XEDU, a XML-based framework for developing didactic resources

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Abstract

Modern educational applications are using the Web as a medium to enhance the learning process. One of the more promising Web technologies is based on using XML as a way to structure the information items and to represent the multiple relationships between them. This paper presents XEDU as a framework that uses XML for organising and developing didactic resources. The proposed framework provides a set of abstract didactic structures and the interface to associate them either to XML-based contents and other complex didactic resources. The final goal is to help instructors to develop their own didactic resources which can be easily managed.

1. Introduction

Modern educational applications are using the Web as a medium to enhance the learning process. One of the more promising Web technologies is based on using XML as a way to structure the information items and to represent the multiple relationships between them. Previous Web technologies were focused on how to present the information items in a browser and how to navigate through them. They were mainly based on HTML, a markup language with a fixed set of tags that could describe a fixed number of elements. XML (Extensible Markup Language) [1] is a meta-markup language which allows the user to define the tags he needs. This feature can be useful in a teaching context. For example, the information about a course can be structured in packages such as the proposal in the Ineit-Mucon project [2], whose structure is typically composed by *Objectives*, *Prerequisites*, *Contents*, *References*, *Activities*, *Questionnaires*, or *Glossary*.

The tag names for defining these structures can be chosen by the own instructor. He can create a DTD (Document Type Definition) to represent these units or he can use other pre-defined DTD. No presentation details are included in the XML document according to the DTD. Next, the instructor determines how to deliver the information, either on a Web browser, a book, or any other format.

This paper presents XEDU as a framework that uses XML and related technologies for developing this kind of didactic resources. The proposed framework provides a set of abstract didactic structures which can be used for organising the educational resources. This feature eases the reuse and maintenance of all these resources.

The remainder of the paper is organised as follows. Section 2 describes some work about the XML application to educational applications. Section 3 shows the main concepts of the XEDU framework. Section 4

shows an example. Finally, section 5 presents some remarking conclusions.

2. Related work

In the context of educational applications, XML has been used to represent a high number of didactic resources. There are proposals such as presented in [3] using SGML (the XML ancestor) to define DTD's for teaching material. More recent educational applications are described in [4] that develops a XML based test tool or in [5] which present tutorial examples based on XML.

The *Sebastián* project [6] presents the use of a XML-based language called EML (Educational Markup Language), as a tool for applying Web technologies in distance learning environments. Bourda and Hélier [7] use XML to implement IEEE learning objects. Vernier [8] presents EDUML as an XML-based language with similar purposes. Organisations like IMS [9] propose the use of XML for describing didactic resources.

In most cases, the XML-based didactic resources are considered as independent elements. This situation makes hard the integration of new resources. Some works such as the proposed in [5] or [10] intend to structure and organise the development of these elements.

3. The XEDU proposal

3.1. Didactic structures

The XEDU proposal is based on the separation between the structure and the contents associated to the didactic resources. This separation permits sharing contents among different subjects as well as having structures related to the same subject but which differ in the number or the depth of their contents. The concept of didactic structure is used as an hypermedia composite in order to gather educational resources. It is based on XML notation that

provides enough freedom to represent any kind of structure. An example of didactic structure is shown in Figure 1.

```
<Package>
        <Title>Memory Management</Title>
        <Objectives>Knowing how the operating system
manages the memory resource</Objectives>
        <Objectives>Understanding        the        memory
management algorithms </Objectives>
        <Prerequisites        Target="MA-MemoryHierarchy"
Related Subject="Computer architecture"/>
        <Prerequisites        Target="PM-ProcessExecution"
Related Subject="Operating system"/>
        <Contents        Title="Memory        Management
Introduction" Target="MM-Intro"/>
        <Contents Title="Memory Definition" Target="MM-
Def"/>
        ...

</Package >
```

Figure 1.- Didactic structure example.

Figure 1 shows part of an XML document that describes the structure of a *Package* unit [11]. This root element has a *Title* element, an *Objective* set, a *Prerequisite* set, and a *Content* set, among other elements. The *Objective* set includes several text data related to the package goals. The *Prerequisite* set defines the *Target* and the *RelatedSubject* attributes that link to *Content* elements located in a different package. The *Content* elements have a *Title* attribute that describes the topic scope and a *Target* attribute that contains a reference to its content. For example, the content titled as *Memory Management Introduction* is identified as *GM-Intro*. This target points to another XML document that describes the main characteristics of such content.

3.2. Content definition

The *Content* is the entity that represents the piece of information associated to each didactic resource. There are several types of contents: from the traditional media such as text, sound, graphic, or image which can be only "played" (passive content) to other

more active elements such as animations or simulation programs. All these contents have a common framework in XEDU. An example is shown as an XML document in Figure 2.

```
<Content>
        <Label>About the basics of memory management
in a operating system</Label>
        <Author>Félix Buendía García</Author>
        Id="GM-Intro"
        Category="browsing"
        Type="text"
        Units="paragraphs"
        Value="OperatingSystem/Memory
Management//Introduction"
</Content>
```

Figure 2.- Content definition example.

The *Label* and *Author* elements provide a brief description of the content and its author. The *Id* attribute is used to identify the current content in the corresponding didactic structure (e.g. the *package* unit defined in Figure 1). The *Category* attribute together with the *Type* attribute point out the way how the content will be managed. For example, the value "browsing" means that this text content will be only accessed for browsing (e.g. using a Web browser). The *Unit* attribute describes what are the basic content components. These components can be used as anchors which are a reference locus into a didactic structure or a content. These anchors are the basic element to represent links between different contents. The *Value* attribute contains a XPath expression that locates the content data. All this information allows the system to locate and process, in an automatic way, the content data. Additionally, security mechanisms can be included to protect the content access from non-authorised users.

3.3. Didactic structure management

There are different aspects to consider in the management of didactic structures. One of them is their organisation. A didactic structure can be organised in multiple ways. For example, the *Package* structure aforementioned, is easily adapted to a hierarchical index.

Another feature is the possibility to define multiple navigational paths: sequential, hierarchical or relational. Specific paths can also be defined. For example, the student cannot access to the *Memory Definition* topic if he has not previously accessed to the *Memory Hierarchy* prerequisite.

Presentation is also an important part of the didactic structure management. The objective in this level is not to define physical characteristics of multimedia contents (e.g. font, colours, or letter size) but to assign presentation templates to display the didactic structure elements. In such a way, didactic structures can be associated to XSL scripts to convert the original XML format to other formats (e.g. HTML) or they can employ CSS style documents to provide an homogeneous display.

Another important aspect is to control the actual operation of the didactic structures and how they react to events in an interactive environment, e.g. the Web. In this point, it is important to supervise and track the accesses to their elements. For example, a student who is accessing several packages and needs to control his progress assessment. A client/server-based architecture is used to support this event control.

4. Application example

An example to illustrate the application of the XEDU framework is based on a Computer package, designed originally for the Ineit-Mucon project [11]. This package was formerly developed using HTML documents but it was difficult to maintain and reuse.
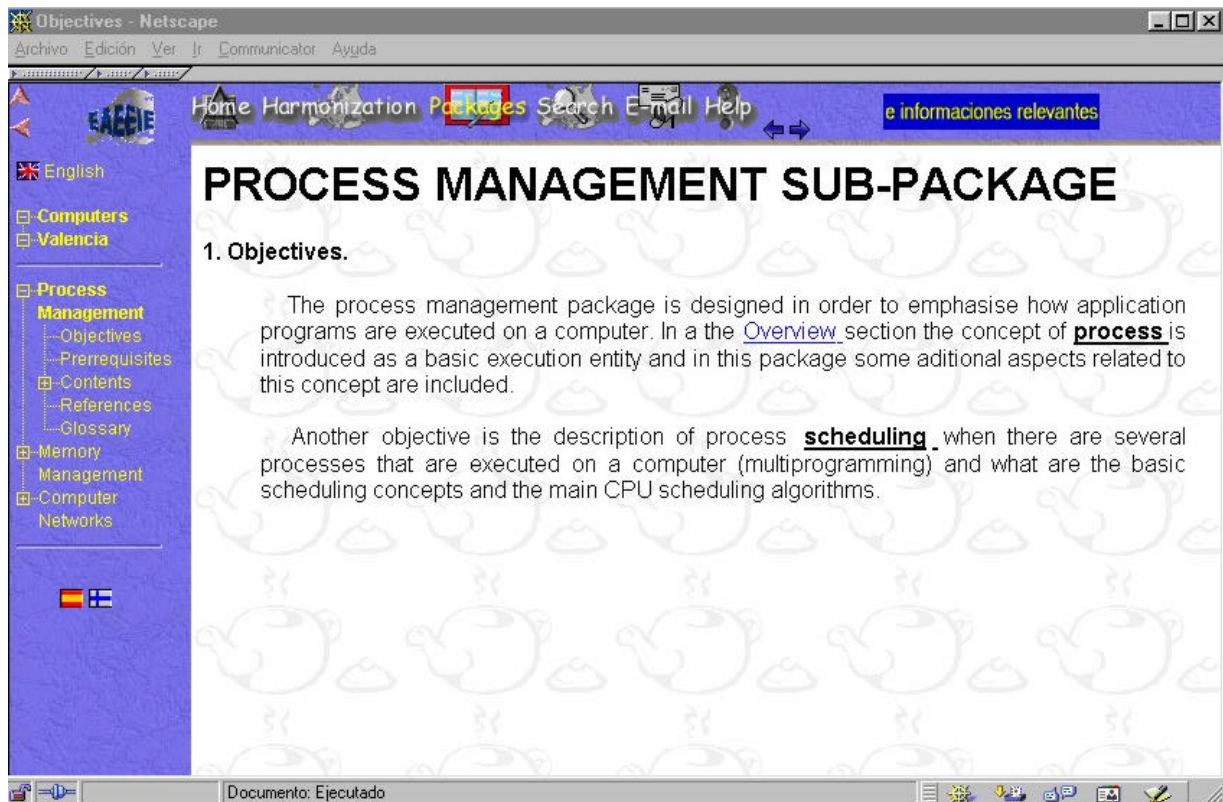
Figure 3- Computer package example.

In the context of the Theiere project [12], these HTML documents have been replaced by XEDU didactic structures.

4.1. Example description

Figure 3 shows the browser appearance when a user accesses to the *Process Management* sub-package. It represents a web page divided into several areas or frames. There is an upper frame that includes a set of general options such as *Home*, *Harmonisation*, *Packages* and utilities such as *Search*, *E-mail* or *Help*. When the user clicks on a option like Packages, the left frame is assigned with a index map associated to this option. The main frame is used to show the content information.

This visual representation is not different from a typical HTML static display. In this case, different dynamic HTML pages are generated as XML-based didactic structures are being accessed. For example, the index frame is re-built each time a inner option is clicked. The goal is to display only two index levels to avoid overloading the user with too much information. Obviously, the difficulty to build this index system with static HTML pages is clear.

Another advantage of this dynamic generation is the possibility to display different organisations of the package unit or to select some specific content options to build-up a reduced index adapted to a particular user. The same feature can be applied to adapt the content display. For example, Figure 3 shows two different objectives of the package. In another presentation, the main objective can be highlighted.
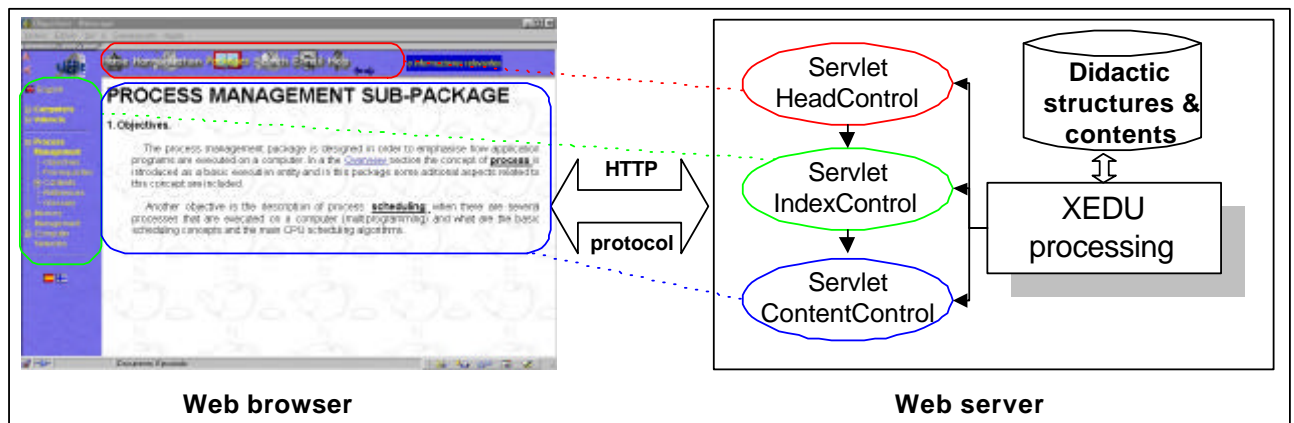
Figure 4. System architecture schema.

4.2. System architecture

The system architecture is shown in Figure 4. The user can access to the system using a Web browser with a given HTTP address. This access is managed by the *HeadControl* servlet that is a Java program executed in the Web server. This servlet is addressed to control the display of the main system options.

When a package option is accessed to, the *HeadControl* servlet gets the selected didactic structures and processes their XML documents. This processing determines an index or whatever other data organisation associated to the didactic structure. It also includes a navigational model, a presentation module and an event manager. In this case, an *IndexControl* servlet is used to manage the index structure.

This servlet calls the *ContentControl* servlet to perform the management of contents associated to the selected didactic structures. It permits to control their presentation in aspects such as the font, letter size, or colours.

5. Conclusion

The paper have shown some applications of XML and related technologies to the management of didactic resources. This contribution is based on the definition of a framework like XEDU that provides didactic structures to organise those resources. Such didactic structures can be assigned with several organisation, navigational and presentation modes helping the instructor tasks. Elsewhere, the possibility of linking these structures with any kind of contents, allows their reuse in other educational contexts.

As future works, the application of XEDU is planned within the Theiere project that will be an excellent testing ground. Such idea does not intend removing classical educational solutions based on HTML pages but it intends to harmonise both systems This approach will also permit to check the working of the system architecture that underlies the XEDU framework.

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