Integrating Web 2.0 Features into a Learning Management System

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Abstract: The e-Learning world is overcrowded by Learning Management Systems. Whatever they are Web-based or stand-alone software, lots of them are mere content delivering platforms and only a few provide a good end-user satisfaction. Since now two years, the University of Luxembourg is designing its own Web-based distance learning framework and faces the same problems. Besides, a growing advent called Web 2.0 is gaining ground in various application fields. Briefly speaking, Web 2.0 is about content management and new ways of communication and interaction between users. Currently, this technology is more and more viewed by scientists as a new way of learning. As a consequence, this trend directly competes with e-learning systems. But in the meanwhile, most of features that could be qualified as Web 2.0 compliant could easily be shaped into learning management systems and be a way to overcome their current limits. For instance, users of these future integrated systems would be attracted not only to study a course, but also because they can communicate with other users in a collaborative way and learn from each other.
Our paper describes how we challenged this situation by shaping Web 2.0 skills into our e-learning platform named *SPOTLight*. We designed a brand new solution with innovative interactions and learning perspectives. The paper is structured as follows: first, an overview of the framework is described, followed by social and pedagogical issues of the problematic. Second, a brief introduction to the state of the art of Web 2.0 provides further understanding of collaboration potentialities on the Internet and an analysis details the constraints we faced for each feature according to our context, resulting to a set of tools we decided to integrate into SPOTLight. Afterwards, the development management procedure we used for the implementation is detailed. Indeed, integrating Web 2.0 features creates important new issues in terms of user interface, which make us rebuild the core architecture using software as a service model. Finally, this paper outlines our future strategy about new features from the Web 2.0 world we will progressively add to SPOTLight.

Keywords: e-Learning platforms, Web 2.0 technologies, Web-based learning management systems, Collaborative on-line learning

1. Introduction

These past years, a major innovation known as *Web 2.0* rose up from information technology. It is a complex concept consisting in new ways of communication between users and web site content control by users. Now, users are viewed as the heart of a web site. It redefines our perception of the Web in the way we access, communicate and learn information in our everyday life (Kolbitsch & Maurer, 2006). Blogging, wiki or pod-casting are examples that nobody can't miss.

Beside this revolution, e-learning frameworks show some limitations while using it. For instance, students like to discuss about an online course on a real-time chat system. It is useful and it improves their knowledge. Nevertheless, it is useless when a user wants to keep track of the conversation content because it's not possible. Another point lies in the idea that human behavior of group working is not translated into current e-learning systems, or at least not as well as Web 2.0 sites do. Here a few boundaries of E-learning frameworks become visible.

SPOTLight, the Luxembourg University e-learning platform, is being designed through a main wire: innovative distance learning. This has been done in the first version of this platform, by programming a pro-active system (Zampunieris, 2006). The first job was to implement a pro-active system (Casel, El Alami, Garot & Zampunieris, 2007) and some administration features, like managing users, SCOs, and so on. Communication streams between users are limited and dealing with content is only possible into a one-to-one scheme from course content to a learner.

Obviously, we assume that the next features of SPOTLight must not result to the same drawbacks of current learning management systems. No assets of Web 2.0 are yet introduced into the first SPOTLight version. As a result, our innovative motivation brings naturally the SPOTLight framework and the Web 2.0 concept to converge. We shall first show that this paper describes an overview of this project by analyzing the limitations of learning management systems we must improve. Then, we

shall focus on Web 2.0 features, studying it according to our needs and by presenting the implementation issues. Finally, we shall evoke our future work, still in the Web 2.0 environment.

2. SPOTLight
2.1 Overview
SPOTLight is an open source learning management system, in experimentation at the University of Luxembourg with online courses in use for the second year. Our major motivation in this project is to be SCORM compliant (SCORM, 2004). When we produce a course or when we develop the framework, we are always respectful of the standard specifications. The innovative asset of this platform is a pro-active system (Zampunieris, 2006). This concept is quite easy to understand but much more complex to implement. It aims at detecting events in the database according to special rules. An event is supposed to be meaningful information for the user. Once the system selects an event in the database, it notifies the user by a message on his screen. Then, the monitoring tool is another useful module. Any teacher can use it at any time to get important feedback on students. For instance, a teacher can grab the access time of a student about a certain course. Other features are all about platform administration. For example, it is possible to manage courses, students, teachers, and so on and so forth. These management features reduce the administrator workload.

2.2 From LMS to LCMS
First generation of e-learning systems is focused on delivering online content, which is too viewed as a learning object (Downes, 2005). Whether it is true or not, they are refined at a rigorous level by standards. Their organization is similar to the one of a course book. E-learning platforms are made up of no more than online courses. They represent the core of the learning process. He underlines that "learning management system takes learning content and organizes it in a standard way, as a course divided into modules and lessons".

On the SPOTLight interface, the interaction occurs between course content and a learner, when reading it. This one-to-one interaction behavior is quite minimal (Siemens, 2004a). Furthermore, the content has not the priority insofar as users can write their own comments or questions about a lesson chapter for instance, even to communicate altogether. Reed's law describes how to scientifically understand the value of information management. He states that a network value increases in two to the power of the number of users connected to it (Reed). In addition to an oral discussion in a classroom, participation of learners on a framework improves knowledge quality. A lot of current learning management systems adopt tools like blogging or comments which are now called *learning content management systems*.

2.3 New pedagogical issues
Technologies change a human everyday life. In the same way, it is changing our behavior towards web. An American Institute for Research shows that a wide gap now takes place between students and their schools (Levin & Arafeh, 2002). The key findings of the study describe the way teenager students use Internet for school tasks. It appears to be close to the way they use it in their daily tasks. They illustrate the Internet as a virtual textbook and reference library, a virtual tutor and study shortcut, and even a virtual study group. To lead to a success in an e-learning framework, it is important to consider these changes. Virtual communities are widely used by students in their personal life with Internet sites like Facebook (Facebook, 2008).

A Community of Practice (Lave & Wenger, 1991) revolves around three main points: what is it about, how it functions and what ability it has produced (Wenger, 1998). They are neither community of interests (Wenger, 1998) nor teams (Lave & Wenger), but they are self-organized systems around a certain knowledge area and activity. So it gives them a feeling of identity and a social cohesion. Learning is not perceived as the acquirement of knowledge, but it is placed in a collective process where people participate to produce a shared practice. In 2004, a new pedagogical theory called *connectivism* has been introduced (Siemens, 2004). It stands for "the integration of principles explored by chaos, network, and complexity and self-organization theories. Learning is a process that occurs within nebulous environments of shifting core elements" (Siemens, 2004b). As a consequence, learning seems to be happening through nodes represented by online virtual communities.

3. Web 2.0 features
3.1 State of the art

The schema below lists what it already exists inside e-learning or non e-learning platforms in terms of social networking features. The collaboration criterion sorts results in the vertical axis. At the top level, content creation process involves more users whereas it requires the less at the bottom. Collaboration involves at least two or more users to create a same content. Three main parameters are pointed out:

- Information format: text-based, audio-based, video-based
- Time: asynchronous/synchronous communication
- Collaboration pattern: one-to-many, many-between-many, many-to-many

Many others Web 2.0 features also exist on the web like syndication or profile management. We reduce the list by filtering on the role a feature can play in a learning management system.
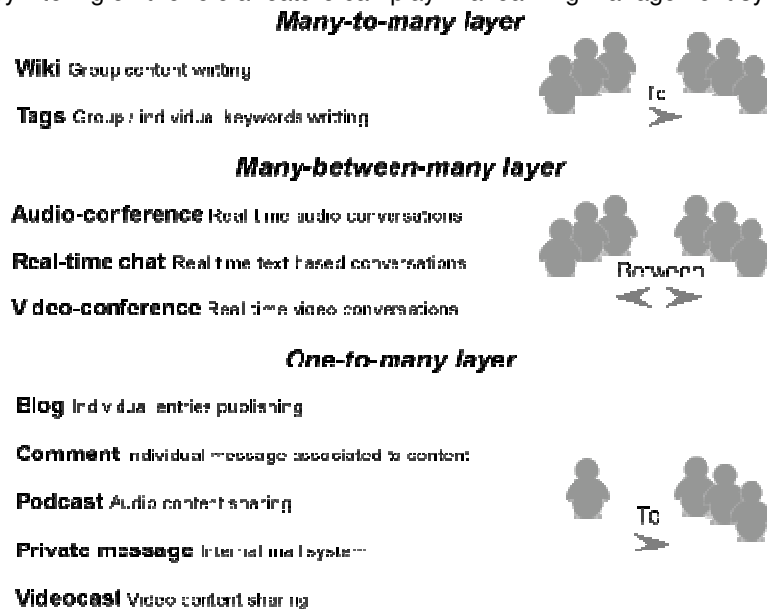

Many-to-many layer

Wiki Group content writing

Tags Group shared virtual keywords writing

Many-between-many layer

Audio-conference Real time audio conversations

Real-time chat Real time text based conversations

Video-conference Real time video conversations

One-to-many layer

Blog Individual entries publishing

Comment Individual message associated to content

Podcast Audio content sharing

Private message Internal mail system

Videocast Video content sharing

Figure 1: State of the art of collaboration tools

3.2 Selection of tools

Our main interest about Web 2.0 is about its richness in online collaboration and information management. The idea is to keep courses as a central information repository surrounding it with communication processes. Indeed, we can't afford to add blogs or wikis beside SPOTLight, resulting in multiple entry points and information reference concurrency. As a solution, we don't choose features dealing with the collaboration pattern of many-to-many learners.

Moreover, audio-conference and video-conference tools are great assets for a distance learning platform but we can't afford to develop it considering the time it should take to create them. The last tool in the many-between-many layer is the chat system. Although, we keep our focus on text-based information, we want to push it out because students are all using their own chatting system and we can't be a hundred per cent sure they'll use it for the course purposes and not for personal ones. Additionally, it isn't possible to keep track of information with this kind of tool. It appears useless when we promote the need and the importance of information management.

All features to be implemented are on the one-to-many layer. The comment and the private messaging modules are developed during the first half of the development period, followed by the podcasting and videocasting tools during the second half of the period. The blogging tool is not in our plan because it leads the framework to multiply the number of access point to content. Setting the blogging tool apart lets us keep online courses as a key reference for students. Thus, we avoid concurrency between the online slides written by a teacher and content web pages written by a community of students.

The additional tools we think to add are a calendar, a forum and a document-sharing place. Many frameworks offer these tools (Docebo, 2008), which we don't consider as Web 2.0 ones because they already existed before the birth of this concept. A calendar is a good asset because users could see their important events on the same interface. The calendar is obviously shared, so a student can see

events of his virtual community. Then, with the forum tool users could create asynchronous discussions about the topic they want. The last tool is a document sharing system. By using it, teachers could share supports or important reading of a course. Even, students could use it to share a common work to hand in on SPOTLight.

4. Orientations
4.1 The new interface articulation
After having in mind the panel of solutions we are about to choose, we wonder how to articulate it on the user interface. Three main different levels of navigation exist in classical platforms as well as in SPOTLight. They are listed below from the entry point to the last level:
1. Platform's home page: the welcome/root page
2. Course home page: course's home page with its related links like course's forum, resources manager, etc.
3. Course content interface: where the course's slides are displayed or edited

We would like to create an attractive space for collaboration as we can see on iGoogle (iGoogle, 2008). It displays on the user interface a set of tools in small boxes. In our case, a tool can belong to several contexts for instance a course context or the home page. The context is the parameter used to filter information to display. We call it the *context of view*.

Table 1: The three context levels in SPOTLight

1. Home page	2. Course / Group	3. Course content
Agenda	Document manager	Personal notes
News	Forum	Comments
Private message		

4.2 The root level
The home page is a complete personal interface. All boxes can be dragged onto the home page's space and from one session to another the state of each box is saved. The box status concerns the display type (reduced or fully displayed) and the place onto the screen. The agenda module gathers public events in that level. Teachers can communicate important facts to everybody using public news. Despite that only teachers can edit news, everybody can read it. Finally, the private message system is the global communication system upon which it is possible to discuss privately with users.

4.3 The course / group level
This level aims at creating two distinct virtual worlds. On the one hand the first one which is the course context is official whereas on the other hand the working community context is less official, less conventional. It is a private place where we can work in a virtual community with a total privacy. Group users can talk in the forum. Persons who belong to the group can create a topic of conversation where people are free to participate: writing questions, answering, etc. It is also possible to use a common repository where users can share files. The uploaded file must deal with the purpose of the group or of the course. A file must respect certain types and sizes. The course content also presents teachers information in a box because it is useful information.

4.4 The course content level
This level always contains two options: the personal and the shared comments. On the interface perspective, the screen is divided into two parts: the course content area and a tab panel, which is on the left side. It is made up of three panels. One tab shows the course path, the second one contains the learner's comment, and the last one has the shared comments. As in real life, students act like writing personal notes while participating in a course class and this is the reason why we think it is a good idea to shape it into an online platform with the personal note system. What is more, it is also possible to publicly comment course content. In the blogging world, it is a successful and widely used option, where the blogger gets relevant feedbacks by readers who want to participate and share their own point of view. The main benefit of these options is the level of granularity about information they deal with. When forum conversations are quite general, shared and personal comments refine information knowledge at the level of course's slides.

4.5 A modular interface
Considering that contexts are entry points where various modules are displayed, we must provide a main area for each tool where users can find more options about the tool. Tools are placed according to its relevance of use in the context. For instance, the calendar can be reused in all contexts by filtering content according to the context. On the homepage context, the calendar box displays public events whereas on a course context it lists events in relation with the course. A click on the box title or on an event points directly to the main interface of the calendar with all its features. Furthermore, there are tools that can't be added into boxes. The monitoring tool is such an example. Consequently they are added into the menu bar.

5. Implementation
5.1 Need of group management
Some developed modules are put into a context. It means that data are stored specifying the context of use. For instance, an event created at the home page context would get a public scope by default. On the contrary, an event edited on a group context would only concern this group. Context access restrictions can still be edited another time. The context of use acts like a filter, the home page context deals with public data of the module whereas a course or a group context filters elements in connection with this one. It is a kind of restrictive access that is why context comes up with group management.

The concept is to associate groups to students aiming at filtering content. There are two kinds of groups. The *course groups* contain students and teachers of the course. The *working groups* are nothing more than a social network made up by students. Each time a course group or a working group is created, its access rights are also defined for every user who belongs to it. It is important to underline the difference between virtual groups and logical groups: the first ones are virtual communities whereas the second ones are about access rights. Group management already existed in SPOTLight. It deals with user's roles like administrators, teachers, students... Additionally to the two groups listed above, there is an overall group at the top level: *the public group*. This one is important because it allows the association of global events to everybody.

Having an insight view of context interfaces, we assume that boxes can be repeated from one screen to another. For instance, both a course context and a working group context display an agenda. The main difference is data the system selects in the database. Thanks to code factoring, it is not necessary to build a different function for each tool in each context. One function is created in the main API, in the model layer, and it is employed in the controller layer specifying the group that acts like a filter to retrieve data concerned by the context.

5.2 Modules integration
Some features would be quite easy to develop whereas others would need more time. To integrate the set of features listed above with a short amount of time we decide to look at existing open source libraries and products which fit the best our requirements in terms of features and programming design patterns. The constraint is to find modules developed in PHP: the SPOTLight web scripting language. This programming language is not a constraint in itself, but open source tools have often complex code structure, resulting in a more complex integration task for ourselves. Nevertheless, integration is the best solution because it is a waste of time to rebuild it ourselves, and such tools are reliable, efficient, secured, and optimized.

SPOTLight is designed upon the flexible MVC pattern, which makes all solutions built in a same homogenate structure. If the module found is designed through the same pattern, the integration workload will be reduced. Otherwise code lines must be dissected and the workload would be as important as if we designed the module ourselves. Thus we decide to fully design the document manager, personal notes, slide comments and groups management. Indeed, existing tools that look like these modules were neither conceptually mature nor technically well-designed.

The private message system and the forum are both integrated from the phpBB open-source forum (phpBB, 2008). The agenda is also integrated based on the Web Calendar open-source tool (Webcalendar, 2008). These two existing modules are not MVC compliant. They are not developed using the object programming paradigm of PHP 5. First, the integration consists in firstly analyzing the database module's tables. An adaptation is performed upon tables involved in our modules. Once

those changes are done, the tables are integrated into the SPOTLight database. Then, we identify two important code parts: the database queries and the interface rendering. The code is separated into three parts: database queries are introduced into the model layer and the interface rendering code is split into display functions in the controller layer. The view is designed by us, calling the interface rendering functions.

6. Future work
6.1 Authoring tools
An authoring tool is a kind of platform inside the platform itself. Briefly, it is an online system from which we can create elaborated content. It is not merely a word-processor. It should provide efficient features to set up advanced content requiring basics technical skills and a short training period. This feature is quite difficult to choose or to develop because it implies a lot of requirements (Harris, 2002).
- Standards compliance: such as SCORM and W3C for accessible content
- User friendly: it must focus on efficiency, effectiveness, and satisfaction
- Interoperability: including tiers content should not require programming skills
- Media and file support: the authoring tool must offer the author to include multimedia content such as a video.

Moreover, this tool could provide a group ware environment between the author and the pedagogical officer. This online group ware working, like file annotations or version could enhance productivity. This collaboration would let the author to be informed about pedagogical issues in writing online courses that are different to traditional ones.

6.2 Off-line communication
In all existing platforms, it is not possible to communicate to a user while he is off-line. A good example consists in mailing a last minute online meeting cancellation. Any framework must deal with this task, which we aim at creating in the next SPOTLight version. Thanks to a new Adobe technology, Adobe AIR so named, we could design a rich internet application to ensure a communication between the user's computer and the SPOTLight framework. The users would have to deploy this small program on his desktop only one time. Afterwards, the gadget would permanently communicate with the SPOTLight server, as long as there is an internet link. This gadget would alert the learner with a user friendly notification when an incoming private message appears on the server side. This tool could also integrate pro-activity notifications.

6.3 More multimedia sources
Varying the resources format is a challenge for e-learning. As far as multimedia is successfully used in web sites, two mains solutions appear: the use of podcasting and videocasting. In both cases teachers as well as students can publish their content to everybody or only to their virtual community. Moreover, the mobility aspect of these media is an advantage. It makes these solutions useful when students travel a lot by buses and trains... They would be able to watch or listen to their favorite multimedia content whenever and wherever they want.

7. Conclusion
Thanks to the SPOTLight flexibility, no major difficulty appeared during the implementation of all features. This framework can now be called *SPOTLight 2.0*. SPOTLight is now a social network. Students and teachers can all communicate in an easy way with different kinds of tools according to their needs. Furthermore, students can work with it, writing their own content. Information management is part of the framework. The work done so far is a base upon which an authoring tool and other important modules will be added.

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