

# EHAS Course Editor. A multimedia tool for e-learning course creation.

I. Fernández-Olea<sup>1</sup>, A. Saez-Torres<sup>2</sup>, J. Cid-Sueiro<sup>1</sup>, A. Martínez-Fernández<sup>1</sup>

<sup>1</sup>Departamento de Teoría de la Señal y Comunicaciones. Universidad Carlos III de Madrid. Spain.

<sup>2</sup>Grupo de Bioingeniería y Telemedicina. Universidad Politécnica de Madrid. Spain.

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## Abstract

*The EHAS Program (EHAS stands for "Enlace Hispano Americano de Salud", and could be translated as Spanish-American Health Link or Liaison) works to improve the health care in rural areas of developing countries, using the new information and communications technologies. Although EHAS is intended of the investigation and development of technological solutions to equip rural health centres and health outposts with appropriate communication infrastructure (voice and data transmission via radio), it also takes care about mark up service implementation over these networks (computer based epidemic surveillance systems, remote formation, emergencies management, medicines, etc.). This Project is framed within the continuous formation systems for EHAS's health personnel in rural remote areas, and its main goal is to design an authoring tool for e-learning course creation. The application, called "EHAS Courses Editor", consists of a free and open source document editor, developed in Java, which uses XML for document data support. It will allow creating courses based on a given structure, the EHAS course structure, in a way as easy as possible.*

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## Introduction

The Spanish-American Health Link program (EHAS, *Enlace Hispano Americano de Salud*) is devoted to improve the Health care at rural areas in developing countries (see [1], [2] and <http://www.ehas.org>), using advanced information and communication technologies, providing adequate communication infrastructures (voice and data transmission via radio) to primary assistance rural centres, and implementing mark-up services over these networks (epidemiologic surveillance, distance learning, emergency management, medicines, etc.). The EHAS program is providing access to telemedicine services [3] [4] to areas in developing countries, like the *Alto Amazonas* region, in Perú, with minimal communication infrastructures.

As stated in [5], "providing access to reliable health information for health workers in developing countries is potentially the single most cost effective and achievable strategy for sustainable improvement in health care". The application described in this paper should be understood in the context of the systems for distance continuous training for rural Health staff in EHAS. It consists of an author tool for the creation of e-learning courses with multimedia facilities, and has

been called "EHAS Course Editor". It is mainly a document editor in XML format developed in Java [6] [7] [8]. The tool should allow the creation of documents according to the structure required by EHAS courses, in an easy way and trying to overcome the special features of XML.

The end users of this application will be medical staff at universities associated to EHAS, that will be in charge, in cooperation with the Health authorities at each activity zone, of the continuous training of rural staff whose knowledge about informatics may be poor.

Because of the special characteristics of this context, the application should satisfy the following requisites:

- It should be free and open-source.
- It should be platform-independent.
- The format of the output files produced by the editor should be portable to as much number of computers and operating systems as possible.
- The application should allow the insertion of multimedia resources (images, animated gifs, audio or videos).

The course editor should have a high usability interface, in the WYSIWYG (What You See Is What You Get) style, showing contents to author in a friendly way and

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as similar as possible as they are going to be shown to the students.

In relation to tracking and visualization of courses, it must be noted that, since the EHAS program covers several countries and a large content production is expected, a simple LMS (Learning Management System) has been developed for class organization, content access and location, permission updates, tutorial sessions, discussion forum, student tracking, etc.

The goal of this system, making a difference with other found in the market, is that the platform where the student must work is an exact and individualized copy of the central server, which is updated in a transparent way (for the user) by means of e-mails. This system translates the advantages usually ascribed to virtual rooms (including the student activity tracking) to rural isolated zones in developing countries, without needing real-time connections. The integration of the edition tool into the LMS, in such a way that users with course creator profile can access the courses through the platform and modify them with the EHAS course editor, is still under development.

Besides the editor, a course display tool (EHAS Course Displayer) with full multimedia facilities (supporting images, animated gifts, audio and video) has been developed, and is accessible from the editor. The tools permits the course author to test every time the aspect of the course as will be shown to the student.

The end goal of all these developments is to improve the diagnostic and therapeutic capacity of rural centres by means of a continuous process of rural staff formation. The importance of this stems from the fact that, up to date, no systems to be used in isolated zones with very low connectivity have been developed.

### Structure and Elaboration Process of an EHAS Course.

An EHAS course follows the scheme shown in Fig. 1:

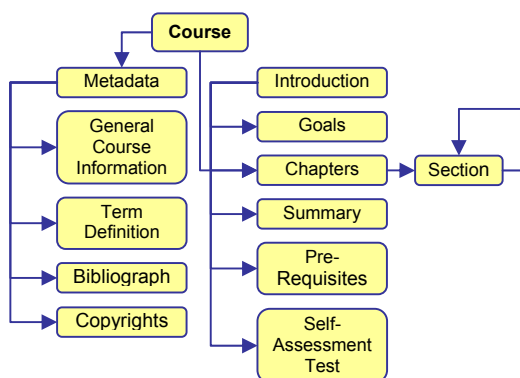


Figure 1: Structure of an EHAS course

An EHAS course may have an introduction, some goals and some pre-requisites. EHAS courses are organized in chapters, and chapters can be divided in a nested structure of sections. The course content is locate inside

chapters and sections, and may consist of text, tables, multimedia resources, etc.

A summary may appear at the end of each chapter or section, or at the end of the entire course. Also, self-assessment tests can be included.

Besides of this, EHAS courses incorporate metadata complementing course information:

- General course data: course title, information about authors, dates, scope.
- Term definitions, providing information about the meaning of technical concepts appearing in the course.
- Bibliographic references.
- Copyrights related to the course contents (multimedia resources, sentences, tables, etc).

The process of composing an EHAS course can be split in three parts:

- **Edition:** Composition of the course content according to the structure established by the EHAS DTD (DTD mailcourse). An XML file representing the course content results from this process. The EHAS Course Editor is a fundamental part of this process.
- **Publication:** course transformation to other formats by means of XSLT transformation engines. This transformation includes the splitting of courses in lessons for its distribution by e-mail. The result of this process is a set of HTML files corresponding to course lessons and the auxiliary files that will permit to present correctly the course in the EHAS displayer. The role of the Editor in this process is to launch the transformations and provide the required parameters to the XSLT files implementing them.
- **Display:** visual presentation of the course in the EHAS Course Displayer. The role of the editor at this part is to launch the displayer with the parameters required to show the course in the correct form.

Fig. 2 schematises this process:

### Design and Development Process of the EHAS Course Editor.

The development process of the EHAS Course Editor started with an exploration and evaluation of existing XML editors. Commercial as well as free and open source XML editors were evaluated. Although commercial editors were not an option to consider (mainly because one of the design specifications is that the tool should be free and open source), reviewing commercial editors was important to determine some directions towards the new design could follow.

The facilities of free open source editors to adapt the requirement of the EHAS distance learning scenario were also evaluated.

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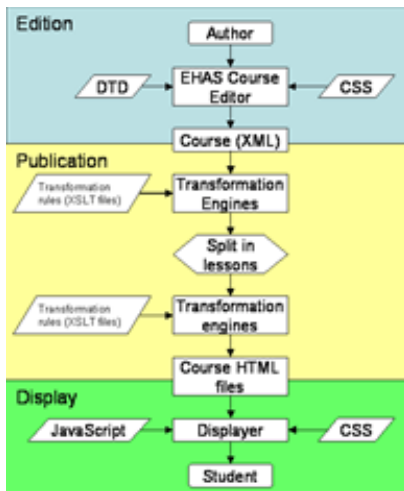


Figure 2: Course production process

Among commercial editors, XMetal, XMLmind XML Editor (XXE) are the most adequate to the EHAS requirements.

Three free open source editors were tested: VEX (Visual Editor for XML), Xerlin (previously called Merlot) and GenDoc.

The result of this evaluation process was twofold: on one side, a set of desirable requirements for the EHAS Course Editor was defined. On the other side, an application that would serve as the basis for the development of the EHAS Course Editor was selected: this application is GenDoc.

In relation to the set of requirements established for the EHAS Course Editor, these are the following:

- Use of valid norms for the W3C (World Wide Web Consortium) or in the validation process by this consortium: XML, HTML, XSLT, XPath and CSS. The use of these technologies for data representation allows separating the system from the physic and logical architectures.
- Portability, that must be understood as the possibility of using the EHAS Course Editor in the following platforms: Windows (98 and subsequent), Unix (Linux) and Macintosh. Java and XML technologies are highly adequate in this context.
- Creation of a free open source application under the premises of GPL (General Public Licence).
- Providing the maximum independence and interoperability between the course structure, its content and its visual presentation. This facilitates reusability.
- To extend the capacities and functionalities of the application serving as the basis for the EHAS Course Editor by preserving, as much as possible, the original architecture.

- In relation to the previous point, propose to the GenDoc development group the integration of the modifications done over the program. All modifications were discussed with the GenDoc development group. The final modification took into account many comments and suggestions from this group.
- Reliability: The EHAS Course Editor must be a reliable and robust tool. It should guarantee an adequate performance, no matter what platform is executing it.

Apart from the former, the EHAS Course Editor must be an easy to use tool, allowing the course edition in a fluent and suitable way, and offering the end user an interface hiding, when possible, the particularities of the XML document edition.

In relation to the course edition process, the requirement of the EHAS Course Editor are:

- The edition and validation of courses based on the EHAS DTD must be possible.
- The document edition process should be analogue to that of many other word processing applications (as OpenOffice). This includes the visual presentation aspects as well as the response to certain keyboard events (as, for instance, the carriage return pulsation).
- The user should be able to reuse courses or content previously elaborated (with this or another tool) to create new courses or adapt existing ones. In this respect, it must be noted that the interchange of course elements among different files elaborated with the EHAS editor is straightforward. Moreover, content created with other tools (as, for instance, MS Word) can be easily adapted by simple cut and paste operations.
- Possibility of presenting in the document style view only some fragments of the course (e.g.: sections) instead of the full document. This makes easy the handling of large size courses.
- Possibility of transforming XML files into HTML format for Web publishing, by applying cascade style sheets to obtain an appealing visual presentation.
- Personalization of the visual presentation of the DTD elements (insofar as this is permitted by the CSS support)
- Graphic support for tables and images.
- Possibility of inserting multimedia resources.
- Automatic insertion of elements. Some DTD components must be inserted automatically when a parent component is inserted. Suppressing some DTD components from the style view (as, for instance, the bibliography components of the term definitions) and providing a graphic interface to be edited.

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- Some DTD components, as term definitions or bibliography components should be editable at any time, but they must be inserted in the appropriate document location so that the document remains valid for the DTD.

The motivation to select GenDoc as the base application for the EHAS Course Editor where the following:

- GenDoc is in a stable development phase. The project maintains a high degree of activity (very recently, version 1.0 beta 5 has been released)
- It has a WYSIWYG interface.
- It is easy and intuitive to use, although preserving some particularities from the edition of XML documents (for instance, in the way of adding components to a document).
- It is highly configurable, thanks to a powerful plugin interface. In spite of this, the interface can be improved, because it only covers document presentation and publishing issues, but not the behaviour of the editor.
- GenDoc can add multimedia capacities by means of the plugin interface.
- The GenDoc documentation is complete enough (API accessible via web, documentation obtained by means of Doxygen, user manual, project documentation with information about the internal architecture). Although not completely updated, it has been a good source for the analysis of the editor source code.

### EHAS Course Editor.

GenDoc XML editor was the starting point to develop the EHAS Course Editor. Several modifications were done to improve performance, that are the response to there main purposes:

1. To show, in the style view, document fragments, instead of the entire document, with the goal of improving performance when handling large size documents.
2. Extending the plugin interface to increase the plugin control over some aspects of the application. Besides the visual aspect of components, the plugin should control the node insertion and the handling of the actions to take when the carriage return of the delete key are pressed.
3. Several bugs in the document edition have been corrected (e.g. depending on the configuration of the screen colours or the version of the Java running environment, an error in the document display prevents to see the editing document) and several existing capacities and functionalities have been improved (e.g. providing the editor with the ability to restore older versions when application errors appear, allowing the user to recover the work done).

To fulfil the personalization process of the EHAS Course Editor and adapt it to the EHAS structure as much as possible, a plugin for the GenDoc Editor has been developed.

Both the GenDoc Editor and the modifications carried out are as much generic as possible, so as to provide the authoring tool a general default behaviour.

Besides of this, another plugin for GenDoc has been developed in order to adapt the editor to the EHAS DTD (*mailcourse*), to provide new functionalities to the editor (graphic support for tables and images), to add new access buttons to the editor functions, and to personalize the visual presentation of the document. In detail, by means of the *plugin*, the EHAS Course Editor has been provided with the following functionalities:

- Interface for access to /modification of general course data.
- Document pre-view capacities, as it would be observed by a student through the e-learning platform.
- Graphic support for tables, images and animated gifs.
- Basic table management capacities: insertion/deletion of rows/columns.
- Graphic support for ordered and unordered lists.
- Graphic support of self-assessment tests.
- Graphic User Interfaces for course metadata edition: general course information, glossary terms, bibliographic references and copyrights.
- Access to the user manual.

Next figure shows the appearance of a document edition with this tool:

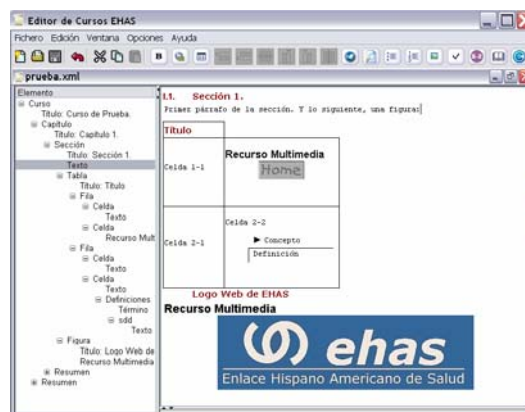


Figure 3: EHAS Course Editor.

An example of the course preview is shown in Fig. 4.

### Editor Performance

In relation to the application, we must note that, although it is mainly a pilot project, it can be considered as a *robust* and *stable tool*. A great effort has been done

to suppress, as much as possible, severe application errors. Also, in order to make easier the trial periods, a mechanism has been provided to the average user to save the work done up to the moment and avoid lost work in case of fatal errors. Besides, a mechanism to report errors automatically to the development team, as well as means for the user to report, by its own initiative, less severe error that could appear in the application, have been implemented.

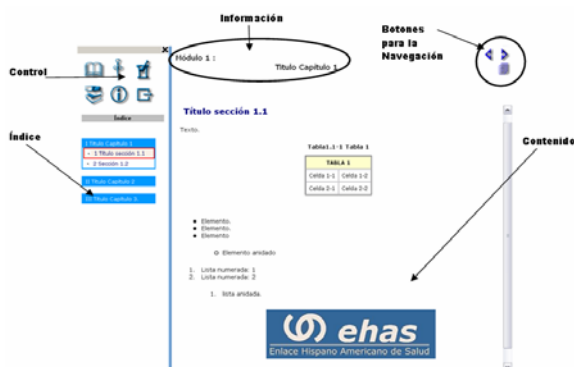


Figure 4: Course pre-view shown by the Editor

Another important feature of this tool is that of being *easy to use*, overcoming some of the difficulties of editing XML documents. An important factor in this respect is the *graphic support*. No one of the existing tools analyzed and mentioned before has, by its own, a graphic support of images, animated gifs and tables. GenDoc do has some *plugins* providing the tool a graphic support for images, but, among free and open source tools, no one, as the EHAS Course Editor, provides graphic support for tables. Moreover, additional support for other multimedia capacities as videos and audio play is being planned. At present, the editor allows the insertion in the document of any type of multimedia resource, because all of them as supported by the course displayer. However, they are only shown

Another factor of the major importance is the behaviour of the editor in handling documents. In the majority of free editors that have been analyzed, including GenDoc, the edition control is carried out, at most, by means of the mouse and contextual menus, which is the most direct way to insert elements in the document. Also, each component and associated sub-components are introduced one-by-one, even though they may be complimentary. This makes editions unnecessarily cumbersome, and removes the user from the feeling to be editing a document as in a classic word processor. The EHAS Course Editor incorporate a mechanism of *automatic component insertion*, in such a way that, when a new component is inserted, all complimentary subcomponents are inserted automatically. For instance, when a Chapter or Section element is inserted, the title is automatically inserted. Tables are especially remarkable. While, in other editors, DTD components of a table must be inserted one-by-one, the EHAS

Course Editor does this work automatically, just by indicating the number of rows and columns in the table. Besides of this, several buttons have been included in the task bar making easy the insertion of the most common elements, as images, tables, glossary terms, etc. Even, the editor behaviour after several key pressing actions has been modified (carriage return, backspace or tab key) in order to make it similar to conventional word processors. All this contributes the user to feel being editing a document, not an XML file.

The memory load of the editor should also be mentioned. One of the first goals established for the application was to reduce the memory load in GenDoc. After analysing the execution of GenDoc with monitor software like Jprofiles, it was observed that most memory resources was used by the presentation in the style view. This suggest to reduce the number of elements to present so as to reduce the machine load. The EHAS course editor implements a mechanism to present, in the style view, only those sections or chapters that have been selected in the tree view of the document, instead of the full document. The result of this strategy was a great success. While the base editor (GenDoc) cannot handle files beyond 500Kbytes, the EHAS Course Editor can handle up to 1.7 MByte files. The memory consumption of the EHAS Course Editor is clearly lower than that of GenDoc.

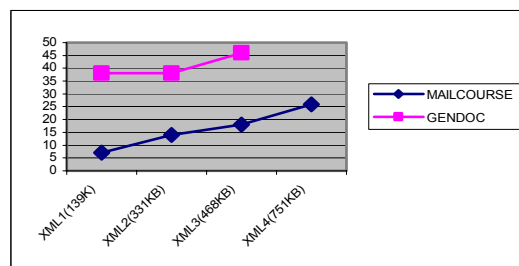


Figure 5: Memory Consumption

The benefit of this memory reduction are the ability to handle more easily small documents, to preserve open a larger number of documents, and to be able to handle large size documents. However, this process is not yet fully optimized, because the node insertion times are slightly higher that those in GenDoc. Besides of this, the time consumed to change sections should be added. In spite of this, these performance reductions are compensated by the mentioned benefits.

Another remarkable feature of the EHAS Course Editor is the possibility *to transform courses to HTML* and display them in conventional web browsers and, also, in the EHAS Course Displayer. Moreover, the transformation takes into account that the course could be distributed by means of e-mail connections (each course is divided in its compounding lessons). While most tested editors can transform courses to other formats, like HTML, these transformations are not valid for the purposes of EHAS, because nor they can generate the files with the lessons, for the e-mail distribution, nor they can generate the files required for the course display in the "EHAS Course Displayer".

This is the reason to adapt the existing transformations in EHAS and integrate them in the editor.

Finally, it is important to note that the internal architecture of the original GenDoc program was preserved. All new built-in functionalities (as, for instance, the automatic node insertion) have been integrated by means of the plugin, enforcing the extension of the plugin interface in GenDoc. The remaining improvements as, for instance, the restoration after errors, has been carried out in the main program and, at present, are being evaluated by the GenDoc team for the integration in future versions of the application.

### Conclusions.

A new authoring tool has been developed that is free, open source, platform independent, oriented to e-learning courses with the structure of the EHAS DTD and, also, that can be displayed with the display tool developed by EHAS. Besides, taking into account the low connectivity conditions of most students that will receive the EHAS courses; they will be distributed by means of e-mail connections.

This tool has been developed in Java using XML data formats and is based in a previous development: GenDoc.

Even though, in order to obtain the best editor performance, the editor must observe the course structure given by the EHAS DTD, this is flexible enough and has a sufficient number of elements to match the requirements of other organizations. In fact, the EHAS Course Editor is being used by other educational projects, as MEDEA (Universidad Carlos III de Madrid, Spain), or the project for nurse (in emergency door) formation by the FUDEN organization in Rep. Dominicana. Also, any person can analyze the source code developed by EHAS to improve it or adapt it to his own needs. Besides, in order to cooperate with the international community, the source code is distributed freely, and any code derived from it should also be released.

### Future work.

With the aim to get an editor easier to use and more appealing, to take advantage of the multimedia capacities and overcome the XML format underlying the document, several improvements are being stated:

1. The possibility of configuring the tree view, so as it shown only those DTD components selected by the user.
2. Improving the CSS support. The visual presentation is expected to be delegated to CSS as much as possible, and give support to CSS 2.
3. Adding support to XML Schemas, because they present some advantages with respect to the DTD.

4. Improving the table management. New functions will be added to combine and split cells, select different types of borders, etc.
5. Improving the multimedia resources support, by providing the editor the possibility to modify images as well as give support for the reproduction of sound and videos.
6. Adding the possibility of transforming documents to PDF format.
7. Adding an application update mechanism that verifies periodically if there are new versions and download them.

### Acknowledgements.

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