title: [Text field] Language: [Text field] URL: [Text field] Description: [Text field]

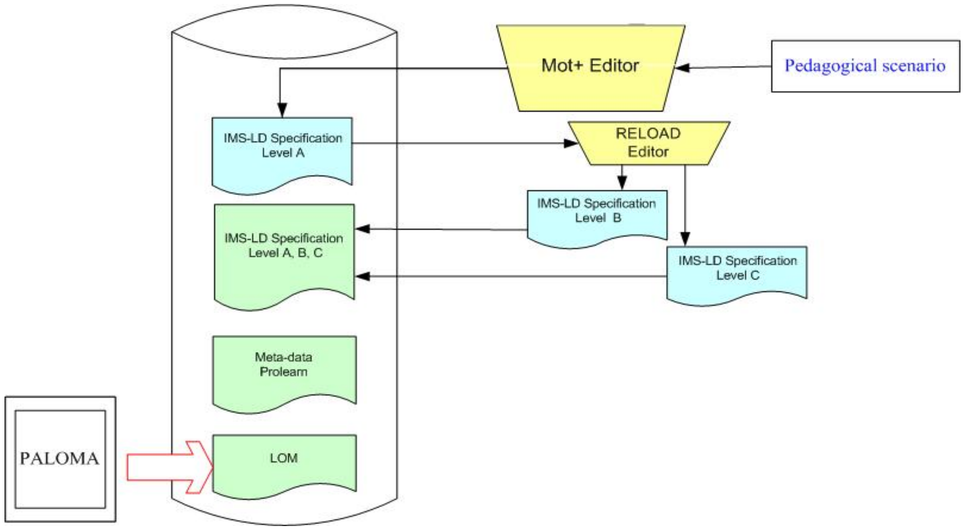

FIGURE 5. STORAGE OF METADATA AND THE LEARNING SCENARIO

STORAGE PROCEDURE

This section addresses the storage procedure for laboratory metadata, instructional scenarios and learning objects.

The editor MOT+ configured to be compliant with IMS-LD standard is selected to design the learning model and generate an XML file with Level A specifications. Unfortunately, as MOT+ does not allow for the addition of links and Level B and C specifications, a second editor, RELOAD Script LD [5], is used to enriched the proposed model. The description of the learning scenario with this specification will ensure the compatibility of devices (and their availabilities), use and pedagogy. Moreover, the learning object descriptions respect the LOM standards, as with the PROLEARN network metadata descriptors. Figure 5 illustrates the learning scenarios and metadata storage processes.

CONCLUSION

This paper presents the conceptual model that will be used for our future work on the associations of various learning scenarios. These scenarios are inserted into PALOMA. The stored components are used in both collaborative and remote practical work contexts. Basically, it uses pre-built scenarios which are IMS-LD compliant to generate learning environments that are distributed and transparent to the user. In the near future, we plan to validate the suggested model using scenarios investigating various measuring instruments and actors (users) in remote locations.

AKNOWLEDGMENT

The authors greatly acknowledge the support of the Natural Science and Engineering Research Council of Canada (NSERC) in the framework of LORNET network.

REFERENCES

[1] H. Saliah-Hassane, I. de la Teja, O. Dioume, C. Kedowede, G. Paquette, M.Saad, L. Villardier. (2003). On-line Laboratory Brokerage System for Education and Research International. Conference on Engineering Education, Valencia, Spain

[2] M. Léonard & D. Lalonde (1997). Logiciel MOT - Éditeur de graphes - Modélisation par objets typés. Montréal: LICEF http://www.licef.teluq.uquebec.ca/gp/eng/productions/mot.htm

[3] IMS-LD, IMS Learning Design, http://www.imsglobal.org/learningdesign/

[4] Koper, R., & Olivier, B. (2004). Representing the Learning Design of Units of Learning. Educational Technology & Society, 7 (3), 97-111. http://ifets.ieee.org/periodical/7_3/10.pdf

[5] Reload, http://www.reload.ac.uk/tools.html

[6] Paquette, G., L'ingénierie pédagogique pour construire l'apprentissage en réseau. Montréal: Presses de l'Université du Québec, 456 s, ISBN 2-7605-1162-6, 2004

[7] Frank Leymann, 2001, Web Services Flow Language (WSFL 1.0), www06.ibm.com/software/solutions/webservices/pdf/WSFL.pdf

[8] Tony Andrews and All, 2003, Business Process Execution Language For Web Services version 1.1, ftp://www6.software.ibm.com/software/developer/library/ws-bpel.pdf

[9] Koper, R. (2004). IMS Learning Design: What it is & Update on Current Activities Heerlen, Oct. 21, 2004, Educational Technology Expertise Center, Open University or the Netherlands, Unfold & Surf Six Joint Meeting.

[10] Learning Technology Standards Committee of the IEEE. Draft Standard for Learning Object Metadata, [on line] http://ltsc.ieee.org/wg12/files/LOM_1484_12_1_v1_Final_Draft.pdf

[11] PALOMA, Paloma User Guide, [on line]: http://www.licef.teluq.uquebec.ca/documentations/Aide/PALOMA/user%5Fguide/paloma/en/Guide/

[12] PROLEARN, 2004, Online Experiments, [on line], http://www.prolearn-project.org/articles/wp3/index.html