Edukalibre: a tool for collaborative creation of educational material[*]

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ABSTRACT

Libre Software, with its characteristics and its particular development model, has promoted the birth of a novel set of team work methodologies, which have proved to be useful in many different domains. 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 with the following advantages: 1) It allows several authors to collaborate in the authoring of a document, 2) Authors can keep track of a document's history and have access to different versions along the document's life, 3) Users have freedom to choose from a wide range of editing tools to create the contents. It is even possible to edit them on-line using a standard web browser. 4) Users may also select the tool for interacting with the system (alternatives range from web browsers to WebDAV clients), 5) It is possible to automatically convert to and from a wide variety of document formats, including editable ones like DocBook/XML, OpenOffice.org and LaTeX, and printable formats like PDF and postscript or HTML ready to be published in the web.

At the time of writing this paper, there is a fully functional version of the system, whose development has been entirely based in Libre Software tools and is distributed under a Libre Software license.

Keywords

Architectures for web-based education delivery environments, Collaborative development of learning material, Libre software development model, Open source, version control systems.

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 organizations are exploring the possibilities of applying information technologies to their educational processes including the Internet, multimedia content, streaming technologies, etc [1, 17, 7].

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 [19] 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 versus student/learner paradigm. This is why the vast majority of educational web-based systems are conceptually designed for the elearning-by-ereading model and are build as large monolithic structures that are fixed in length, sequenced and scoped, non-flexible for continuous updates, difficult to organize, non-reusable or hard to reuse, etc [20].

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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 [2, 6]. 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) [4, 5, 16, 11]. It is now clearly recognized that the Libre Software approach have led to revolutionary methods for producing programs and advancements in software development [15, 10].

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 [3]. 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 [13], Carnegie Mellon University [8], and Harvard [14]), 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 favor 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 [13], Open Learning Initiative [8], 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 [21].

The idea of producing collaborative learning in a community is not new. Some authors [18, 9] 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 recognized 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 organization of a classroom and a learning community [8].

Isolated Class Structure	Learning Community
Homogeneous groupings	Heterogeneous grouping
Class discipline	Community organization
Competition	Collaboration
Knowledge delivery	Knowledge construction
Teacher centered	Student centered
Independent, individual work	Interdependent, team-work
Expertise flows from 1-to-many	Expertise flows in many directions

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 is convenient for developers who have the habit of using several complementary tools, but is 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 specialized training for users. Moreover, these tools should themselves be Libre Software to guarantee the appropriate customization 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 [1]. The project started on October 2003 an is expected to last until December 2005. It is coordinated by University Rey Juan Carlos (Spain), and includes partners from University of Leeds (United Kingdom), University of Porto (Portugal), University of Karlsruhe (Germany). The project web site 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 [12]. 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. Some of these tools have been improved and also specific tools have been created to interact with the system. Fig. 1 shows this interaction between the different components of the Edukalibre 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 interact with the system.

Fig. 2 shows the flow of a document hosted by the system. First, it has to be uploaded using one of the possible interfaces. Then the document goes thought the "Conversion Tools" module. In this step, the document is converted to the final formats automatically. Finally, all the different formats are stored in the document repository.

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

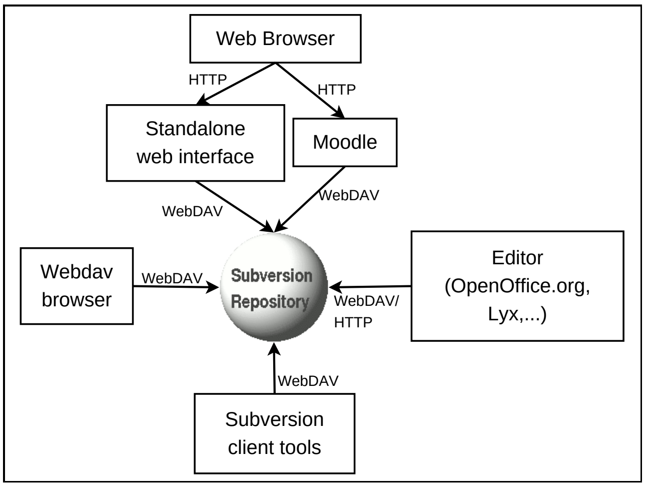


Figure 1: Components of the system

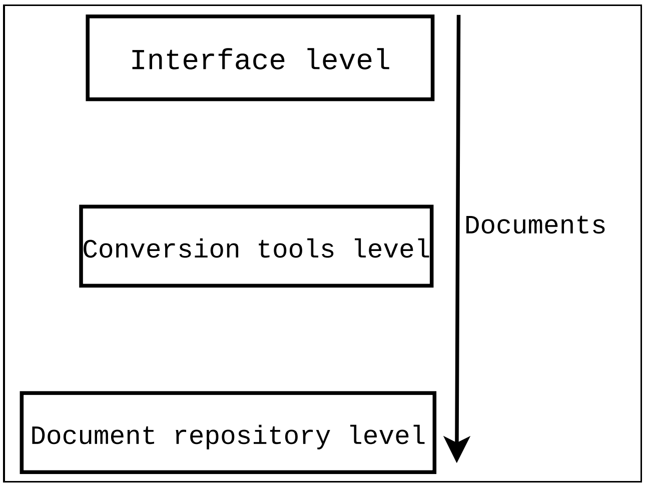


Figure 2: Architecture levels

[1] http://europa.eu.int/comm/education/programmes/socrates/minerva/ind1a_en.html

documents and providing information about them.

The system deals with two kinds of documents. One of them is the base format, and the other one is the end-user format. The base format is the document that can be edited and modified by the users (like DocBook/XML[2], LaTeX[3] or OpenOffice.org files). The end-user formats are those which are generated automatically from the base format (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 format of documents while the latter hosts solely the end-user formats. The document repository is a Subversion [4] repository with additional plug-ins to perform some specific tasks when a document is uploaded, while the other is just an HTTP server hosting compiled versions of all documents.

The repository manager also provides methods to extract meta-data information about the contents of the repository manager:

- Listing of documents stored 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 is a 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 the previous section 2, each base format document is automatically converted to the 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 cas e, the system follows these steps: First of all, since the repository only accepts valid files, a validation has to be done on the document to check if it can be converted correctly to the end-user formats. If the document is valid, it is stored in the subversion repository. Then it is converted to the end-user formats. These new end-user formats of the document 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 Fig. 3.

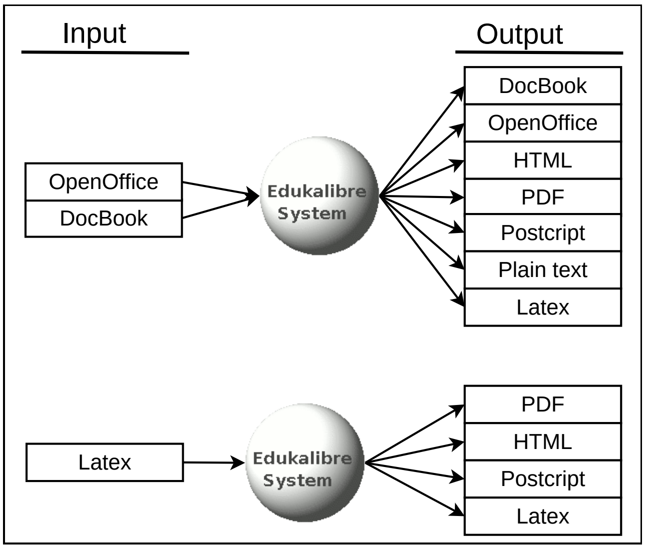


Figure 3: Conversion formats

2.3 Interfaces

The modularity of the system makes it accessible via different interfaces, with different functionality from each of them. From one side, 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 accessible with a web browser via a web 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 carry out some actions in an easy way. With it, users could 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 document.

Collab can be installed as a stand-alone web interface, which may be integrated in an easy way in any PHP site. It can also be used from a Course Management System like Moodle [5], for which we have developed a special module which installs flawlessly in any Moodle site and makes very easy the full integration in the Moodle CMS.

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 documentation in general. The system provides some key functionalities which makes it suitable for several learning scenarios. The Edukalibre System has been designed an developed with flexibility and ease of use in mind. In order to adopt these two basic characteristics, freedom on the election for the user is maximized whenever tools or interfaces have to be chosen. We provide an 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

[2] http://www.docbook.org/

[3] http://www.latex-project.org/

[4] http://subversion.tigris.org/

[5] http://moodle.org

average computer user will be able to easily understand 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 the flexibility and the ease of use within the system, 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 minimize 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 specially important for newcomers who prefer a less powerful but more friendly tool to develop contents.

In the same way, an expert user having more skills when using computers may tend to the most advanced features of programs. 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.

3.1.1 Tools to interact with the system

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 to perform tasks such as uploading and downloading documents to and from the system.

3.1.1.1 Editors for the Edukalibre System.

Software editing tools are an important part of the document creation processes of todays world. People use them commonly and they have become essential to companies and organizations 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 is 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 maximizes 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 this 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[6] for DocBook/XML and of course native OpenOffice.org documents. Any other offimatic application supporting the edition of any of the base formats of the Edukalibre System could also be used. Sometimes, WYSIWYG editors lack of enough power and features for 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. For such users, WYSIWYG editors may be not suitable and more powerful text editors could be used instead. There is a wide variety of choices when it comes to use one of this editors. From VI to Emacs, many of them offer very convenient features like automatic tag completion, syntax highlighting, auto indentation, DocBook/XML validation, etc.

- *On-Line Editing*: There is a third choice allowing to edit or create documents directly over the Edukalibre System on-line 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 favorite editor or even his favorite 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 on-line editors via its web interfaces. One of them uses a Wiki-Wiki syntax which allows editing in a very easy way. There is another possibility, which is based on Collab, a 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.

3.1.1.2 Interfaces to the system for document management.

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 an 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

[6] http://openoffice.org

this reason, the system offers many 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*: There is a web interface available for the Edukalibre System, this is called Collab. It consists of a PHP-made web page that acts as a front-end to the Edukalibre System. When anyone connects to the system, 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:

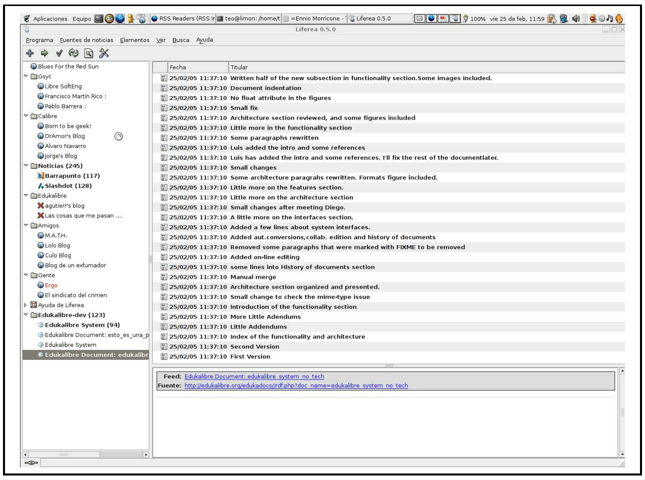
    - The title of the document.
    - The author (if there are more than one, the first one is shown).
    - The abstract (if there is one).
    - The base format in which the document was created and links to the compiled versions of the document
    - Links to the log files generated during the conversion (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 on-line editor, allowing to directly modify 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 on-line 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 allows users to collaboratively edit and manage files on remote web servers. This kind of technology is implemented in many ways. It is included in some web browsers, editors (Emacs, OpenOffice.org) and file managers (Nautilus) and it is used in the Edukalibre System. This brings to the system a lot of new possibilities since documents can be accessed with any WebDAV client. 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*: There is also the possibility of accessing the system from a command line interface. As it will be shown later in the Architecture section, the heart of the Edukalibre System is a Subversion repository. This repository can be accessed with any Subversion client. 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 over 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 are 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 favorite 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 include useful information like the log of the last modification made to it (Figure 4). 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.



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

Figure 4: Liferea News Aggregator keeping track of an Edukalibre document

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 an 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 mates in a fast and clear way. This is why version control is a crucial feature in the Edukalibre System.

In the creation of documentation, there is a pile of changes in each version that the creator could like to track.

During the life of a document, there is a set of modifications that lead to newer versions from time to time. Each of this changes is stored by the Edukalibre System whenever a new version is created. 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, this one is created by the authors and only they have the proper 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 is also a huge number of different formats for electronic documents. Each of these formats have their very own characteristics and are 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 known 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 Fig. 3).

By default, these final formats are generated in 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, who 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*.

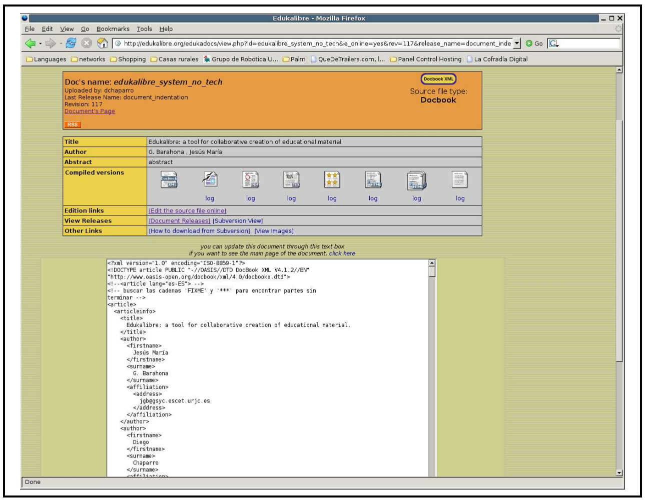
This kind of collaborative interaction is clearly better than prior methods. Flow of new versions between authors is much faster now, since any of them could get the latest version from the system at any time, and checking the system as frequently as desired. Flow of information and exchanging of ideas between authors is more clear 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 COMMON USE

As we have seen in previous sections, the Edukalibre System provides a lot of functionality and advantages. But at this point, the reader may be wondering for what and how can it be used?

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. Advanced users can use more advanced and powerful tools while more inexperienced ones could choose more simple tools. Next we present a detailed description of common uses 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. Once then, the user has to select one editor to write the document. For example, a user could want 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 on-line editor available at Collab (Fig. 5).


Edukalibre - Mozilla Firefox
File Edit View Go Bookmarks Tools Help
http://edukalibre.org/edukadocs/view.php?id=edukalibre_system_no_tech&e_online=yes&rev=117&release_name=document_inde
Go
Languages
networks
Shopping
Casas rurales
Grupo de Robotica U...
Palm
QueDeTrailers.com, l...
Panel Control Hosting
La Cofradía Digital
Docbook XML
RSS
log
Done

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]

you can update this document through this text box
if you want to see the main page of the document, click here

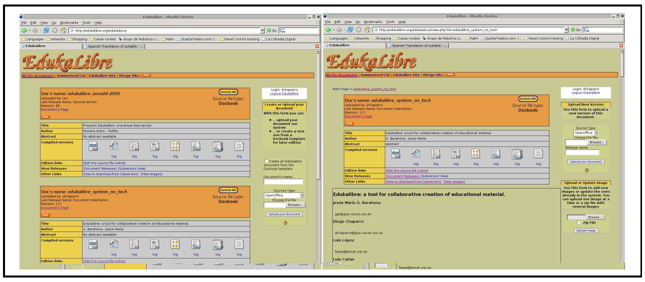
```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE article PUBLIC "-//OASIS//DTD DocBook XML V4.1.2//EN"
"http://www.oasis-open.org/docbook/xml/4.0/docbookx.dtd">
<!--<article lang="es-ES"> -->
<!-- buscar las cadenas 'FIXME' y '***' para encontrar partes sin
terminar -->
<article>
  <articleinfo>
    <title>
      Edukalibre: a tool for collaborative creation of educational material.
    </title>
    <author>
      <firstname>
        Jesús María
      </firstname>
      <surname>
        G. Barahona
      </surname>
      <affiliation>
        <address>
          jgb@gsyc.escet.urjc.es
        </address>
      </affiliation>
    </author>
    <author>
      <firstname>
        Diego
      </firstname>
      <surname>
        Chaparro
      </surname>
```

Figure 5: Simple on-line editor integrated in 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 uploaded from the "Document Page" also. Fig. 6 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.


Edukalibre - Mozilla Firefox
File Edit View Go Bookmarks Tools Help
http://edukalibre.org/edukadocs/
http://edukalibre.org/edukadocs/view.php?id=edukalibre_system_no_tech
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
Main Page > edukalibre_system_no_tech
Docbook XML
RSS
log
Browse...
Upload your document
Upload Image

Doc's name: *edukalibre_eessdd-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:

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
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Luis López
llopez@escet.urjc.es
Luis Cañas
llopez@escet.urjc.es

Login: dchaparro
Logout Edukalibre

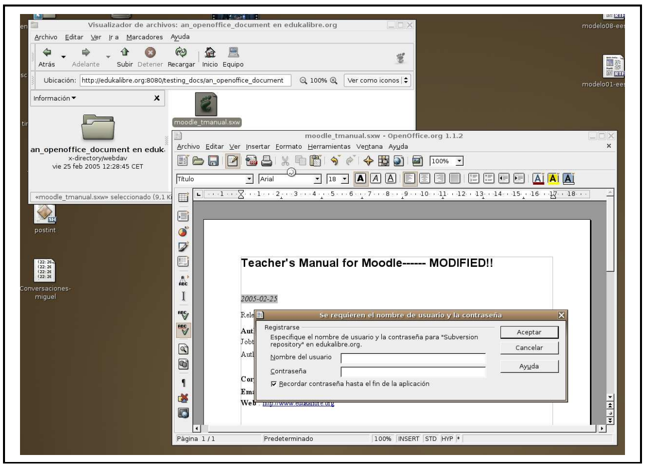
Upload New Version
Use this form to upload a new version of this document.
Source Type: OpenOffice
Choose the file:
Release name:

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
□ **Zip File**

Figure 6: Uploading a new document (left) or a new version (right)

  As it is also shown in Fig. 6, 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 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 off-line. The user could use the on-line editor, shown in Fig. 5 to make some quick changes to the document. Sometimes it is better to download the document, edit it off-line 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. Take an OpenOffice.org document, we assume to be hold in the system as an example. There is no on-line 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 the user wants to introduce could be made. Just like as the document was in the hard disk (in fact it is, since we are working on a local copy). When asked for where to save the changes she would just have to indicate the url to the path in the repository where the document came from, and that should be enough to generate a new version of that document in the Edukalibre System. Of course there is also an authentication layer and automatic conversions would be generated no matter how the system is accessed (Fig. 7 illustrates this process).


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 - OpenOffice.org 1.1.2

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

2005-02-25

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

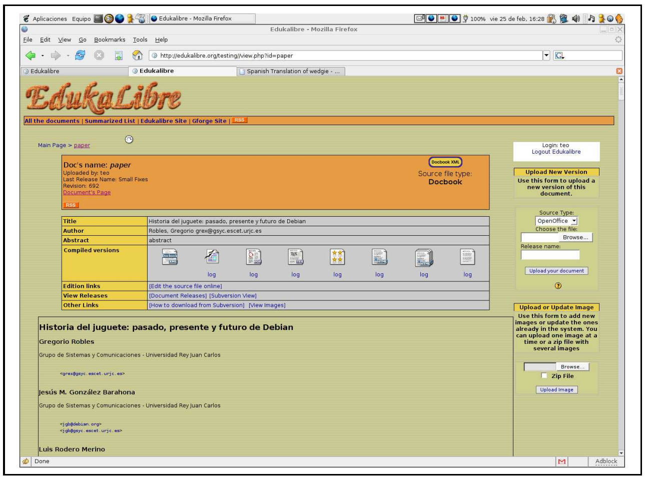
Contraseña

☑ Recordar contraseña hasta el fin de la aplicación

Figure 7: Modifying a document with Nautilus and Openoffice.org

- *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 Fig. 8) 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 for 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 the 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 log of the conversion process for each format. At the bottom of this second box there are a few links to various pages. One of them takes the user to the edit on-line page, another one presents a page with information of previous versions of th e document. There is a link to a ViewCVS page of the document in which the user could compare the differences between different versions (with the *diff* option). Another link goes to a page containing just the images of the document (in case it had any).

- *Document history* The history of any document can be seen from the document page in Collab interface, in the link "Document releases". The history of a document shows a list with all versions uploaded to the system, and the following information for each version: release name, title, author, abstract, link to the base formats and the corresponding converted formats, and the possibility to edit online each version and upload a modified version. Fig. 9 shows an example view of a document history.


Edukalibre - Mozilla Firefox

http://edukalibre.org/testing//view.php?id=paper

File Edit View Go Bookmarks Tools Help
Edukalibre
Edukalibre
Spanish Translation of wedgie - ...
EdukaLibre
All the documents | Summarized List | Edukalibre Site | Gforge Site | RSS
Main Page > paper
Docbook XML
RSS
log
Done
Adblock

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

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]

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

Historia del juguete: pasado, presente y futuro de Debian

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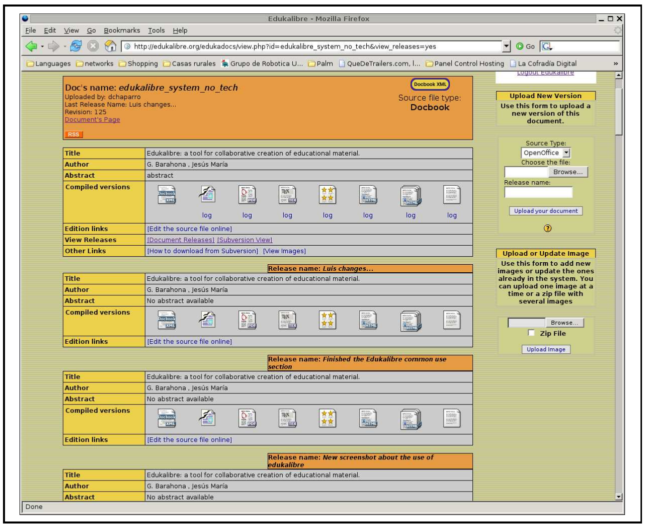
Luis Rodero Merino

Figure 8: The main page of a document in the Collab interface


Edukalibre - Mozilla Firefox

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

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

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

Figure 9: History of a document in the Collab interface

4.1 Example scenarios

Edukalibre System can be used in a great number of possible situations, most of them in the educational field, but it can be extended to other scenarios as well. Some example situations for which the platform has been developed could be the following:

- Students working in groups in a specific study field. Lets say those students have to write a group report to show their conclusions. They could use the Edukalibre System to write the report in DocBook/XML, each one writing some parts of the document, some of them writing from the university and some others writing from their homes. Each one could select his favorite editor, and use the method they want to upload the document to the system. For example, some of them may use Collab and some others may use subversion client tools from the command line.

- Some researchers from different universities and countries have to write a technical report jointly to be published in a journal and they chose to write the document in LaTeX format. They split the document into sections, and each one deals with one section. When all sections are written, each researcher reviews the whole document and makes the needed modifications.

- Two teachers write a document for a university lecture, and they publish it in the Edukalibre System in order to make it available to students through the Internet. Moreover, the teachers want the students to contribute to the document as an assignment, so they create accounts for them in the Edukalibre System. This way the students would be able to collaborate in the writing of the document adding useful information, notes and a very valuable feedback.

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 fulfills the need 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-leaning 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 that it can be used and distributed with all the advantages an freedom users may require.

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