Edukalibre: a tool for collaborative creation of educational material

Luis López*, Jesus M. Gonzalez-Barahona, Diego Chaparro, Teófilo Romera and Luis Cañas

Grupo de Sistemas y Comunicaciones (GSyC),
Universidad Rey Juan Carlos, c/Tulipán s/n,
28933 Móstoles (Madrid), Spain
E-mail: llopez@gsyc.escet.urjc.es E-mail: jbg@gsyc.escet.urjc.es
E-mail: dchaparro@gsyc.escet.urjc.es E-mail: teo@gsyc.escet.urjc.es
E-mail: lcanas@gsyc.escet.urjc.es
*Corresponding author

Abstract: Libre Software, with its characteristics and its particular development model, has promoted the birth of a novel set of team work methodologies. In this direction, the Edukalibre project imports and adapts those methodologies to apply them to the creation and management of educational contents. With this purpose, we have developed a system, which provides users with mechanisms for the collaborative authoring of documents. The system automatically converts to and from a wide variety of document formats, including editable ones like DocBook/XML, OpenOffice.org and LaTeX, and printable formats like PDF, postscript and HTML.

Keywords: architectures for web-based education delivery environments; collaborative development of learning material; Libre Software development model; open source; version control systems.

Reference to this paper should be made as follows: López, L., Gonzalez-Barahona, J.M., Chaparro, D., Romera, T. and Cañas, L. (2007) ‘Edukalibre: a tool for collaborative creation of educational material’, *Int. J. Continuing, Engineering Education and Lifelong Learning*, Vol. 17, No. 1, pp.15–32.

Biographical notes: Luis López obtained his PhD in Electrical and Electronic Engineering at Universidad Rey Juan Carlos in 2003 and his MS in Electrical and Electronic Engineering at Universidad Politécnica de Madrid and at ENST Télécom-Paris in 1998. He is author of more than 50 publications including ten papers published in different research international journals and 20 contributions to conferences and workshops.

Jesus M. Gonzalez-Barahona received his PhD in Electrical and Electronic Engineering on 1998 at Universidad Politécnica de Madrid. He is currently Associate Professor at Universidad Rey Juan Carlos. His research interests are concentrated on open/libre software engineering, in particular in conceiving quantitative studies of open/libre software developments and on the applications to education of libre software methodologies and practices. He has supervised more than ten research projects with public funding (Spanish CICYT, Framework Program, Minerva, etc.) and private funding

(Telefónica I + D, Construcciones Aeronaúticas, etc. He is author of more than ten papers published in national and international journals and 35 contributions to different conferences.

Diego Chaparro is preparing his PhD in Computer Science at the GSyC group in Universidad Rey Juan Carlos. Meanwhile he is collaborating in the Edukalibre European project.

Teófilo Romera has a MS in Computer Science by Universidad Rey Juan Carlos, where he is currently preparing his PhD. His main research interests include libre software engineering and distributed tools for collaborative work using the internet.

Luis Cañas is a Computer Science student at Universidad Rey Juan Carlos. He is currently collaborating in the development of the Edukalibre Project.

1 Introduction

The introduction of internet technologies in general and the World Wide Web in particular has changed the way people interact. This revolution is having a deep impact in all aspects of human life and its changing the way we work, the way we relate and also the way we learn. Nowadays, information and learning contents may be available at any time, at any place to any interested user. Regarding this, many academic institutions and industrial training organisations are exploring the possibilities of applying information technologies to their educational processes including the internet, multimedia content, streaming technologies, etc., (Adelsberger et al., 2002; Rosenberg, 2001; Horton, 2000).

In this context, the application of web-based learning systems is becoming extremely popular in all kind of educational institutions around the world. This is mainly due to the fact that the deployment of this kind of solution is easy and cheap and does not require any advanced skills to be accessed by users. Besides, it incorporates all advantages of internet technologies including possibility of rich and multimedia contents, asynchronous learning and collaboration, etc. Just as an example, more than 85% of US educational institutions plan to establish some kind of web-based distance education system (http://www.ed.gov) for the design and development of online course-ware to offer online credit and non-credit academic and short-term certificate training courses of various types.

Currently, most of those systems are used for re-enforcing or complementing traditional teaching techniques. For this reason they are mainly based on the instructor/trainer vs. student/learner paradigm. This is why the vast majority of educational web-based systems are conceptually designed for the e-learning-by-e-reading model and are build as large monolithic structures that are fixed in length, sequenced and scoped, non-flexible for continuous updates, difficult to organise, non-reusable or hard to reuse, etc (Uskov, 2003). For these reasons, new educational paradigms for web-based learning systems are currently emerging. Novel methodologies and architectures are being investigated to provide more effective mechanisms for the creation, sharing and reuse of educational resources on the web. In particular, there is a need for innovative self-controlled and self-paced learning techniques based on the learning-by-doing model of education in a collaborative environment.

In this paper we propose one of these architectures, whose objective is to use a set of methodologies resembling those used in the Libre (free, open source) Software projects. The Libre Software development methods have tremendously changed the way software is being produced and deployed (Bezroukov, 1999; Hassan et al., 2001). These methodologies are mainly based on the existence of strong communities of practitioners who share experiences, code and knowledge and constantly help each other. It has been successfully applied in a large number of domains including operating systems (Debian, FreeBSD, Fedora), desktop environments (GNOME, KDE), web browsers (Mozilla, Firefox), web servers (Apache) or office suites (OpenOffice.org) (Germán, 2003; González-Barahona et al., 2004; Reis and Mattos Fortes, 2002; Lameter, 2002). It is now clearly recognised that the Libre Software approach have led to revolutionary methods for producing programs and advancements in software development (Raymond, 1997; Koch, 2004).

We want to remark that there are many similarities between the Libre Software development approach and some novel techniques of collaborative learning. In fact, there are authors proposing that the activities occurring on Libre Software communities can be seen as a learning process where the involved parties contribute to, and learn from, the rest of the community (Edwards, 2001). Hence, the application of these methodologies in educational environments could have a great impact of the way the web is used for teaching and learning. For this reason, we believe it is extremely important that the educational community becomes aware of the potential of the libre development model.

There is a growing interest to adopt aspects of the open development model into the learning process. The first steps are being undertaken by leading educational institutions such as MIT (http://ocw.mit.edu/index.html), Carnegie Mellon University (http://www.cmu.edu/oli/), and Harvard (http://ocp.hul.harvard.edu/), which challenged the traditional way of thinking (according to which teaching materials were available only to students enrolled in the courses) and provided freely available, high-quality academic content on the web. Economical and technological factors favour this approach including marketing and reputation benefits, wider spread of innovation and knowledge in society, possibility of getting feedback from professionals and students all around the world, etc. This open learning content idea is being taken on board with great enthusiasm and implemented in a number of projects including Open Learning Support, MIT OpenCourseware (http://ocw.mit.edu/index.html), Open Learning Initiative (http://www.cmu.edu/oli/), etc.

This idea of making contents universally available could produce a revolution in education similar to the one brought by the Libre Software concept in the software industry. Nevertheless, for this revolution to fully happen, open learning contents are not enough. Libre Software cannot be only understood in terms of accessibility to the source code. There are deep issues related to the way the different agents coordinate forming a community and obtaining a benefit by cooperating. The process by which this community grows and synergies are formed is intriguing and not fully understood yet. Nevertheless, we postulate that by providing similar facilities than the ones available for source code development, an analogous phenomenon could occur in the field of educational content generation. Remark that this hypothesis is reasonable given that a similar philosophy is successfully being applied to knowledge generation in initiatives like Wikipedia (http://en.wikipedia.org/wiki/Main_Page).

The idea of producing collaborative learning in a community is not new. Some authors (Wilson and Ryder, 1996; Irvine and Brna, 2003) describe a dynamic learning community as one in which control is distributed amongst autonomous members who may engage in flexible and negotiated learning activities and high levels of dialogue, interaction and collaboration with a commitment to the generation and sharing of new knowledge. In these works it is also recognised that by promoting creativity, innovation and collaboration and by supplying the ability to modify contents, the community is able to diagnose and address most learning needs. Nevertheless, they not clearly establish the mechanism by which this promotion may occur.

Table 1 Differences between the organisation of a classroom and a learning community

Isolated class structure	*Learning community*
Homogeneous groupings	Heterogeneous grouping
Class discipline	Community organisation
Competition	Collaboration
Knowledge delivery	Knowledge construction
Teacher centred	Student centred
Independent, individual work	Interdependent, teamwork
Expertise flows from 1-to-many	Expertise flows in many directions

Source: http://www.cmu.edu/oli/

We propose to fully develop the Libre Software idea in education to make this happen. Until recently, technical challenges made it very difficult to support truly open, dynamic, educational resources constructed collaboratively by large groups of teachers and even students. The Libre Software community has created a vast amount of technologies to support their practices. These support the multiple communications necessary to enable people at differing locations and times to work together and function as a group. However, these technologies have not been explored in the educational context due to diverse reasons. First, they are suitable for software developers but are not intuitive enough to be adopted by average teachers and students. Second, they are designed to tackle small tasks, which are convenient for developers who have the habit of using several complementary tools, but its inappropriate for teaching and learning communities.

In this context, it is clear that novel tools are needed to effectively support the collaborative construction of open educational resources. A web-based system seems to be the natural choice to implement them for two reasons. Firstly, this technology offers the possibility of integrating all kind of contents and formats. Secondly, it is widely spread and it does not need any specialised training for users. Moreover, these tools should themselves be Libre Software to guarantee the appropriate customisation and deployment using the same open collaborative concept. In this paper we propose an application fulfilling all these aspects. We describe a novel, truly open platform to support the creation of free, collaborative constructed educational content on the web, which has been deployed within the Edukalibre project? The project is aimed at examining the connection between Libre Software development and creation of open content for education. It is funded by the European Commission under the Socrates/Minerva program (http://europa.eu. int/conun/education/progranimes/socrates/ minerva/indla_en.html). The project started on October 2003 is expected to last until

December 2005. It is coordinated by University Rey Juan Carlos (Spain), and includes partners from University of Leeds (UK), University of Porto (Portugal), University of Karlsruhe (Germany). The project website is http://www.edukalibre.org.

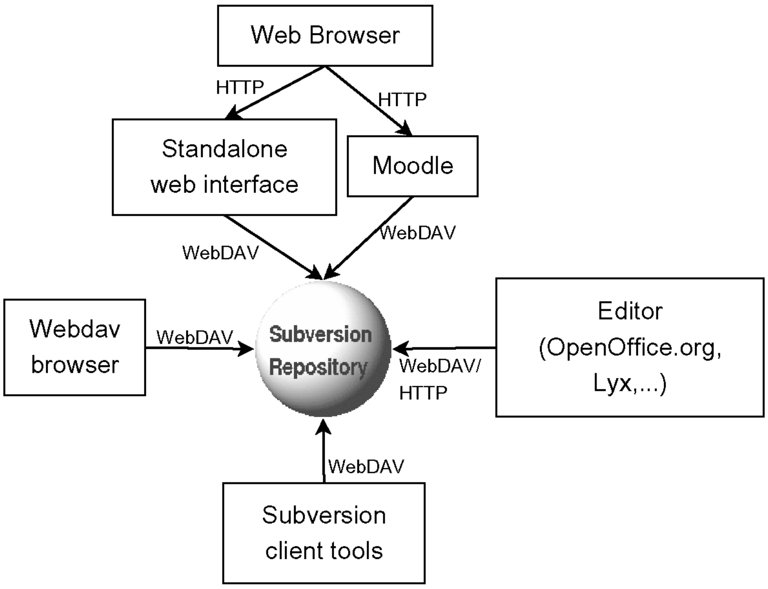
We wish to remark that the main focus of this project is on the problem of collaborative educational content creation. For this reason, the Edukalibre system cannot be seen as a full featured Learning Management System (LMS), covering the whole learning process, as the ones described by popular standards like SCORM (http://www.adlnet.org/). Hence, the functionality provided by our application is orthogonal to the requirements specified in those standards in the sense that, once the learning contents have been generated, they could be easily used in a SCORM compatible LMS or not, depending on the final user wishes.

The Edukalibre System is described in the rest of this paper. Firstly a brief, non-technical description of the core architecture is presented. Then, a detailed explanation of most of the functionality the system is shown. After that, some examples of real use of the Edukalibre System illustrate how the system can help teachers and students in real scenarios. Finally, conclusions about this work are extracted.

2 Architecture

The Edukalibre project has created a platform, which involves several tools, applications, and communication protocols that interact with each other. Most of these tools and protocols are widely available and commonly used Libre Software tools. So, our main work in the creation of the platform has been to implement some glue software to make the interaction of the tools work. Besides, some of these tools have been improved and also specific tools have been created exclusively for the system. Figure 1 shows the different components of the Edukalibre System and how these interact.

Figure 1 Components of the system



The system is divided in three levels, one of them, the document repository, may be considered the core. The second is a group of tools, which deal with automatic conversion of documents to end-user formats. Finally, the third main component is a set of different user interfaces, which allow users to access the system.

2.1 Repository manager

The repository manager is the core of the Edukalibre System and also the heart of the collaborative editing tool. It provides the main functionality of the system storing the documents and providing information about them.

The system deals with two kinds of documents: base format and end-user format. Base format documents can be edited and modified by users (like DocBook/XML (http://www.docbook.org/), LaTeX (http://www.latex-project.org/) or OpenOffice.org files). End-user format documents are generated automatically from the base formats and are not editable (like Postscript, PDF, HTML, etc).

The core repository is basically a storage system in which documents, together with information (author, dates, etc.) about them, are stored. This repository is basically composed by two elements: the version control document repository and the end-user repository. The former stores the base formats and is implemented with a Subversion (http://subversion.tigris.org/) repository with additional plug-ins, while the latter hosts solely the end-user formats and consists on an HTTP server hosting compiled versions of the documents.

The repository manager provides methods to extract meta-data information about the stored contents including:

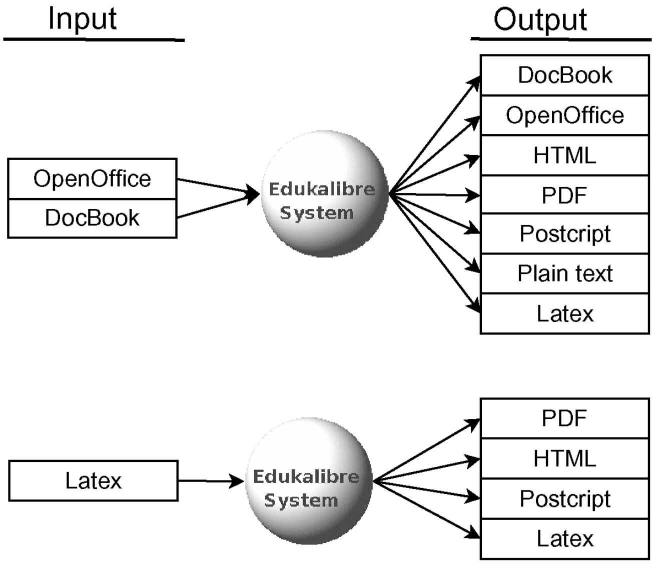
- listing of documents included in the system
- information about the history of each document (including versions, authors, dates, etc.)
- log files from the conversion process of each end-user format generated
- general properties for each document (including base format, title, abstract, etc.).

2.2 Conversion tools

Documents are the cornerstone of the Edukalibre System and there are number of tasks that are automatically carried out when a document is uploaded to the system. One of the most important of them is the document conversion to several formats. As we have explained in Section 2, each base format document is automatically converted to a set of pre-defined end-user formats.

Each time a new document, or a new version of an existing document is uploaded to the repository an automatic format conversion is launched. In this case, the system follows these steps. First, the document is validated to check that it fulfils the specified base format. If the document is valid, it is stored in the subversion repository. After that, it is converted to the end-user formats, which are finally stored in the end-user repository. It is important to notice that only base formats of the documents are stored in the control version repository. Thus, the system is capable of maintaining version control for them, but not for the end user formats. The schema for conversions between formats is given in Figure 2.

Figure 2 Conversion formats



2.3 Interfaces

The modularity of the system makes it accessible via different interfaces, with different functionality for each of them. For example, the repository manager (Subversion) allows the access via WebDAV protocol, which provides a very powerful way to carry out a variety of important tasks like accessing the history of a document or committing a new version of a document. In order to do so, the user should use a WebDAV capable browser (like Nautilus) or editor (like OpenOffice.org).

Besides, the system can also be accessed with a standard web browser via an HTTP interface, which has been specifically developed from scratch within the framework of the Edukalibre project. This web interface is called Collab. Collab allows authenticated users to manage documents easily and intuitively. For example, users may see the history of a document, access the different formats of each version for each document or upload a new document or a new version of some documents. Collab can be installed as a stand-alone web interface, which may be integrated seamlessly in any PHP site. It can also be used from a Course Management System like Moodle (http://moodle.org), for which we have developed a special module suitable, to be installed and fully integrated in any Moodle site.

3 Functionality of the Edukalibre System

The Edukalibre System is just one of the products issued in the Edukalibre project. As we have explained in the previous section, this system offers simple and flexible ways to collaboratively create educational material, or other documentation. The system provides some key functionality, which make it suitable for several learning scenarios. The Edukalibre System has been designed a developed with flexibility and ease of use in mind. In order to adopt these two basic characteristics, freedom on the user election is maximised whenever tools or interfaces have to be chosen. We provide a heterogeneous and varied set of possible choices to guarantee that all different possible needs are covered. The ease of use is achieved partly through this flexibility. As such a wide range of tools are available, an average computer user will be able to easily understand at least one of our interfaces, which are mainly based in popular and widely extended tools such as web browsers, WYSIWYG editors, text documents, etc. The Edukalibre System also tries to achieve ease of use incorporating automation of many tasks. To offer a clearer image of how we achieve this flexibility, we devote the following subsections to introduce the key functionalities and features of the Edukalibre System.

3.1 User-system interaction

The Edukalibre System is intended to support access from as many different interfaces as possible. In this way, we try to minimise the training time users need to be able to use it. As we support different kind of front-ends, we give users the chance to choose the way they interact with the system, reducing the learning curve. At the same time, we avoid non-expert users to shrink back when faced to a novel technology like this. This is especially important for newcomers who prefer a less powerful but friendlier tool to develop contents.

In the same way, an expert user highly skilled may wish to access most advanced features. In this case, she could possibly want to approach the system using more sophisticated tools allowing extended functionalities. For this reason, we also supply this possibility, which, of course, requires higher expertise and training.

There are basically two kinds of tools that may be used to interact with the system. The first one is the editor, which is suitable to edit, modify or create a document. The other is the system front-end, which is used to access the management interface for documents, which allows performing tasks such as uploading and downloading documents to and from the system.

Software editing tools (text processors) are an important part of the document creation process. People use them commonly and they have become essential to companies and organisations where most workers, highly skilled or not, have learnt the basic use of, at least, one editing tool. Editors are available for almost any computer architecture and operating system, and there are a huge variety of them. The Edukalibre System tries to cope with documents created with as many different editors as possible. This guarantees flexibility and maximises the choices for the users.

- *WYSIWYG editors*. This kind of editors can show a trustworthy representation of the final look of the document at the time of editing it. This is why these editors are more friendly to users and easier to learn. There are several different WYSIWYG editors for creating and editing each of Edukalibre's base formats. You can use Lyx for LaTeX documents, Conglomerate for DocBook/XML ones and OpenOffice.org (http://openoffice.org) for DocBook/XML and, of course, native OpenOffice.org documents. Other offimatic applications supporting the edition of any of our base format could also be used. Sometimes, WYSIWYG editors lack features requested by advanced users. In this case, other solutions should be adopted.

- *Text editors*. A more experienced user may be familiar with one of the system base formats so that she can feel comfortable directly editing the source. This is possible in DocBook/XML or LaTeX documents and gives the chance to have a better control over the final content and style of the document. That user should, of course, have some specific knowledge about the ins and outs of those formats, and this may harden the learning process. In any case, once some basic skills are achieved, users soon find that this is a more powerful and flexible method to create or edit documents. There are a wide variety of choices when it comes to use one of these editors. From VI to Emacs, many of them offer very convenient features like automatic tag completion, syntax highlighting, auto indentation, DocBook/XML validation, etc.
- *Online editing.* There is a third choice allowing editing or creating documents directly over the Edukalibre System online web font-end. In this case, the only tool a user needs to edit or create a document in the system is a web browser. This supplies a high flexibility to the system since almost any device connected to the internet has a web browser available. We may imagine an application scenario in which an author is visiting a friend. Talking to his friend, she has a new idea for a document she is working on. She could pick a piece of paper and write down some notes to remember the ideas later. But she also could borrow his friend's computer and put them directly on the real document in that very moment. It does not matter if his friend's computer does not have his favourite editor or even his favourite operating system. Probably that computer would have a web browser, and that should be enough to edit the documents when using our Edukalibre System. In this way, the rest of the authors collaborating in the same document would see the latest additions from his colleague as soon as they have been written, and probably more faithfully too, since the author did not have to wait to improve the document running the risk of forgetting the idea. The Edukalibre System offers several types of online editors via its web interfaces. One of them uses a WikiWiki syntax, which allows editing in a very easy way. There is another possibility, which is based on Collab, our php-driven interface, which works like a simple text editor except it is used through a web browser. We will see more details about the Collab interface later in this paper.

As we stated before, besides editors, there is another kind of tool, which lets the user interact with the Edukalibre System. Editors are just for editing creating documents. Uploading a file, keeping track of its changes or reading the comments that the rest of the authors let in the uploading log, are tasks that most of those tools cannot handle. For this reason, the system offers another set of different interfaces with that purpose. Once again, diversity is preferred in order to achieve as much flexibility as possible. Following this philosophy, it is important to offer different ways of doing the main tasks trying to cover as many approaches as possible. The described tasks include uploading and downloading files, accessing to the current and previous versions of a document, checking differences between two versions of a document, etc. The most important and critical features of the system can be accessed through any of the available interfaces. For example, all of them deal with authentication or offer automatic format conversion. In any case, it is guaranteed that the use of one or other tool cannot break the consistency of the documents.

In the next paragraphs we present the interfaces that the system offers to upload or retrieve documents.

- *Web browser*. Our Collab web interface also acts as a front-end to the repository manager. When anyone connects to the system through it, she can see the list of available documents. For each document, there is a box presenting some useful information about its latest release. This information includes:
    - the title of the document
    - the author (if there are more than one, the first one is shown)
    - the abstract (if there is one)
    - the base format in which the document was created and links to the compiled versions of the document
    - links to the log files generated during the conversion (compilation) process
    - a link driven to the Document's page, in which there is a HTML formatted complete view of the document
    - a link to the online editor, allowing to directly modifying the document
    - a couple of links pointing to a page with information for every previous version of the document, and to a ViewCVS web interface for the repository.
    - a link to a page with information on how to download the document from a command line SVN client
    - a link to a page holding all the images of the document (just in case it had any).

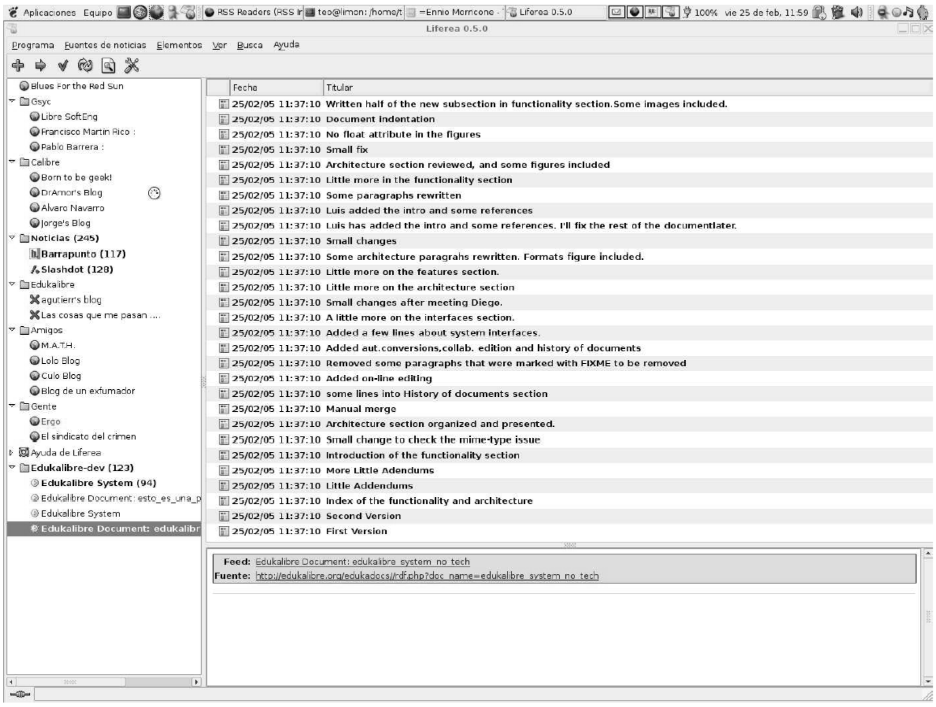
  Anyone with an account in the system could just log in and modify, create or upload documents. Of course, by doing any of those tasks, new versions of the different formats that the Edukalibre System supports would be generated and made available online instantly.

- *WebDAV editor/browser*. The Edukalibre System is also accessible through the WebDAV protocol. WebDAV is a set of extensions to the HTTP protocol, which allow users to collaboratively edit and manage files on remote web servers. This kind of technology is available in many ways. It is included in some web browsers, editors (Emacs, OpenOffice.org) and file managers (Nautilus). This brings to the system a lot of new possibilities since documents can be accessed with any of these WebDAV clients. For example, consider Nautilus and Openoffice.org. Nautilus is a file manager, which is part of the GNOME desktop. When a file manager supports WebDAV, this means that you can visit and navigate any remote WebDAV repository with it in the same way you would do with the files of you hard disk. You could then use Nautilus to see the contents of an Edukalibre repository. After browsing for a while, you could also choose an OpenOffice.org document, which is being maintained by the system, and open it. A new OpenOffice.org window should appear and you could edit that document. After that, you could save your changes as usual. Those changes would be committed in the repository the original file came from. In the case of Edukalibre, this is just another way of interacting with the system. The rest of the features remain intact and are complementary to this one. This means that, just like through the web interface, if an author modifies or creates a document in this manner, the automatic format conversion takes place as well. We wish to remark that there is also user control for the WebDAV access.

- *SVN tools*. Most common clients to Subversion repositories are programs executed from a command line interface. There are also a few graphical clients for Subversion, but they are still in early stages of development and its use is not recommended. Expert users may prefer this mechanism to graphical front-ends like web interfaces. In this way they may be more productive and one of Edukalibre's objectives is to allow anyone to become as productive as possible. The use of the command line interface does not diminish any of the system's capabilities previously cited. There is still an authentication layer and an automatic format conversion is carried out.

- *RSS*. There is an extra interface to the system, which lets users stay tuned to what happens in the Edukalibre System. It may not be considered a full-featured interface because it only supports reduced functionality. This extra interface is RSS channels. There is one for the entire system, which will generate a new announce in the channel for each new document. There is, as well, a channel for each document, which will generate a new, announce each time the document is modified. You could use your favourite RSS aggregator (like Straw or SharpReader) to keep up to date on what is happening to a document you are interested in. This way, you could find out if a colleague, who is working with you in the elaboration of a document, has added anything to that document recently without the need of using any of the other more complex interfaces. News in a document channel includes useful information like the log of the last modification made to it (Figure 3). Of course this is not a true interface to the system as long as you cannot access Edukalibre to modify or create documents through it. But it is indeed a way to interact with the system given that you can get information from it.

Figure 3 Liferea news aggregator keeping track of an Edukalibre document



Fecha	Titular
25/02/05 11:37:10	Written half of the new subsection in functionality section.Some images included.
25/02/05 11:37:10	Document indentation
25/02/05 11:37:10	No float attribute in the figures
25/02/05 11:37:10	Small fix
25/02/05 11:37:10	Architecture section reviewed, and some figures included
25/02/05 11:37:10	Little more in the functionality section
25/02/05 11:37:10	Some paragraphs rewritten
25/02/05 11:37:10	Luis added the intro and some references
25/02/05 11:37:10	Luis has added the intro and some references. I'll fix the rest of the documentlater.
25/02/05 11:37:10	Small changes
25/02/05 11:37:10	Some architecture paragrahs rewritten. Formats figure included.
25/02/05 11:37:10	Little more on the features section.
25/02/05 11:37:10	Little more on the architecture section
25/02/05 11:37:10	Small changes after meeting Diego.
25/02/05 11:37:10	A little more on the interfaces section.
25/02/05 11:37:10	Added a few lines about system interfaces.
25/02/05 11:37:10	Added aut.conversions,collab. edition and history of documents
25/02/05 11:37:10	Removed some paragraphs that were marked with FIXME to be removed
25/02/05 11:37:10	Added on-line editing
25/02/05 11:37:10	some lines into History of documents section
25/02/05 11:37:10	Manual merge
25/02/05 11:37:10	Architecture section organized and presented.
25/02/05 11:37:10	Small change to check the mime-type issue
25/02/05 11:37:10	Introduction of the functionality section
25/02/05 11:37:10	More Little Adendums
25/02/05 11:37:10	Little Addendums
25/02/05 11:37:10	Index of the functionality and architecture
25/02/05 11:37:10	Second Version
25/02/05 11:37:10	First Version

Feed: Edukalibre Document: edukalibre_system_no_tech
Fuente: http://edukalibre.org/edukadocs//rdf.php?doc_name=edukalibre_system_no_tech

3.2 History of documents

The collaborative creation of any kind of document brings a new set of problems that the Edukalibre System tries to solve. When various authors work in the same document there is a need to have a strict version control. Keeping track of changes made to the documents and having mechanisms to undo those changes when needed, is a must. Also, these authors may not meet frequently due to geographical constraints. Furthermore, they may even not know each other. This is how a version control system becomes another form of communication between them. Whit it, authors can show changes to their colleagues in a fast and clear way. This is why version control is a crucial feature in the Edukalibre System.

During the life of a document, there is a set of modifications that lead to newer versions from time to time. The Edukalibre System stores each of these changes during the whole lifecycle of the document. This mechanism offers the possibility of tracking the different versions, reviewing old versions or comparing between them to see the differences.

The idea of having such a version control mechanism for the creation of documents comes from the way Libre Software is developed. Like in software development, an Edukalibre document has its main branch, the author creating it is the only one having rights to modify it. Once a document has been created, authors can decide the set of users who may access it. This means that an author could allow a user to modify a document. In this case, the reader becomes contributor and has write permissions on the document. This kind of interaction helps to make more complete documents, since feedback from many sources is easily accepted this way.

As in other types of version control systems, the core of the Edukalibre System offers the possibility of creating branches of stored documents. For instance, if a contributor has some new ideas for a document, a new branch could be created. This way, the authors could maintain two branches with similar documents but different characteristics, maybe aimed to different readership. It would be possible to decide what should be in each branch, keep them isolated or even merge them in the future.

3.3 Automatic conversions

One of the main targets of the Edukalibre System is to keep as flexible as possible. The world of computers is nowadays quite complex. There is a wide variety of architectures, operating systems, software, etc. There are also a huge number of different formats for electronic documents. Each of these formats has their very own characteristics and is aimed to cover different needs. Some formats are better for web publishing, others are good for printing and others have a more comfortable editing process. The Edukalibre System copes with many of the most popular and useful formats to ensure flexibility and portability of the document it holds.

When a user commits a change to the Edukalibre System, the document is automatically transformed to different formats: PDF or PS for better printing, HTML to be published on the web, simple text which is very portable and OpenOffice.org which allows users an easy edition (the source formats for the original documents, and the final formats which the Edukalibre System can generate for each version of a document can be seen in Figure 2).

By default, these final formats are generated each time a document is modified. But the user can decide which final formats will be generated at any given version. A user may also choose not to obtain final formats in each modification. It may happen that an update of the document is needed but no automatic conversion is desired at all. The final formats of any of the releases could be obtained at any latter moment.

3.4 Collaborative edition

One of the main features of the Edukalibre System is the possibility of collaborativelly create and elaborate documents. This means that the system supports several different authors working in the same document, which may even live in very distant locations. This is not an obstacle for the Edukalibre System since it provides mechanisms for the interaction between authors further than the simple and chaotic mail exchange.

A document in the system can be modified at any time. Instantly a new version is generated and any user could see the new document. But what happens when two or more authors try to commit changes to a document at the same time? If they have been working in different sections of the document, the system just merges both version and creates a new one containing all the changes from both authors. Just in case both of them had changed the same part of the document the system would warn about that fact and would not store the latest changes. So, this kind of conflict would be detected but not solved by the Edukalibre System. There is clearly the need for human supervision. One of the authors would be required to solve the conflict *manually.*

This kind of collaborative interaction is clearly better than prior methods. Flow of new versions between authors is much faster now, since any of them could get the latest version from the system at any time, and checking the system as frequently as desired. Flow of information and exchanging of ideas between authors is clearer now. With the Edukalibre System authors do not need to explain what they would like to do with a document. They could just do it and show it to the rest of the authors. There is always the chance to just go back to any previous state of a document.

4 Edukalibre using scenarios

The Edukalibre System is designed to be used by teachers, students, researchers or any other contributor willing to create educational material in a collaborative way. It provides efficient and useful ways to cooperate in the writing of documents, and a variety of different tools to facilitate all the tasks related with the writing, review and management of documents. Next we present a detailed description of common using scenarios of the Edukalibre System.

- *Write a new document*. When a user wants to write a new document, some decisions have to be made. First of all, the user has to choose the format she wants to write the document in. At the moment, the system supports three base formats: DocBook/XML, LaTeX and OpenOffice.org. After that, the user has to select one editor to write the document. For example, a user may wish to write the document in DocBook/XML format, and in that case she could choose a simple text editor (like emacs or gedit), the OpenOffice.org editor (which is capable to import and export documents from and to DocBook/XML) or the simple online editor available at Collab.

The choose of one or other depends on the situation, the internet connection, or even the technical knowledge of the user at every moment. The user could work on the document with different editors, but the base format of the document cannot be changed.

- *Upload a document*. To upload a new document or a new version of an existing document to the system, any of the different interfaces explained in Section 2.3 could be used. The decision would probably depend mostly on the technical knowledge of the user. Most users will probably choose the simplest way: The Collab interface.

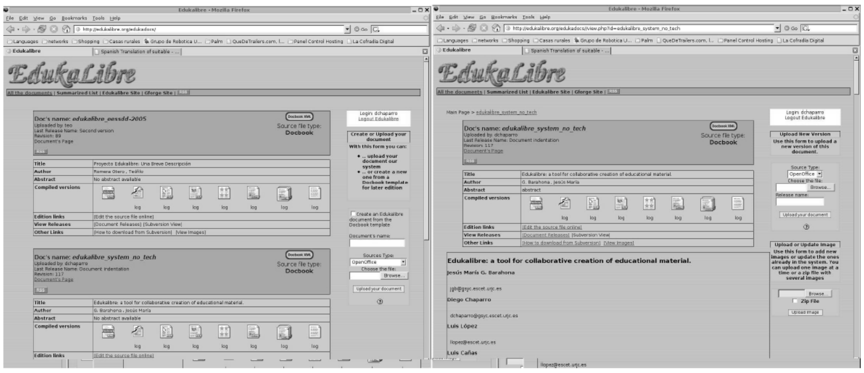
  To upload a document using Collab interface, the first step is authenticate in the system using a valid account (username/password). Once the user is authenticated, she will be able to upload a new document from the main page of the site. A new version of an existing document could be also uploaded from the 'Document Page'. Figure 4 shows the Collab interface carrying out these two actions. As shown in this figure, in order to upload a new document the user must provide a document name, choose the base format and select the file to be uploaded. Uploading a new version of an existent document is very similar. The user has to supply a name to the new version, choose the file format (not needed in most cases) and select the file to upload. As it is also shown in Figure 4, the user may upload or update images to be included in the document from the same web page. Images can be uploaded one by one or grouped in a zip file.

- *Modify a document*. As we have seen in Section 2.3, there is a wide variety of ways to access the system in order to modify a document. If the user chooses Collab and the document is a LaTeX or DocBook/XML one, then there is no need to download the file and edit it offline. The user could use the online editor to make some quick changes to the document. Sometimes it is better to download the document, edit it offline and upload the changes later. We have already seen how to upload a document through Collab in the previous pages but that is not the only way to carry out a document modification. For example, consider an OpenOffice.org. There is no online editor for OpenOffice.org documents in the Edukalibre System, so we would have to download it. We can do it through any of the different interfaces, for example we could use WebDAV with Nautilus. In this case, Nautilus would launch OpenOffice.org to edit the document. Then, any modification could be introduced acting as if the document was in the local hard disk. When asked for saving the changes, one just have to indicate the url to the path in the repository where the document came from, and that is enough to generate a new version of that document in the Edukalibre System. Of course there is also an authentication layer and an automatic conversions would be generated no matter how the system is accessed (Figure 5 illustrates this process).

- *Retrieve document information*. Through one of the interfaces (mostly Collab), the user can get information about the documents. Just a glance at the Document's web page in Collab (which can be seen on Figure 6) is enough to retrieve a lot of information about a document. There is an upper box containing the name of the document in the Edukalibre System, the user name of the last person who uploaded changes to it, the name of the last release and the type of the source file (DocBook/XML, OpenOffice.org or LaTeX). Just below that box, there is another one with more specific information. In this other box, you can read the Title of the document and its first author. The abstract, if available, is shown here too. There is also a row of icons representing the different formats the document has been converted to. A broken icon (the image of a torn document) means that something went wrong during the conversion. There is a link to the conversion log for each format. At the bottom of this second box, there are some links. One takes the user to the online edit page; another one presents a page with information of previous versions of the document. There is also a link to a ViewCVS page in which the user can compare the differences between the stored versions. A final link goes to a page containing just the images of the document (in case there is any).

- *Document history*. The history of a document can be seen from the document page of the Collab interface, following the link 'Document releases'. This history shows a list with all versions uploaded to the system, and displays the following information for each of them: release name, title, author, abstract, links to the base formats, to the corresponding converted formats, and to the online edit interface. Figure 7 shows a screen shot of a typical document history.

Figure 4 Uploading a new document (left) or a new version (right)


Edukalibre - Mozilla Firefox
File Edit View Go Bookmarks Tools Help
Go
Languages networks Shopping Casas rurales Grupo de Robotica U... Palm QueDeTrailers.com, l... Panel Control Hosting La Cofradia Digital
Edukalibre
Spanish Translation of suitable - ...
EdukaLibre
All the documents | Summarized List | Edukalibre Site | Gforge Site | RSS
Docbook XML
RSS
log

http://edukalibre.org/edukadocs/

Doc's name: *edukalibre_oessdd-2005*
Uploaded by: teo
Last Release Name: Second version
Revision: 89
Document's Page

Source file type: **Docbook**

Title	Proyecto Edukalibre: Una Breve Descripción
Author	Romera Otero , Teófilo
Abstract	No abstract available
Compiled versions	log log log log log log log
Edition links	[Edit the source file online]
View Releases	[Document Releases] [Subversion View]
Other Links	[How to download from Subversion] [View Images]

Doc's name: *edukalibre_system_no_tech*
Uploaded by: dchaparro
Last Release Name: Document indentation
Revision: 117
Document's Page

Source file type: **Docbook**

Title	Edukalibre: a tool for collaborative creation of educational material.
Author	G. Barahona , Jesús María
Abstract	No abstract available
Compiled versions	log log log log log log log
Edition links	[Edit the source file online]

Login: dchaparro
Logout Edukalibre

Create or Upload your document
With this form you can:
- **.. upload your document our system**
- **.. or create a new one from a Docbook template for later edition**

□ Create an Edukalibre document from the Docbook template
Document's name:
Sources Type: OpenOffice
Choose the file: Browse...
Upload your document

http://edukalibre.org/edukadocs/view.php?id=edukalibre_system_no_tech

Main Page > edukalibre_system_no_tech

Doc's name: *edukalibre_system_no_tech*
Uploaded by: dchaparro
Last Release Name: Document indentation
Revision: 117
Document's Page

Source file type: **Docbook**

Title	Edukalibre: a tool for collaborative creation of educational material.
Author	G. Barahona , Jesús María
Abstract	abstract
Compiled versions	log log log log log log log
Edition links	[Edit the source file online]
View Releases	[Document Releases] [Subversion View]
Other Links	[How to download from Subversion] [View Images]

Edukalibre: a tool for collaborative creation of educational material.

Jesús María G. Barahona
jgb@gsyc.escet.urjc.es

Diego Chaparro
dchaparro@gsyc.escet.urjc.es

Luis López
llopez@escet.urjc.es

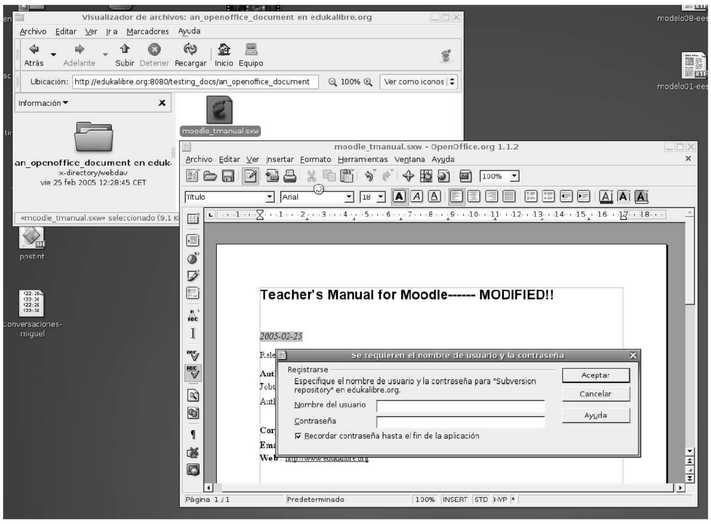
Luis Cañas

Login: dchaparro
Logout Edukalibre

Upload New Version
Use this form to upload a new version of this document.
Source Type: OpenOffice
Choose the file: Browse...
Release name:
Upload your document

Upload or Update Image
Use this form to add new images or update the ones already in the system. You can upload one image at a time or a zip file with several images
Browse...
□ **Zip File**
Upload Image

Figure 5 Modifying a document with Nautilus and Openoffice.org



Visualizador de archivos: an_openoffice_document en edukalibre.org

Ubicación: http://edukalibre.org:8080/testing_docs/an_openoffice_document

an_openoffice_document en eduk
x-directory/webdav
vie 25 feb 2005 12:28:45 CET

«moodle_tmanual.sxw» seleccionado (9,1 K

moodle_tmanual.sxw - OpenOffice.org 1.1.2

Teacher's Manual for Moodle------ MODIFIED!!

2005-02-25

Web : http://www.edukalibre.org

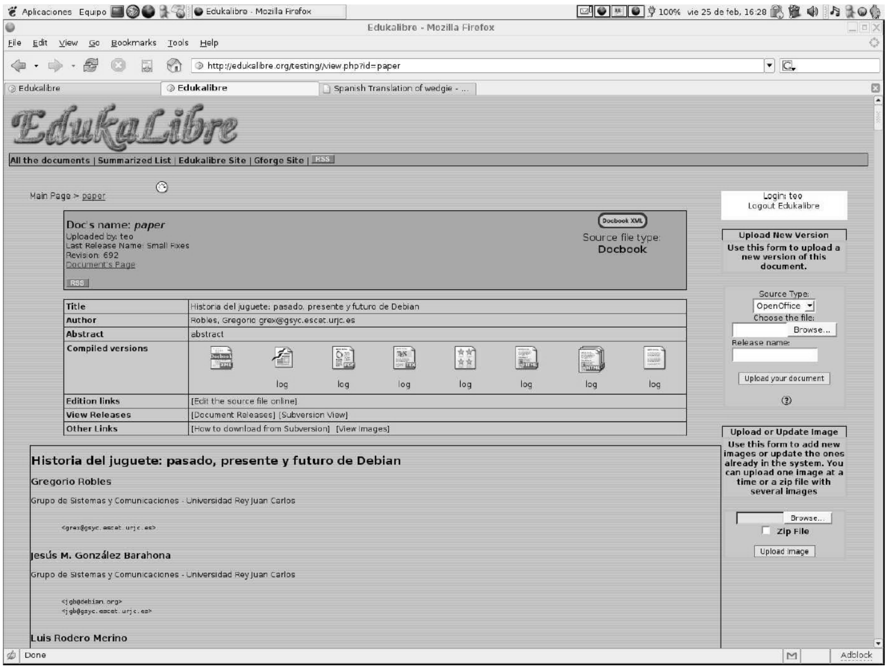
Se requieren el nombre de usuario y la contraseña

Registrarse
Especifique el nombre de usuario y la contraseña para "Subversion repository" en edukalibre.org.
Nombre del usuario
Contraseña
☑ Recordar contraseña hasta el fin de la aplicación

Aceptar
Cancelar
Ayuda

Página 1 / 1 Predeterminado 100% INSERT STD HYP *

Figure 6 The main page of a document in the Collab interface


Aplicaciones Equipo
Edukalibre - Mozilla Firefox
100% vie 25 de feb, 16:28
File Edit View Go Bookmarks Tools Help
http://edukalibre.org/testing/view.php?id=paper
Edukalibre
Edukalibre
Spanish Translation of wedgie - ...
EdukaLibre
All the documents | Summarized List | Edukalibre Site | Gforge Site | RSS
Done
Adblock

Main Page > paper

Doc's name: *paper*
Uploaded by: teo
Last Release Name: Small Fixes
Revision: 692
Document's Page
RSS

Docbook XML
Source file type:
Docbook

Title	Historia del juguete: pasado, presente y futuro de Debian
Author	Robles, Gregorio grex@gsyc.escet.urjc.es
Abstract	abstract
Compiled versions	log log log log log log log
Edition links	[Edit the source file online]
View Releases	[Document Releases] [Subversion View]
Other Links	[How to download from Subversion] [View Images]

Historia del juguete: pasado, presente y futuro de Debian

Gregorio Robles

Grupo de Sistemas y Comunicaciones - Universidad Rey Juan Carlos

<grex@gsyc.escet.urjc.es>

Jesús M. González Barahona

Grupo de Sistemas y Comunicaciones - Universidad Rey Juan Carlos

<jgb@debian.org>
<jgb@gsyc.escet.urjc.es>

Luis Rodero Merino

Login: teo
Logout Edukalibre

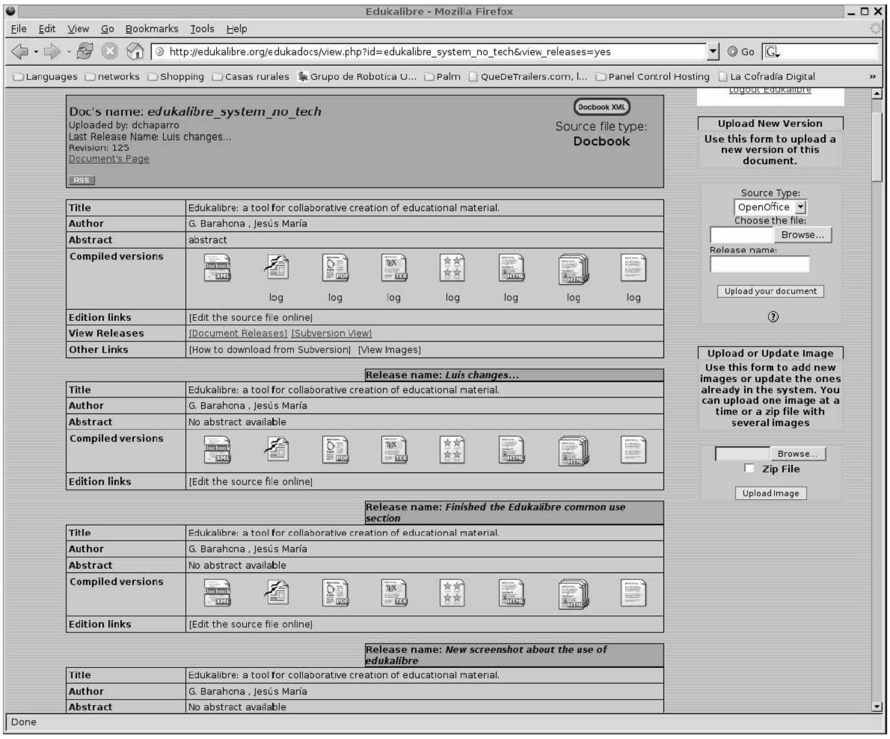
Upload New Version
Use this form to upload a new version of this document.

Source Type: OpenOffice
Choose the file: Browse...
Release name:
Upload your document

Upload or Update Image
Use this form to add new images or update the ones already in the system. You can upload one image at a time or a zip file with several images

Browse...
□ **Zip File**
Upload Image

Figure 7 History of a document in the Collab interface


Edukalibre - Mozilla Firefox
File Edit View Go Bookmarks Tools Help
http://edukalibre.org/edukadocs/view.php?id=edukalibre_system_no_tech&view_releases=yes
Go
Languages networks Shopping Casas rurales Grupo de Robotica U... Palm QueDeTrailers.com, l... Panel Control Hosting La Cofradía Digital
Logout Edukalibre
Done

Doc's name: *edukalibre_system_no_tech*
Uploaded by: dchaparro
Last Release Name: Luis changes...
Revision: 125
Document's Page
RSS

Docbook XML
Source file type:
Docbook

Title	Edukalibre: a tool for collaborative creation of educational material.
Author	G. Barahona , Jesús María
Abstract	abstract
Compiled versions	log log log log log log log
Edition links	[Edit the source file online]
View Releases	[Document Releases] [Subversion View]
Other Links	[How to download from Subversion] [View Images]

Release name: *Luis changes...*

Title	Edukalibre: a tool for collaborative creation of educational material.
Author	G. Barahona , Jesús María
Abstract	No abstract available
Compiled versions	
Edition links	[Edit the source file online]

Release name: *Finished the Edukalibre common use section*

Title	Edukalibre: a tool for collaborative creation of educational material.
Author	G. Barahona , Jesús María
Abstract	No abstract available
Compiled versions	
Edition links	[Edit the source file online]

Release name: *New screenshot about the use of edukalibre*

Title	Edukalibre: a tool for collaborative creation of educational material.
Author	G. Barahona , Jesús María
Abstract	No abstract available

Upload New Version
Use this form to upload a new version of this document.

Source Type: OpenOffice
Choose the file: Browse...
Release name:
Upload your document

Upload or Update Image
Use this form to add new images or update the ones already in the system. You can upload one image at a time or a zip file with several images

Browse...
□ **Zip File**
Upload Image

5 Conclusions

In this paper, we have described the Edukalibre System, a novel tool allowing the collaborative development of educational contents, which is based on the Libre Software methodologies and development models. We have presented the main features of the system, which are already available as a full functional application. We have shown that this Libre Software model fulfils the needs that may arise in the creation of this kind of contents. For this reason, we propose that it has many potential applications in the field of e-learning and we believe the educational community should become aware of this fact. The system has been developed using Libre Software tools and it has also been released through a libre license. So, it can be used and distributed with all the advantages freedom users may require.

Acknowledgements

The work described in this paper was supported by the European Commission's, Socrates/Minerva program, under grant number 110330-CP-1-2003-1ES-MINERVA-M. This communication reflects the views only of the author, and the Commission cannot be held responsible for any use, which may be made of the information contained therein.

References

Adelsberger, H.H., Collis, B. and Pawlowski, J.M. (2002) *Handbook on Information Technologies for Education and Training*, Springer, Heidelberg.

Bezroukov, N. (1999) 'Open source software development as a special type of academic research', *First Monday*, Vol. 4, No. 10, http://firstmonday.org/issues/issue4_10/bezroukov/.

Edwards, K. (2001) *Epistemic Communities, Situated Learning and Open Source Software Development*, http://opensource.mit.edu/papers/kasperedwards-ec.pdf.

Germán, D.M. (2003) 'The GNOME project: a case study of open source, global software development', *Software Process Improvement and Practice*, Vol. 8, No. 4, pp.201–215.

González-Barahona, J.M., López, L. and Robles, G. (2004) 'Community structure of modules in the apache project', *Proceedings of the 4th Workshop on Open Source Software Engineering. 26th International Conference on Software Engineering*, pp.43–47.

Hassan, A.E., Godfrey, M.W. and Holt, R.C. (2001) 'Software engineering research in the bazaar', *Proceedings of the 1st Workshop on Open Source Software Engineering at the 24th International Conference on Software Engineering*.

Horton, W. (2000) *Designing Web-Based Training*, Wiley Computer Publishing, New York.

Irvine, P. and Brna, P. (2003) 'Growing an internet-based community for lifelong self-learners: empowering the community', *International Journal of Continuing Engineering Education and Lifelong Learning*, Vol. 13, Nos. 1–2, p.21.

Koch, S. (Ed.) (2004) *Free/Open Source Software Development*, Idea Group, Inc., Hershey, Pennsylvania.

Lameter, C. (2002) 'Debian gnu/linux: the past, the present and the future', *Free Software Symposium 2002*, Tokio.

Raymond, E.S. (1997) 'The cathedral and the bazar', *First Monday*, http://www.firstmonday.dk/issues/issue3_3/raymond/.

Reis, C.R. and Mattos Fortes, R.P. (2002) 'An overview of the software engineering process and tools in the Mozilla project', *Workshop on Open Source Software Development*, Newcastle.

Rosenberg, J.M. (2001) *E-Learning*, McGraw-Hill, New York.

Uskov, V. (2003) 'A 3rd generation web-based instructional tool for education and lifelong training', *International Journal of Continuing Engineering Education Lifelong Learning*, Vol. 13, Nos. 1–2, pp.110–131.

Wilson, B. and Ryder, M. (1996) 'Dynamic learning communities: an alternative to designed instruction', in Simonson, M. (Ed.): *Proceedings of Selected Research and Development Presentations*, pp.800–809.

Websites

Carnegie Mellon Open Learning Initiative: http://www.cmu.edu/oli/.

Harvard University Library Open Collections Program: http://ocp.hul.harvard.edu/.

The Minerva Action: http://ec.europa.eu/education/programmes/socrates/minerva/index_en.html.

Moodle: http://moodle.org.

OpenOffice.org: http://openoffice.org.

Subversion: http://subversion.tigris.org/.

Docbook: http://www.docbook.org/.

LaTeX: http://www.latex-project.org/.

MIT OpenCourseWare: http://ocw.mit.edu/index.html.

Sharable Content Object Reference Model: http://www.adlnet.org/.

Website of the US Department of Education: http://www.ed.gov.

Wikipedia: http://en.wikipedia.org/wiki/Main_Page.