

From Educational Meta-Data Authoring to Educational Meta-data Management

V. Papaioannou, P. Karadimitriou, A. Papageorgiou, C. Karagiannidis and D. Sampson

Informatics and Telematics Institute (I.T.I.)

Centre for Research and Technology – Hellas (CE.R.T.H.)

1, Kyvernidou Street, Thessaloniki, GR-54639 Greece

Tel: +30-31-868324, 868785, 868580, internal 105

Fax: +30-31-868324, 868785, 868580, internal 213

E-mail: {vickyp, karadim, tp, karagian, sampson} @iti.gr

www.iti.gr

Abstract

Educational meta-data can significantly assist the effective and efficient retrieval of educational resources. Currently, there are a number of tools for educational meta-data authoring, facilitating the creation and modification of educational meta-data files. This paper outlines the requirements, and proposes an architecture for the development of a complete EMD management toolkit which go beyond meta-data authoring, supporting the educational community in the full management of educational meta-data.

1. Introduction

Information and telecommunication technologies facilitate mouse-click access to enormous knowledge repositories and educational resources, unconstrained from time, location, etc. The full exploitation of this mass body of knowledge in education can be, however, compromised, by the difficulty in describing, classifying and maintaining these knowledge sources in such a way that they can be retrieved in an “*educationally efficient and effective way*”.

Educational Meta-Data (EMD) are attracting increasing attention in this context, since they facilitate the description of educational resources, so that they can be easily retrieved [1], [2]. A number of international efforts have been initiated during the past few years, aiming to define EMD standards for the common description of educational resources. These standards include fields that are considered necessary for the description of educational resources – such as the type of the resource (i.e. whether it is an experiment, simulation, questionnaire, assessment, etc), the target learner age, difficulty level, estimated learning time, etc – as opposed to “general purpose” meta-data standards (e.g. the Dublin

Core, purl.oclc.org/dc), or standards that have been developed for different fields of knowledge (e.g. geo-spatial meta-data standards, badger.state.wi.us/agencies/wlib/sco/metatool/mtools.htm). The most well-known international EMD standardisation initiatives are the IEEE LTSC (ltsc.ieee.org), IMS (www.imsproject.org), AICC (www.aicc.org), ARIADNE (ariadne.unil.ch), and CEN / ISSS (www.cenorm.be/iss/Workshop/lt/) [3].

At the same time, a number of tools have been developed for the description of educational resources through EMD. These tools can be roughly classified into two major categories: “*XML authoring tools*”, and “*educational meta-data authoring tools*”.

The former category includes tools for the creation of files in XML, which is the most commonly used format for meta-data files in general (i.e. not only for educational purposes). They usually support a number of functionalities, including the mapping of XML documents to other meta-data formats (e.g. RDF), updating, validating, searching and manipulating XML documents, etc. These tools are not specifically developed for educational purposes, but they can be used for the creation of EMD files, if the user imports the specific DTDs required for respective EMD standards. This, however, requires a *substantial* meta-data technologies expertise. Examples of these tools include EditML (editml.homepage.com) and XMLSpy (www.xmlspy.com).

The latter category includes tools that have been specifically developed for educational purposes. That is, they usually facilitate (through a user-friendly interface) the creation of *educational* meta-data files that are based on a specific *educational* meta-data standard. However, these tools usually do not support the mapping, management and modification of meta-data files, validation on structure and data entries, etc. Examples of these tools include the EUN Resource Description tool (www.en.eun.org) and the Reggie Metadata Editor (metadata.net/dstc).

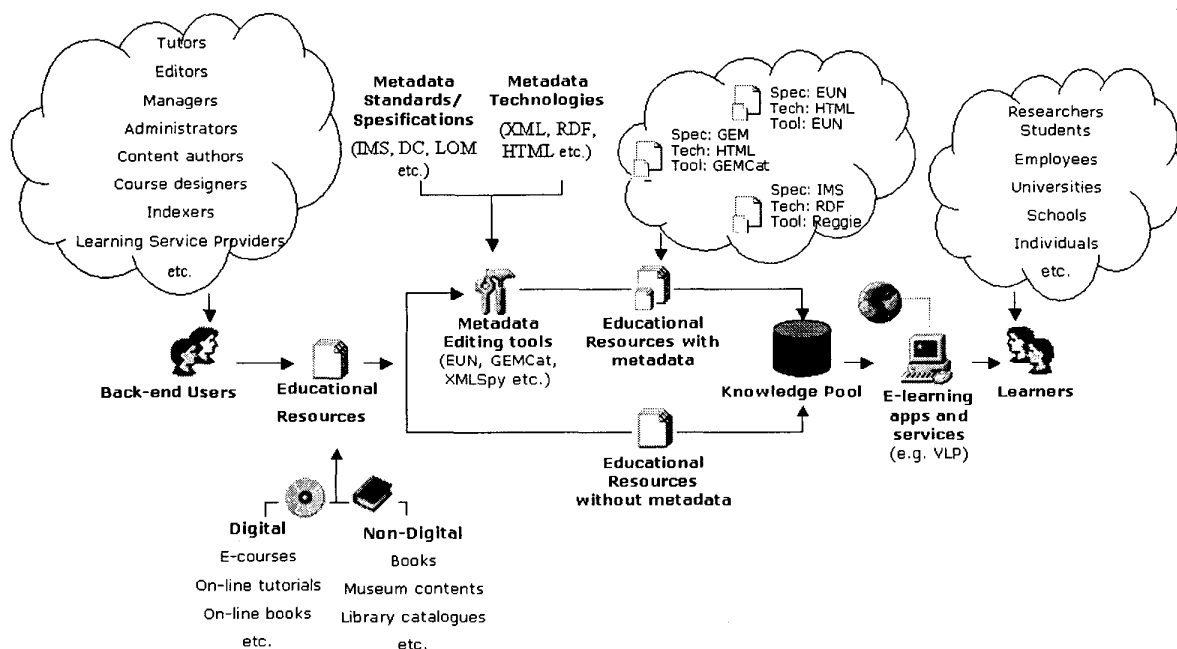


Figure 1 – Requirements for Educational Meta-Data Management

In summary, the educational community has not yet exploited the full potential of EMD, since:

1. still, a lot of educational resources are available in the Internet without a meta-description, i.e. without EMD files for their description
2. for those educational resources that are described through EMD files, their description can be based on *different standards*, and/or *different file formats*
3. even when EMD files are based on the same standards and file formats, they can still differ if they are developed through *different meta-data authoring tools*

This paper focuses on the requirements for educational meta-data *management*, and proposes an architecture for the development of a complete EDM *management toolkit*, which overcome the above limitations, supporting the educational community to fully exploit the potential of EMD.

2. Requirements for Educational Meta-Data Management

The main requirements for educational meta-data management can be derived from Figure 1, where the different people, technologies, tools, etc. involved in meta-data management are shown. As it is shown in this figure, meta-data management, towards a collective and harmonised EMD repository, requires: creation of new and modification of existing EMD files, validation of meta-data information, support of *all* the EMD standards /

specifications, creation of *new* meta-data specifications for specific requirements (e.g. for including additional fields which are necessary for a specific application), support of all meta-data technologies, mapping of EMD files between different EMD specifications/standards, etc. These basic requirements are briefly elaborated below.

Creation of new educational meta-data files: this is the most basic function in EMD management. The user should have the option to define the new EMD file according to *any* of the existing EMD standards and specifications (e.g. create an IEEE LOM, or an IMS EMD file). Moreover, since this function is mainly targeted to educational resources *authors*, who are not necessarily experts in meta-data technologies, it should be supported through a user-friendly interface (e.g. through wizards), providing help concerning the information that needs to be inserted into each EMD field.

Modification of existing educational meta-data documents: this function concerns the update of data entries and modification of the document structure of existing EMD files, by inserting or removing values in EMD fields.

Support of all educational meta-data standards: EMD management should support the creation of EMD files in any existing or emerging EMD standard/specification. Moreover, EMD management should support the definition of new EMD sets, through adding / removing fields in the EMD standard, and saving the new EMD set.

This would ensure that all existing and emerging EMD standards are supported.

Mapping of meta-data standards: the EMD files can be created according to a number of EMD standards. Therefore, EMD management requires that the user is able to map EMD files that are based on a specific EMD standard (e.g. IEEE LOM) to any other EMD standard (e.g. IMS).

Validation of semantic educational meta-data: one of the main problems with EMD files is that they can include inaccurate information. Therefore, EMD management should facilitate the validation of the information included in EMD files, when this is possible. The user should be informed if the entries in the fields are unacceptable (e.g. when text is inserted in fields where a number is expected). In addition, EMD management requires that the validation of the structure of EMD files, concerning their conformance with to the selected EMD standard / specification.

Meta-data document management: EMD management would also take into account the needs of EMD repository managers to find, update, delete, sort and group any set of EMD files through multiple document selections, multiple editing in EMD files, and with the help of a graphical interface including drag & drop features.

3. Architecture for Educational Meta-Data Management

This section proposes an architecture that can support the requirements for EMD management that have been described in the previous section. The architecture is depicted in Figure 2, and each different sub-component is briefly described below.

Repositories: they are used for storing and manipulating all the different types of EMD files (XML Schema, DTD, XML files). The "XML files repository" is used for storing the XML files, the "XML Schemas repository" for the XML Schemas, the "DTD repository" for the DTDs, "XML file databases" (one for every different EMD standard/specification) to group the XML files and allow manipulation of their elements by using queries, the "maps database" to store the maps used for mapping of documents between the available EMD standards/specifications, etc.

Associations: associations between the repositories, and the databases are achieved by using the Document Object Model (DOM). This is a platform- and language-neutral interface, which defines the way a document can be accessed and manipulated. With DOM implementation, a programmer can create a document, navigate its structure, and add, modify, or delete its nodes (elements). The DOM represents a tree structure of the XML

document. A program called XML parser can be used to load an XML document into the memory of the computer. Similarly, the DTD and XML Schema documents can be loaded. When a document is loaded, its information can be retrieved and manipulated by accessing its DOM. In addition, by accessing the DOM, any format of files can be generated (XML files, DTD, XML Schema and DB XML files) and therefore one format can be converted to another through DOM.

Editors: the "XML Editor" provides the interface for creating new XML files or loading and modifying existing ones, and the generated XML files are stored in the "XML file" repository. Similarly the "XML Schema Editor" and the "DTD Editor" facilitate the creation and modification of new or existing XML Schemas and DTDs, respectively, and both the generated documents are stored in the respective repositories.

Validation: the "Validation" component of the architecture provides two different types of XML file validation: structure validation and data validation. Structure validation checks if the XML files conform to the element structure and hierarchy of the associated DTD or XML Schema files. While, data validation checks if XML files conform to the associated XML Schema (if any) in terms of data type. Validation is taking place every time an XML file, DTD or XML Schema is generated or modified, and the outputs of this component are validated XML files or DTD/XML Schemas stored in the respective repositories.

Mapping: the "Map generator" and the "mapping" components allow conversion of XML files from one educational standard to another. The "Map generator" component requires as input two XML files of different standards/specifications. The outcome of this operation is a map that allows conversion between these two standards /specifications. The generated map is stored into the "Map database". The inputs to the "Mapping" component are the XML file for conversion and the map. The outcome of this component is a new XML file of the required standard /specification and it is stored into the "XML file repository".

Wizard: the wizard is an optional interface layer between the user and the "XML Editor". This component provides the available features of the "XML Editor" but with some restrictions: it does not allow modification of the XML file structure and therefore the modification of the DTD and the XML Schema files are restricted. The aim of the wizard is to encrypt the complicated operations of EMD management, and to provide an interface where the user just completes values in a number of fields. It provides guidance for creating XML files that conform to the three main IMS, DC and LOM.

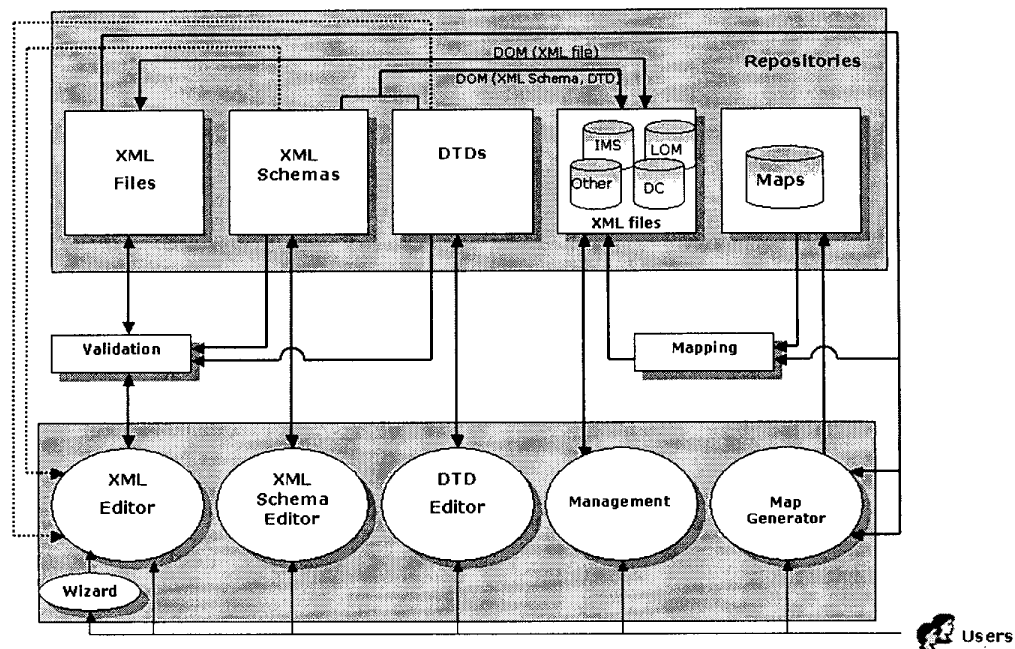


Figure 2 – Architecture for Educational Meta-Data Management

Management: this is a user interface component allowing manipulation of multiple XML files. The component and the “XML files database” are associated, allowing the retrieval, update and sorting of XML files by their element values. The “Management” interface provides the user with a graphical representation of all the XML files stored in the repositories. The user is enabled, with simple commands (sort by, update, select, edit, etc) or with graphical features (e.g. drag and drop), to manage the existing XML files.

4. Conclusions and Future Work

Educational meta-data management is very important for managing educational resources, so that educational e-content can be effectively and efficiently retrieved by on-line learners through e-Learning applications and services. This paper has outlined the basic requirements for EMD management (as opposed to EMD authoring), and has proposed an architecture that can support these requirements.

The ideas presented in this paper have been initiated during the development of an EMD editor (*the EM² tool* [4]). This tool facilitates the creation of new, and the modification of existing EMD files of any EMD standard.

Our on-going and future work in this area involves the extension of the EM² tool, towards the full implementation of the proposed EMD management

architecture; as well as the localisation of EMD management tools, so that they can take into account the different linguistic, cultural, etc, requirements of different countries.

Acknowledgements

The work presented in this paper is partially funded by the European Commission Information Society Technologies (IST) Programme through the IST No 12503 KOD “Knowledge on Demand” Project.

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