PRODUCING DISTANCE COURSES WITH XML

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Abstract

To take advantage of the asynchronous telelearning, documents representing courses must fit appropriate characteristics. The most important of these characteristics is the ability of the courses to adapt itself to the learner profile. The courses must also be interactive, structured, multimedia, web compatible, etc.
The purpose of this paper is to show how using XML and its associated tools is the way to fit all of these characteristics. It also describes the manner these characteristics are integrated.

Keywords

Tele-learning, distance courses, XML, adaptativity

1 Introduction

This study is a part of the SMART-Learning (System for Multimedia Adaptative and coopeRative TeleLearning) project at the RIM research unit (Réseaux Informatiques et Multimédia) at EMI. The goal of this project is to provide courses to distant learners without any space or time constraint, including the possibility of having synchronous sessions (real time) for the conversation between the various actors intervening in the process of learning (learners, trainers...). In addition, the fundamental goal is the adaptability of the courses to the learner according to pedagogical requirements and learner capabilities [1].

Generally, courses that are available on the Internet are hypertext documents. The structure of the hypertext and the reading modes it leads to are opposed to some educational principles. A learner can access any pedagogical sequence of a course without order constraints of these sequences and without having the preliminary knowledge. Consequently, the teaching objectives (specialty, type of training...) aimed by the access to the course will not be reached. In our view and to ensure a pedagogical learning, the course must take account of the learner profile (capacities of training, previous knowledge, language,...) and the learner evolution (prerequisite, speed of knowledge acquisition...)[2].
Another limitation of the hypertext is that the course has no structure and its content is mixed with presentation

markers, which makes it impossible to automatically process the course.

In order to meet the courses needs in telelearning, it is necessary that the course document fits the following characteristics:

(i)   The course must be a hypermedia or at least a hypertext document, in order to guarantee the interactive aspect of the course,

(ii)   It must moreover be written in a syntax allowing it to be put on the Web,

(iii)   The course document must be able to reproduce the course structure and contents,

(iv)   It must also be modular. A course part can be added or updated without changing the whole structure,

(v)   The document must be structured so that its manual or automatic processing is easy,

(vi)   The course document must respect a course model previously defined on pedagogical bases,

(vii)   The structure as well as the content must be independent of the presentation aspect of the course in order to allow the modification of the document style in a global and content independent manner,

(viii)   The course is a hypermedia document that must be able to guarantee the synchronization (or scenarization) of the media it contains,

(ix)   Finally and overall, to guarantee the adaptability of the courses which is a very important feature allowed by the telelearning.

We will show, in the continuation of this paper, how XML and its associated tools make it possible to guarantee, to the documents which represent our courses, the characteristics that we have just listed. We applied and tested these methods in our SMART-Learning system.

2 Course characteristics in SMART-Learning

SMART-Learning is mainly asynchronous. It provides courses to distant learners without any space or time constraint. The objectives of the SMART-Learning course structure is to fit the characteristics defined above and take advantage of the asynchronous telelearning.
The power of SMART-Learning appears in the ability of the courses to be adapted according to the learner profiles, as well as the ability of cooperating through the document.
We are mainly interested in presenting the model for structured and adaptative courses in the Internet (characteristic (ix)). The course structure is essential to satisfy the objectives listed above including the adaptability objective in SMART-Learning. It must allow the production of a generic course which will be used to generate a specific course at the moment of the training

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(figure 1). This model provides the general structure of a course in such way that the sequences presented to the learner are adapted to his profile and to the training level he wishes to reach.

Figure 1 shows how adaptability is processed in SMART-Learning. This schema will afterwards be realized using XML technology which is the only one that allows, in the same time, the adaptability and the other characteristics.
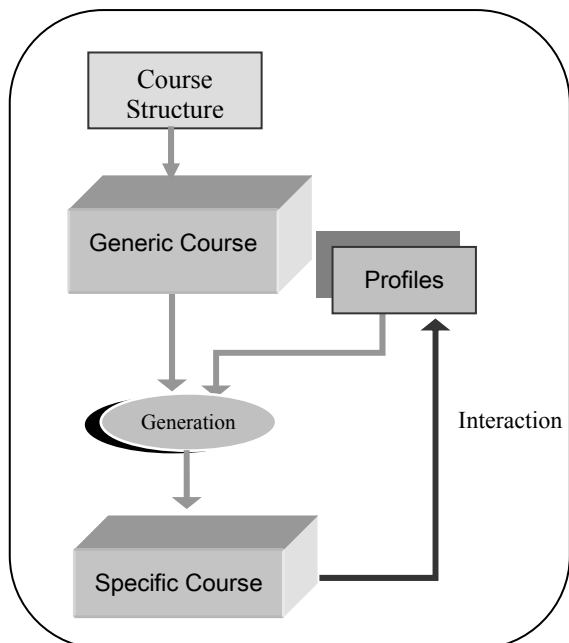

Fig. 1: Learning Process in SMART-Learning

The generic course is intended for all profiles. It is a document which contains, in addition to the learning material, the pedagogical expertise of the trainer. A generic course must take into account the various objectives pursued by the course and the various profile types of the learners who will have access to the course.
This approach makes it possible to generate for each learner, based on his profile, a specific course by using a generation system (figure 1) during the training while the learner is accessing the course. If, for example, the learner profile is modified following the result of an evaluation, the course will be automatically regenerated so as to consider the new knowledge obtained by the learner.

3 Course structure in SMART-Learning

In order to fit the above listed characteristics as well as the pedagogical process, we defined a structure for the course document of SMART-Learning which will be then represented in XML
The production of a course is based on an educational design, which is used to structure the contents in order to facilitate the learning. The course structure must take into account the following criteria [3]:

- To stratify information in order to take account of the complexity levels and to adjust it with the preliminary knowledge of the learner (characteristic (ix));
- To structure the presentation in media elements in order to facilitate the selection, the organization and the integration of information to be presented to the learner (iii, vii, ix);
- To produce the course in several languages in order to improve its deployment for a larger number of possible learners (ix);
- To consider the use of various media (text, audio, video...) which encourages the learner to take a telelearning course (i, ii, viii),
- To take in consideration all the details, even the optional sequences of the course (illustrations, reminders...). In a traditional teaching, the trainer is present at the time of the training and can add missing information or make a not initially considered reminder, whereas in a telelearning application, if the contents of the reminder are not initially considered, teaching will be then defective (i, iii),
- To have a hierarchical structure to represent the course document (iii, iv, v).

The generic course is then seen like a set of pedagogical sequences (PS) structured as a tree with a single root (figure 2). Each sequence constitutes a distinct whole. It can be a course, a chapter, an evaluation or other. A pedagogical sequence (PS) is then broken up into other pedagogical sequences or elementary pedagogical sequences of the lowest granularity. The leaves of the tree constitute the contents to be presented to the learner, they are the media elements (ME).
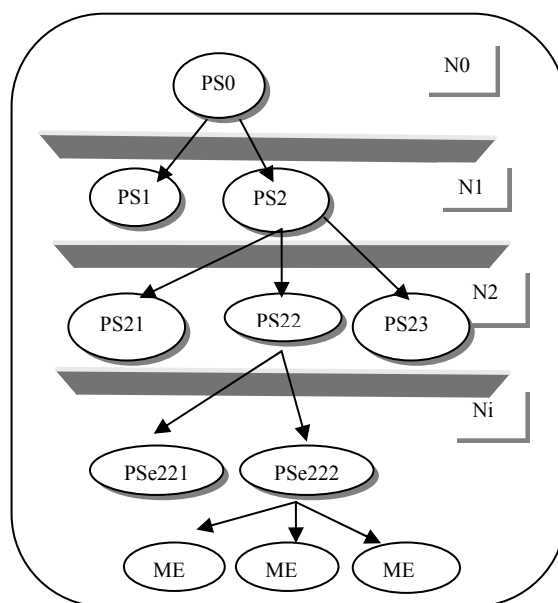

Fig. 2 : Course structure example

Moreover, this structure is valid for any courses whatever the teaching modes to which the designer is used (module, course, unit, etc) to conceive his course. All he has to do is to use the equivalence interface of SMART-Learning. This interface guarantees the equivalence between the terminology of our structure and that used by the course designer [4].

For adaptability reasons, each component (PS, PSe and ME) is annotated by a set of selection criteria which will be used by the learning process in order to generate or not the component according to the learner profile at a given moment. Thus, we defined four categories of selection criteria :

- Educational : this category describes the educational criteria that the course designer must define before the production for training needs. The most significant is "the pedagogical objective". For example, "engineer training" or "technician training";
- Psychological : this category describes all the psychological factors which determine the way of learning. For example, the understanding level;
- Localization: this category describes all the criteria which facilitate and improve the communication between the course author and the learners. For example, the course contents language and other regional characteristics;
- Technical : this category describes the technical needs (flow, hardware characteristics,…) to generate the components which will be presented to the learner according to his environment.

This structuring approach makes it possible to keep the same course structure and to change, for each profile, only the part of the contents which relates to it. It also makes it possible to avoid the errors which result of updating different course versions intended for different profiles. For example, the update of the contents of the PS1 (figure 3) is done only once for the two types of training (engineer and technician) instead of updating two different versions, one for the engineers and the other for the technicians, which could easily involve errors or omissions [2].
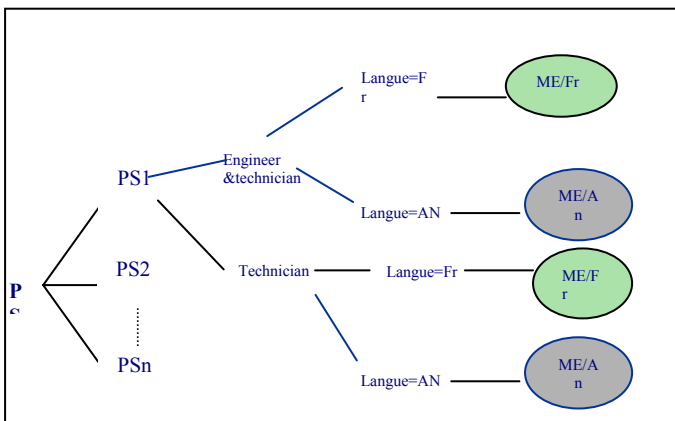

Fig. 3 : Example of relations between the criteria

4 XML AS A SOLUTION

HTML is, of course, the first solution which comes to mind for representing a course on the Internet. However, it fits only three of the characteristics we defined (i, ii and viii).

The XML language, reputed by its facility to exchange complex document on the Internet, is in fact the ideal solution to fit all SMART-Learning and telelearning courses characteristics we defined earlier. XML comes with a set of tools based on XSL, DTD-Schemas, CSS and parsers.

4.1 Hypermedia structured documents on the Web

The eXtensible Markup Language (XML) allows to write hypermedia course documents (i, ii) just like the HTML, but gives in addition the possibility of defining new personal tags contrary to the HTML which presents an extremely rigid and present tagging set.

The possibility of creating his own tags makes it possible to represent any type of document and thus the courses which we defined with adapted tags. The hierarchical structure of XML corresponds to the course structure of SMART-Learning (fig. 2) and thus fits the characteristics (iii and iv).

The automatic processing of course documents (v) is made possible by the XML associated parsers like XT of James Clarck [6], Xalan from Apache [7] or others. The tagging language also allows, by the means of name spaces, the use of several vocabularies in the same document. We can, in particular, represent the tags corresponding to the course structure and the tags corresponding to rules of time precedence between the elements. The synchronization language SMIL (Synchronized Multimedia Integration Language) integrates in this manner into any XML document and thus a course. It conforms, itself, to the XML syntax. In SMART-Learning, the media elements could thus be sequenced and scenarized (viii).

4.2 Definition of course types

It is important, in any telelearning system, to be able to define a course model which corresponds to a pedagogical or presentation method that all the courses must respect (vi).

XML allows it using the DTD (Document Type Definition) concept which is a model which makes it possible to define a document class for SMART-Learning courses. Each document corresponds then to an instanciation of the DTD. Schemas are even more flexible than DTDs to define more rigorous documents types.

3.3 Separation between content and presentation

The great drawback of HTML is the mixing of the content and the presentation instructions (format, style) in the same

document. This makes the contents very difficult to locate and thus to update. It is also very delicate to apply the same presentation style on the same level of text, the section titles or the listings, for example.

These difficulties are overcome (vii) with XML and the associated tools. The structure and the contents of the document are described in an XML document whereas the presentation is defined in an associated document which can be described with several style definition languages depending on the desired presentation. We currently use the first version of CSS. CSS2 will allow much more possibilities when it is recognized by the various browsers. These possibilities will be more increased with the even more complete language XSL:fo.

Current browsers visualize XML documents. However, not all of them recognize the whole set of the XML associated tools functions. It is however always possible to transform an XML file into HTML using XSLT by associating formats described in XML to it. The transformation into HTML allows the document to be then visualized on any browser. This phase will be definitively abandoned when all the browsers are able to recognize XML and its tools.

4.4 Course adaptability

The adaptation of the course according to the user profile is made possible using XSLT. It will first of all be necessary to adopt a structure defining the relation between the course and the profile as in the case of SMART-Learning.

XSLT can transform an XML document into another XML document according to present selection criteria. In SMART-Learning, these criteria (educational, of localization) can be associated to any element of the course (PS, PSe, media). 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 4). In fact, the general transformation parameters contained in the generic XSLT document are transformed using the profile values.
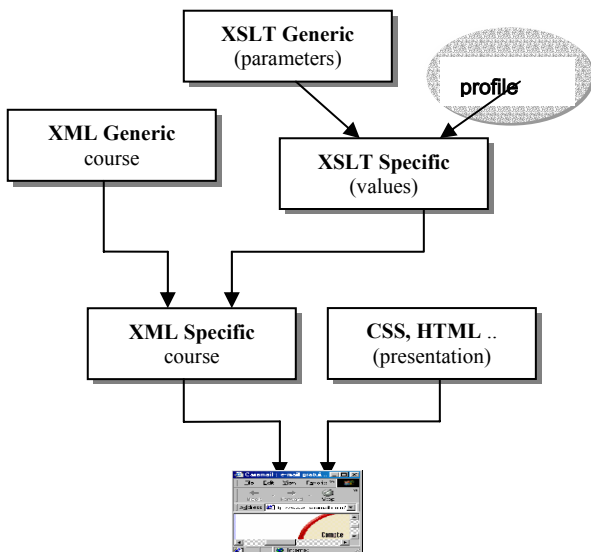

Figure 4: Successive transformations of a SMART-Learning course

Figure 4 also shows how is made the final transformation, using CSS and even XSLT to transform into HTML so that the course can be visualized on a Web browser.

4.5 The XML course transformation processes

This section details how the XML tools allow selecting a learner profile in order to prepare step by step the content that corresponds to a learner according to his profile.

A course or a part of it is represented by a pedagogical sequence. There will be only one generic XML document (see listing 1) to represent a PS, valid for all learner profiles(Engineer, technician, french, english ...). Thus, for each learner profile, it will be enough to apply the adequate XSLT transformation on this generic course.

Let's take the example of a simple course part:

```
P. XML generic course

<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE EPS SYSTEM "course.dtd"
[
<-- media element reference -->
   <!ENTITY titrefr SYSTEM "titrefr.txt">
   <!ENTITY planfr1 SYSTEM "planfr1.txt">
               ----------------------------------------------
]>
<PSE id_PSE="ch1med2">
   <PSE_Obj_Pedag Val=" engineer+technician">
        <PSE_Language Val="french">
               <Media type="text" url="" id_Style=""
               niveau_Media="1">&titlefr;</Media>
               --------------------------------------------
               <Media type="text" url="" id_Style=""
               niveau_Media="2">&planfr1;</Media
               >
        </PSE_Language>
        <PSE_Language Val="english">
               <Media type="text" url="" id_Style=""
               niveau_Media="1">&titreen;</Media>
               <Media type="text" url="" id_Style=""
               niveau_Media="2">&planen1;</Media
               >
               ------------------------------------
        </PSE_Langue>
        </PSE_Obj_Pedag>
   <PSE_Obj_Pedag Val="technician">
        <PSE_Language Val="french">
        --------------------------------------------------
        </PSE_Language>
        <PSE_Language Val="english">
        ----------------------------------------------
        </PSE_Language>
   </PSE_Obj_Pedag>
</PSE>
```

Listing 1 : Generic XML course

Knowing that each learner has a given profile which is supposed to change constantly during all the learning process, it is impossible to predict all possible XSLT transformations that could be applied to the XML generic course. This led us to choose a solution with a generic

XSLT file (see listing 2) containing the parameters representing the profile.

Listing 2 : Generic XSLT transformation

Let's give the following values for a simplified profile:

Profile	
Pedagogical objective	Engineer
Language	French

Table 1 : Profile

Thus, the parameter setting of this generic XSLT by the profile elements will dynamically give an XSLT specific to this profile (see listing 3) containing the values corresponding to the profile(table 1):

Listing 3 : Specific XSLT transformation

Thus, to generate the XML course specific to a profile, it is enough to apply to the XML generic course the XSLT transformation specific to this profile (see listing 4).

Listing 4 : Specific XML course

As the specific XML course is obtained, it is enough to apply on him an XSL or CSS stylesheet according to the wished visualization. Listings 5 and 6 show the use of an XSLT stylesheet that transforms the course into HTML incorporating a CSS stylesheet to be presented to the learner.

Listing 5 : XSL transformation for the presentation

```
External CSS for the presentation

*{background-image:url(..\Media\bg20.gif)},
.texte_niveau1{    font-size:20pt; color:blue;
                   border-style:double;
                   text-align:center
                   }
.texte_niveau2{    font-size:15pt;
                   color:black
                   }
.img_niveau3{      margin-left: 20
                   }
.img_niveau4{      margin-left: 45
                   }
```

Listing 6 : CSS for course presentation

XML and its tools allow thus, using a relatively simple representation, fitting the characteristics of a telelearning course and in particular the adaptative and structured courses of SMART-Learning

5 References

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