e-Learning Enhanced Technology Implementation a Virtual Campus Case

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Abstract. In order to select an e-learning platform to implement on a Virtual Campus Project context we have to consider several factors. We present a e-learning framework "paradigm". Then we present possible criteria, for a real scenario, to analyze e-learning platforms and tools where we cover aspects like selection criteria, language support, standards and specifications compliance and the importance of usability and accessibility to the analysis of platforms and tools. We aim to give a perspective of the methodologies used for analyzing e-learning tools, since there are several aspects to take into account when selecting e-learning platforms and tools to implement like the budget you have available and the goals you wish to reach when using the platform.

Keywords: e-Learning, Virtual Campus, Certification Strategies, Platforms and Tools.

1 Introduction

In resemblance with other countries, e-Learning in Portugal emerged as training systems on enterprises and on education only appeared as small pilot projects.

With the Virtual Campus Project, also known as e-U, through its content component, the promotion of e-learning gained a national importance, since all the higher-education institutions adherent to the project have to implement it. The case we present reports to the implementation of this project on a Polytechnic Institute that has about 7500 users, located on an interior region of Portugal.

Through this project, we try to use e-learning as a mean to seek and catch new audiences for the polytechnic education, showing to the public what is taught in these institutions, being not just a mean of teaching but also a way of spreading and sharing information and knowledge.

As we know nowadays there are several e-learning platforms and tools, some commercial and others open source/freeware, so it's very difficult for an institution to choose the best solution to fit their need, always dealing with several problems.

If you want to buy a platform you have to deal with issues like the cost of licensing, installation, maintenance and extensibility of the platform. On the other hand if

you choose an open source and freeware solution you'll deal with issues of lack of/few documentation, support and maintenance.

One of the things that also interferes with the choice and should be considered is the know-how of the future users of these tools, where you have to consider main target of these tools, their previous knowledge and their IT skills.

In order to clarify how to make an analysis of e-learning systems we will present some strategies we have defined, taking into account factors like standards compliance, accessibility, usability [6][8] and the language support.

First we are going to see some current approaches to e-learning platforms both freeware/open source and commercial and also some authoring & packaging tools. Then we will present a proposed e-learning framework and enter in the process of analysing platforms presenting the factors and criteria we use to evaluate them. Finally we present some analysis examples of e-learning platforms and tools.

2 Implementation Process

The implementation of an e-learning solution should contribute to the success of education, becoming an effective complement or alternative to presential classes and should assure synchronous and asynchronous collaboration with application sharing resources and messaging among other functionalities allowing real time interaction between students and teachers.

The institution wants a solution based on technology that allows the expansibility of the functionalities, the assurance of the level of availability, the importation, exportation and integration of information with other applications already developed.

To embrace this new educational/training approach and to implement the e-learning component of the e-U Project we propose a flexible implementation process which has the following great phases: Inquiry to the institution's community to know their necessities in terms of e-learning; Identify the available e-learning techniques and tools; Development/Acquisition Phase; Production phase; Evaluation phase [1].

We propose two distinct temporal strategies to implement e-learning. The first one, the e-U Project Certification strategy, where the implementation of the chosen platform is divided in different phases: installation, functional architecture, training and certification according to governmental predetermined requirements. The second one, the post-certification strategy, where we avail the impact of the platform's usage and start to plan different scenarios so it can best fit our needs in terms of adaptability and extensibility.

2.1 e-U Project Certification strategy

For this phase we technically advise the adoption of an e-learning platform that has consistent functionalities, already applied to several other educational institutions with success, so the number of errors can be minimal and users can acquire knowledge and get familiarized with e-learning. By adopting this kind of platform we can benefit from all the engineering project already made for other institutions.

Regarding the certification process we must cover the e-U Project objectives and a set of requirements that are going to be tested on the content verification process. These requirements are:

1 - Assure the conformance with the level A directives of Accessibility on Web 1.0 contents [11];

2 - Support of Portuguese language and provide information in foreign languages (at least English), regarding some basic contents like the institution identification, contacts and brief description of the courses;

3 - Assure data interoperability through the compliance with SCORM 1.2 and pass the tests of compliance with SCORM 1.2 CTS v.1.2.7 [10].

Current Approaches. Nowadays, there are several solutions to support e-learning, where most of them are content-centred neglecting some important educational issues. We have reference commercial and freeware/open-source current approaches to e-learning platforms/systems, like Blackboard, WebCT, IntraLearn, Angel, Atutor, Moodle, Sakai and DotLRN like shown on table 1, were it can be applied the criteria according to table 2 [7]. Our goal in studying these platforms was to identify strong points and weaknesses, so we could try to use them in order to choose the best platform [1][2].

Table 1. Analysis of e-learning platforms

Tools/Features	Platforms							
	Comercial				Open Source			
	BB	WebCT	IntraLearn	Angel	ATutor	Moodle	Sakai	.LRN
Technical Aspects								
Interoperability/integration	✓	✓	✓	✓	✓	✓	✓	✓
Standards and specs compliance	(1) (2) (3)	(6) (1)	(1) (2) (3) (4) (5)	(1) (6)	(1) (2)	(1)	(6)	(6)
Extensibility	x	x	x	x	✓	✓	✓	✓
Adaptation and Personalization								
Interface Costum. and personalization	✓	✓	✓	✓	x	✓	✓	✓
Choose Interface Language	✓	✓	✓	✓	✓	✓	x	✓
Students previous knowledge	x	x	x	x	x	x	x	x
Courses and Resources adaptability	x	x	x	x	x	x	x	x
Administrative								
Student Manage. / Monitor. tools	✓	✓	✓	✓	✓	✓	✓	✓
Database Access mechanisms	x	x	✓	✓	✓	✓	✓	✓
Produce reports	✓	x	✓	✓	✓	✓	✓	✓
Admin. workflows quality & functio.	✓	✓	✓	✓	✓	✓	✓	✓
Tracking users	✓	✓	✓	✓	✓	✓	x	x
Resources Management								
Content Authoring and Editing	✓	✓	✓	✓	✓	✓	✓	✓
LOs and other types of content Mng.	x	✓	x	x	x	x	x	x
Templates to aid on content creation	x	✓	✓	✓	✓	✓	✓	✓

	(1)	(2)	(3)	(4)	(5)	(6)		
LO Search and Indexation	x	x	x	x	✓	x	x	x
File upload/download mechanisms	✓	✓	✓	✓	✓	✓	✓	✓
Evaluation of quality of resources	x	x	x	x	x	x	x	x
Learning Ôbjects Sharing/Reuse	x	x	x	x	✓	x	x	x
Communication								
Forum	✓	✓	✓	✓	✓	✓	✓	✓
Chat	✓	✓	✓	✓	✓	✓	✓	x
Whiteboard	✓	✓	x	✓	✓	x	x	x
Email	✓	✓	✓	✓	✓	✓	✓	✓
Audio and Video Streaming	x	x	x	✓	x	x	x	x
Evaluation								
Self Assessments	✓	✓	✓	✓	✓	✓	✓	✓
Tests	✓	✓	✓	✓	✓	✓	✓	✓
Inquiries	✓	✓	✓	x	x	✓	x	x
Costs	H	H	H	H	N	N	N	N
Documentation	✓	✓	✓	✓	✓	✓	✓	✓

SCORM-(1);IMS-(2);AICC-(3);LRN-(4);Section 508-(5);Some IMS Specifications-(6);High–H;None–N

E-Learning Framework "Paradigm". The constant evolution that e-learning has "suffering", with the appearance of several kinks of tools and platforms, has made a change of initial vision of this mean of learning/teaching process. So we have tools to make the authoring of the resources, where we can build the content and at the same time we have the possibility to format it and to give it animation. Also we have tools that permit to aggregate resources, that are similar or that we want to apply to some context. These tools, packaging tools, are very important because they introduce a new concept, the concept of portability of resources, permitting that one can transport resources between different environments.

Almost in parallel with the pure LMS (Learning Management Systems) have appeared the LCMS, Learning Content Management Systems that permit the management of content or in a new level the LOs. So, with these platforms we have possibility of accessing the LOs, we have LO repositories and we can search for a specific LO, or in ca archive one.

About the LMSs new platforms have arrived that introduce new features, better communication tools, with the possibility of audio & video streaming, videoconferencing, also the Multilanguage support that permit to reach more people with different cultures, making a new of personalization. Also these "new" platforms try better to reach people with disabilities being compliant with the different accessibility levels of the Web Content 1.0.

So we have all of these tools and platforms at disposition, both in commercial and Open source "world", but what we find to be an "ideal" e-learning system is one that uses theses different kinds of tools, Authoring & Packaging tools, LCMS, LMS and combine them to promote better results for the different actors (students and teachers) of the L/T process.

Is in these context that we find out that its important an e-learning framework that in a sequenced and structured process combine the different types of tools.

In this framework, we can create the resources and convert them to web format and then annotate them with metadata with the authoring & packaging and annotation

tools. Then we can archive the LOs with the LCMS Repository and use them in the courses in the LMS, as we can see in Fig. 1.
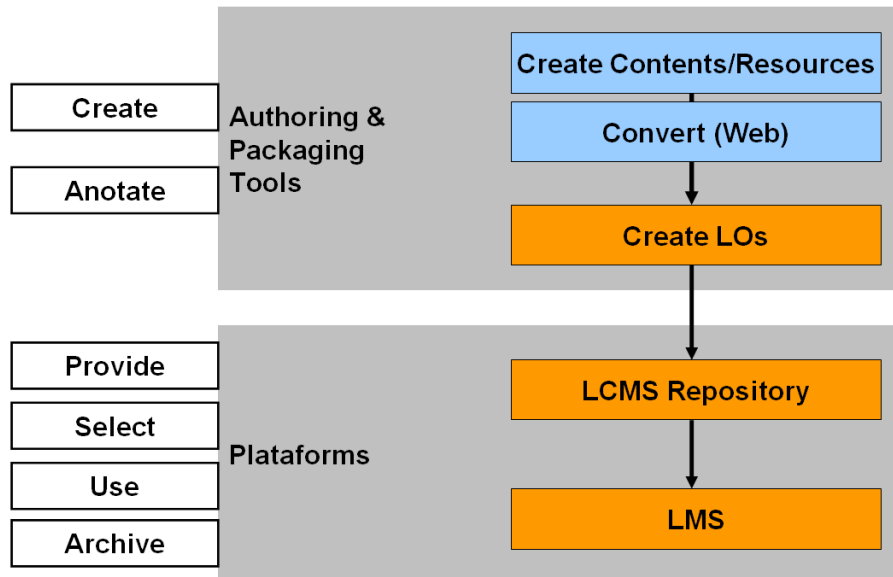

Fig. 1. e-Learning Framework

E-Learning Tools Analysis Criteria. In the process of choosing an e-learning platform we have to choose the criteria to follow. This criteria is the base of a choice of quality but it's also for limiting the solutions to our requirements.

These criteria have weights for distinguishing the different factors and for deciding our choice in the basis of what is important to implement.

To make the evaluation of the platforms we propose the criteria presented on table 2. In the case of choosing a freeware e-learning platform the criteria price should not be considered and the execution team will be technical staff of the institution.

Table 2. Platforms analysis, Criteria and weights

Tools/Features	Relevance	Weight
Technical Evaluation		**55%**
Technical Aspects	Takes into account some technical aspects that should be considered regarding the platforms flexibility	
Standards and specs compliance	The standards and specifications that the platform supports.	
Adaptation and Personalization	Takes care of issues regarding user personalization, adaptation and customization	
Administrative	Takes care of issues regarding the management of the plat-	

	form	
Resources Management	Takes care of issues regarding the management the resources like creation editing and authoring	
Communication	Takes care of the communications tools provided by the platform	
Evaluation	Takes care of the assessment issues	
Usability	Usability of the platform	
Accessibility	Level of Conformance of the web content	
Documentation	Documentation provided	
Execution Team	Execution staff allocated	20%
Price	Price of solution	20%
Execution Time	Execution Time	5%

In the technical evaluation of a real scenario we include the aspects described on the empirical analysis and still include some more issues like the usability (see usability point) of the platforms, the integration with other software already developed or also being acquired, the licensing price, support and maintenance that are issues where we analyse the warranty extension and the training they provide, the availability of source code so you can make changes in the system whenever you want and finally accessibility (see accessibility point).

We think this factor must be the one that has more weight (more than 50%) because it is the most important one since it reflects the features and characteristics of the platform.

In the case of the execution team we evaluate the curriculum of the members of the team that are going to develop or install the platform and also the experience they have.

The Price we evaluate the cost of the solution, by doing a linear equation where the most expensive have less classification.

The Execution time where we evaluate the time the teams takes to implement the solution and the task schedule they present.

Each of these criteria has a final classification that is then multiplied by their weight and summed to get the final classification of a proposal.

Obviously the variation of weight is also directly connected with the factor that we find critical, for example if the price is important or the execution time.

When we are choosing an e-learning system to adopt whether it is commercial or freeware the execution time is very relevant because if you ever need an urgent implementation then if you choose a freeware solution, you have to deal with problems of lack of documentation and configuration for installation, support for the maintenance of the platform, but you also have advantages on choosing these types of solutions like in terms of extensibility, and a higher degree of personalization and customization of the platform regarding the user's desire and also of course in terms of the cost of the platform that is none.

In a commercial solution you have the advantage of the initial implementation, installation and configuration of the platform is more reliable. You have an efficient support, maintenance and training on the platform, but off course all of these have its costs. This kind of solution usually tends to be a closed solution being difficult to develop new components to add to it.

So the choice of the adoption of an e-learning solution depend of the amount of budget you have, the time for implementation, the execution team to do it but mainly you have to base your choice on the functionalities and technical aspects you want the platform to support.

Usability. Usability is not a single dimensional property of a user interface, usability has multiple components and is associated with the following five usability attributes [Nielsen]:

- Learnability – the system should be easy to learn so the user can easily and rapidly work with it;
- Efficiency – The System should be of efficient use so that when user learns how to work of the system he can reach a high level of productivity;
- Memorability – The system should be easy to remember so that the casual user can come back to the system after some period not working with it without having to learn everything all over again;
- Errors – The system should have a low error rate so that users make few errors during the use of the system and in the case of doing errors they can easily recover from them, further catastrophic errors must not occur.
- Satisfaction – The system should be pleasant to use so that users are subjectively satisfied when using it.

Only by defining usability using these measurable components can we arrive to a more precise engineering process where usability is evaluated not just as an abstract concept but as a systematically and objective engineering discipline.

Usability is typically measured by having a number of test users (representative of some scenario) use the system to perform specific task (in a virtual scenario). It can also be measured by testing real users performing tasks while they use the system (production scenario) [8].

*Accessibility.*Tim Berners-Lee, Director of W3C and inventor of World Wide Web, states that "The power of Web is in its universality. The access by all taking away incapacity is an essential aspect." So, taking into account users with incapacities the situation is completely different, that why, nowadays, several countries are now integrating into their laws Internet accessibility issues trying to assure that the reading can be done without using vision, precise moves, simultaneous actions or pointing devices like mouse and the search and retrieval of information can be done through auditive, visual and tactile interfaces [5].

The Web Accessibility Initiative (WAI) of W3C has developed a set of accessibility directives of Web contents, that are related web navigation problematic and with one of the most important principles of accessibility, the principle of harmonious transformation. In practice this principle allows a certain text, audio or image elements to be harmoniously transformed in any of the other two formats (i.e. transform text in audio, audio in text, text in image, image in text, etc.) [11].

In the area of digital information access, mainly through computers, the vision, auditive and tactile senses assume a vital importance. Any perception difficulty by one of these senses bring with it a special need, that in case of information represents a

transformation need according to the user's capacities. In addition to these difficulties we still have the ones with motor character like tetraplegic persons, who are not able to work with the keyboard or mouse.

Nowadays, some of these transformations are possible, thanks to user agents used on Web access, like, navigators and technical helps. Today is possible to transcribe text to audio automatically through a voice synthesizer, text to Braille, make screen amplifications, and modify colour contrast. Meanwhile, there are rules and techniques that Web Designers have to follow to facilitate the work of user's agents in these tasks of adequacy to the user's needs [9].

There are already some advanced solutions regarding the conversion of audio into text (i.e. voice recognition systems), and the conversion of text into image (i.e. avatars for sign language, pictographic language for persons with cognitive deficit), but they are not used very frequently on Web. This demands an additional work for the creators of Web pages in order to reach the so desired harmonious transformation. By providing and audio track it is necessary to have an equivalent textual and sign language description to make the message clear to def persons.

But it is not only the persons with special needs that benefit from information that include the accessibility directives. When these principles are applied, they make web contents to become accessible to a wide variety of web navigation devices, such as telephones, portable hand assistants, news stand, network applications, etc [3]. By making contents accessible to a wide variety of devices, these contents are also going to be available to persons in a wide diversity of situations. The technology itself gains "reading capabilities" and "interpretation". For Example, search engines acquire the capacity to make searches in audio tracks and even in elements as images. Sometimes navigators are able to identify indexes in a huge collection of documents, and can negotiate with the server in which is the preferred language of the user. Technologies like screen readers, for use with blind users, gain a capacity of distinguishing a paragraph from a header.

So, the challenge of accessibility is enormous but at the same time fascinating.

In order to implement accessibility the WAI of W3C has separated those directives in three different levels of priority:

- Priority 1 – Issues that Web content creators have to satisfy absolutely. If they don't absolutely satisfy them one or more groups of users will be unable to access the information included in the documents. The satisfaction of these issues is a basic requirement so that determined groups of users can access to information available on the Web.
- Priority 2 – Issues that Web content creators must satisfy. If they don't satisfy them one or more groups of users will have difficulties to access the information included in the documents. The satisfaction of these issues is traduced in the removal of significant obstacles to the access to information available on the Web.
- Priority 3 – Issues that Web content creators can satisfy. If they don't satisfy them one or more groups of users may face some difficulties on the access to the information included in the documents. The satisfaction of these issues will improve the access to information available on the Web.

2.2 Post-Certification strategy

Before the end of the first year of usage of the platform it is important to choose the strategy to follow as well as to analyse the impact of the platform.

In order to make this analysis we should consider the data that comes from the collection of statistics about the platform usage and from the community inquiries about the level of satisfaction of the platform usage.

After this analysis, a new strategy of e-learning should be chosen that may pass by the following scenarios:

    a.   Continue with the current platform
    b.   Start looking or develop a new one
    c.   Combine different solutions

3 Conclusions

In similar projects of campus Virtual like e-U project, the implementation of e-learning and more spherically the analysis of platforms and tools must consider the context. Preferentially you may choose a more reliable platform error free giving wide vision on e-learning. Gradually it should walk for the development of a platform that would best fits or needs.

As we have seen the paradigm of analysing an e-learning system involves a whole process and deals with many factors.

First we have to know the e-learning system and tools we want to analyse, because we have several LMSs, LCMSs and Authoring and Packaging tools. We have to make that choice regarding the architecture of the system we want to implement.

After choosing the framework we have to see we are doing an empirical analysis or if we are choosing an e-learning system to implement in an organization.

In real scenario, we have to consider the environment and the factors regarding the implementation of the e-learning system, so we have to define the criteria and its weights for selecting a platform that gives a good functional perspective of e-learning

In this analysis we have to take into account more context and project management factors than on an empirical analysis.

Another sensible factor that should be considered is the accessibility, where the system should respect the accessibility directives of Web contents (at least level A) regarding users with incapacities. It is important that the system is accessible to everyone.

Finally, the system should support several languages - the native language of the country where the platform or tool is being installed and provide information in foreign languages – preferentially English and optionally French or Spanish.

So, analysing and choosing an e-learning system requires planning and knowing very well the variables and factors of the choice.

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