An Insight on E-Learning and Cloud Computing Systems

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In this paper, there is a review of e-learning and its elements according to the international standards. The connection of learners, educational material and open source learning platforms is investigated. Trivial educational activities that can be implemented in a LMS are also presented. A special report on a computational model for e-learning, emphasizing on learning graphs and conditions passing from one node to another, is made. In this framework the benefits of cloud computing as a model for e-learning are presented.
Keywords: *E-Learning, Cloud Computing, E-Services*

1 Introduction

The learning process is almost indefinable [1]. A large volume of each man's knowledge comes from informal processes of learning that is observing, asking, testing (through trial and error) and by applying heuristics (heuristic) methods.

Formal education and training tries to convey knowledge and learning techniques using structures, tools, and methods based on different learning theories.

Computers and networking tools currently are used to support and to simulate teaching. They tend to incorporate characteristics that approach the learner needs, in the teaching framework.

At the same time, because of the nature and potential of these tools, some restrictions that are forced to formal education are lifted. Such restrictions are the space-time constraints, and thus conditions that approach the informal learning are created. In this framework we investigate what e-learning is, why it is developed and why it is used. Moreover we examine the effects of cloud computing in e-learning.

There are many different definitions of e-learning. Most of these refer to terms such as learning, knowledge, education, and training. We can formulate a general definition of e-learning, focusing on learning processes that take place in formal learning environments.

The sets of systems that exist and evolve continuously to support such processes offer useful tools for teachers and also dynamic environments. They also encourage interactive study for learners, as will be discussed below. In secondary and higher education at international level e-learning is used as an auxiliary tool in educational process. Moreover, e-learning is very good for training. Many companies like Cisco or Sun have created high level studies, which are implemented with the use of such tools.

But what are the components of learning? What are the key processes taking place during learning and what are the interactions between components of learning?

The components of learning are:

• The People.

On the one hand is the learner who will go through the learning process and will interact with the teacher, the other learners and the learning material. On the other hand is the teacher who will define the learning resources and will give instructions for the execution of the learning process.

• The Content.

Educational material and resources can be anything from a simple object, such as a stone or a text to a very complex digitized object such as an interactive e-book.

The configuration of educational material and how it can be used depends on factors like learners' level, their knowledge, their culture.

Figure 1 shows the basic components of learning and the interactions that occur between

DOI: 10.12948/issn14531305/18.4.2014.02

them. In a typical educational process, the material that will be used, is selected either by the teacher or by specialists that may be not teachers.

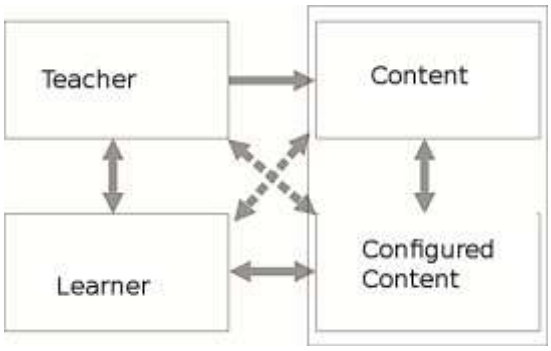

Fig. 1. Components learning and interactions

This depends on the criteria that have been placed, taking into account all necessary data. Also the educational material should be properly arranged, structured and organized in accordance with the learning model (theory) that is chosen, or according to the curriculum which is followed.
The learner interacts with the configured educational material, based on directives that have been incorporated appropriately in it. Additionally learner interacts with the teacher, and perhaps with other learners, either directly or indirectly.
The interactions that occur are usually dynamic. It is possible during the learning process, to change both the available educational material and also the instructions that were initially included in it.
It is also possible, each type of human resource shown in Figure 1 to include more than one people and perhaps with different roles assigned to them. It is evident, therefore, that the terms "teacher" and "learner" refer to, directly or indirectly, involved people in the learning process.
Moreover, the teacher is not necessarily required in all phases of learning. For example, one can learn the use of the pencil experimenting with a pencil and a piece of paper without necessarily to be taught by someone. The learning process in this case is carried out through observation and experimentation, where the learner interacts directly with the materials.
The interactions mentioned above, in the standard education / training, are conducted by a "Management System" which usually is not simple. It consists of items (resources, people, structures, tools) which are combined together. The interactions among teachers, learners, material are carried through this system.

Fig. 2. Interactions among components of a MS

E-learning aims, through technology, to support the realization of such interactions. E-learning systems have a set of components and tools that support learning processes.
We therefore formulate the following proposition:
"E-learning is the automation of learning process (education and / or training) through the use of information technology (IT)"

2 Categories of e-learning systems

The e-learning systems can be classified, depending on the side from which we see them in broad categories [2]. These categories have common characteristics, but obviously they have differences too. The vast majority of these systems refers to the distance education/training. For most such systems, the concept of traditional real class is extended to the virtual classroom which in general simulates traditional class and expands its possibilities and freedom to space and time.
In guided virtual classroom simulations the learning processes take place simultaneously and in real time for all learners. This can be implemented using communication technologies such as video conferencing, etc., without been essential that all learners or the teacher

DOI: 10.12948/issn14531305/18.4.2014.02

to be in the same room.
These systems are called synchronous e-learning systems. Although they are gradually more and more usable they face limitations mainly because of the cost of operation and because of their time limitations; all learners and the teacher need to participate in the process simultaneously. Synchronous e-learning systems could also be characterized the closed type educational software systems that are used in organized classrooms using PC (CD-Rom, etc.).
A second category is the asynchronous e-learning systems. Asynchronous systems are those that dominate nowadays and are based on web technologies. Their wide dissemination is mainly because, by their nature, enable the learner to learn according to the pace and the time he wants. They also allow the teacher to guide according to needs of each individual learner. These features are important since learning pace, previous knowledge and special skills and interests are not the same for everyone. Also, the time of actual learning process may not be the same for all learners e.g. members of a group of employees in a company that have to be trained on a subject that concerns the activities of the company, may not be all available at exactly the same time of day. Thus, an asynchronous e-learning that runs on the internet or the company's intranet is preferable than a synchronous learning system. Furthermore, asynchronous learning is more adaptable to systems of distance learning, which spread rapidly nowadays.
Looking at the e-learning systems from another perspective, the economic, we find that there are commercial packages that have been developed by specific companies and they are evolving. These are sold with a specific number of licenses.
On the other hand, large companies, such as Cisco, or Sun and others have developed e-learning systems mainly for their products. These systems are installed and run on these companies or cooperating agencies and everyone can have graded access and participate in courses which may also lead to a qualified training. Particular interest presents the MIT Open Courseware [12], a system developed by MIT with philosophy and concept of free access to information sources and knowledge around the world.
Open source systems are e-learning systems developed by working groups, based on the philosophy of open source code. They are available not only for use but also for completion - development to anyone. Several organizations, especially universities develop and use such systems. Also, at the secondary and primary education are almost exclusively used open source e-learning systems.
The e-learning systems have some common characteristics:
• Use web-based technologies (Internet).
• Used mainly for open, distance learning, that is teachers and learners are not in the same place.
• Provide tools for creating and managing content – educational material.
• They enable monitoring of the learning process.
• Provide tools of communication between teachers and learners.
• Contain tools for human resource management, ie teachers, learners and possibly technicians that manage the system. This way their roles are separated and therefore the rights to use system's services are also separated.
• They have assessment tools that allow self-assessment.
• They consist of components each of which is responsible to support certain process - the process is usually simple e.g. such a division could be a text or html authoring tool that is supportive of the educational material creation process.
• The sections communicate and supply each other with data or services. For example, a content presentation element can provide a service or a query tool to feed data to another tool or to create a learning route.

3 Standardization

The e-learning systems operate through parts that constantly talk to each other by exchanging data and information. This continuous exchange of information between system components and the way they grow creates the

DOI: 10.12948/issn14531305/18.4.2014.02

need for standardization [3].
These standards define how constant exchange of information between parts of the e-learning system takes place and exactly what form should have the data exchanged between them. This is important because the necessary conditions for proper communication between the parts of a e-learning system are created. Moreover the possibility of easy development and sharing content between different systems is enhanced.
The developed standards mainly refer to the way in which the content - digital material – is mixed and converted into learning material and how the student interacts with it. Also, they refer to the communication between people and the interactions between them and underling platform (Learning Management System)
Nowadays prevailing standards have been developed by working groups or organizations some of which are:
1. AICC (www.aicc.org): International group that designs and creates computer based training related guidelines for the aviation industry. The standards in the area of e-learning mainly refer to computer-managed instruction (CMI) guidelines.
2. IEEE (www.ltsc.ieee.org): An international organization that develops technical standards and guidelines for Electrical, Electronic, Information and Communication systems. The Committee of the IEEE Learning Technology (Learning Technology Standards Committee (LTSC)) provides specifications for how to create templates. The most widespread specification is indicated in the metadata of Learning Objects (Learning Object Metadata (LOM) specification).
3. IMS Global Consortium (www.imsproject.org) Instructional Management Systems - Global Learning Consortium: IMS is an international non-profit organization that includes more than 50 members - organizations from each field of international e-learning community. Its members are manufacturers of hardware and software, educational institutions, publishers, government organizations, groups of systems development, multimedia content providers, and other consortia. The Consortium provides a forum where members with common business interests cooperate to meet the requirements of real world for interoperability and reusability. The IMS focuses on developing standards that define how e-learning systems communicate with back-end applications and learning objects or libraries.
4. ADL (www.adlnet.org) Advanced Distributed Learning of US Secretary of Defense is a government organization that researches and develops specifications for e-learning. The most widely common specification of the ADL is Shareable Content Object Reference Model (SCORM). The SCORM specification combines the most important elements specifications of IEEE, AICC, and IMS.
5. ARIADNE (www.ariadne.edu) Alliance of Remote Instructional Authoring & Distribution Network for Europe.
6. DC Dublin Core (http://dublincore.org/) The Dublin Core Metadata Initiative.

The standards are based on the following principles - needs:
• Reusability: The ability to reuse educational material as a whole or portion of it as it is or with minor changes. The same educational material can be used in different levels, with the necessary adjustment by different teachers and learners.
• Accessibility: The ability to have access to educational material as many learners and teachers as possible, even with different learning profile.
• Interoperability: The ability of two or more systems or their components to exchange information and use the information exchanged.
• Manageability: Possibility of exchanging and storing information for users and content.
• Durability: Ability of continuous improvement and use during time.
The following are two of the main ingredients of standards developed that is Learning Objects and Learning Management Systems.

4 Learning Objects - SCORM standard

In the following there is a reference to the key elements and features of the specifications and

DOI: 10.12948/issn14531305/18.4.2014.02

standards currently used for the organization and description of accessible and reusable learning material [4].
An important term is learning object. "A learning object is any digital or non-digital piece of information (resource) that may be reproduced and be addressed in order to be used for carrying out learning activities."
The previous definition of IMS LOM defines the characteristics of a learning object: It defines the material it comprises, namely the learning material and the purpose for which it will be used. Any material - digital or not digital - can be transformed to learning object if it is added the purpose and the way in which it will be used for a learning procedure. At this point we can observe the following:
• The same learning material could potentially be used to different ways and at different levels. Many learning objects with different learning goals can be created using the same material.
• The same learning material can be used in many different courses offered by different or the same organization. We must determine the information that will accompany the material to provide a learning object such that it is reusable, as stated in above definition.

5 Metadata

The information about the learning material itself is called metadata. Metadata and educational data together constitute a learning object. Metadata that accompany the learning material should have a particular form suitable for reuse and search [5].
Meta-data, in a general sense, is information that is referred to many different types of objects. It is data about other data. They accompany the data and provide information on various characteristics of the data like the type, use, semantics, etc. For example, in a photo gallery, the photographs are data and information such as the date or name of the photographer who did the shooting, are the metadata attached to each picture. Metadata are used in the management of data. Without them, it is very difficult to identify the data, especially when the volume is very large.

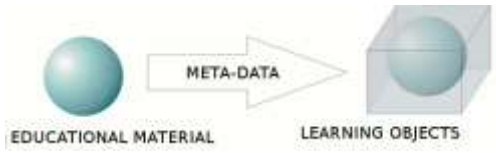

Fig. 3. From educational material to learning objects

The meta-data related to learning objects are a set of fields that have specific information and follow particular structure and rules. Some examples of them are: title, language, description, keyword, education level, version, date.
A set of learning objects could also be a new learning object. In the various levels of formal education and/or training the following data structure is common:
Each of these parts of the above structure could be a learning object. It is just needed to add to it the appropriate metadata. However, usually with the term Learning Object (LO) we refer to relatively simple objects.
The basic standard for the meta-data related to learning objects is the IEEE LTSC LOM [7].
The definition of learning object according to this model as given in the beginning of the paragraph refers to any part of information that can be used for learning activities. It can be of any size, small or large, provided it has the appropriate embedded metadata.
This is very general and practically not particularly useful for the purposes of e-learning. For this reason, in the literature are found various similar definitions of Learning Objects that differ mainly in the size of the learning material.
These differences have the principle purpose to bring the definition near to the system used. It is also a classification effort of material, without defining always clear and common criteria.

6 Learning Objects

Definitions and discussions on learning objects highlight some commonly acceptable characteristics: The learning objects are digital, reusable, oriented to support learning processes. Thus, from the general "anything" we can come to a widely accepted

DOI: 10.12948/issn14531305/18.4.2014.02

definition of learning objects based on commonly accepted characteristics. The following definition is more compatible with the purposes of e-learning:
"Learning object is any digital piece of information whose purpose is to be used for learning processes".
While the learning objects by themselves have some value, however, combining them in groups with clear succession instructions is recommended for educational activities or parts of educational activities. So, are there rules according to which these combinations can be made? In what ways are illustrated and organized the elements that constitute an educational activity in order to be easily accessible and reusable?

7 SCORM and IMS package

As an answer to these questions, a set of norms and rules has developed. This set is called SCORM [8]. It stands for Sharable Content Object Reference Model. It is a set of standards and regulations primarily for web-based e-learning that refers to the organization, development and distribution of learning content.
The SCORM originally developed by ADL but in its current form SCORM 1.3 is based on a more complex concept, (sequencing) which is a set of rules under which the student will experience the objects of the content. The standard uses XML and is based on the work and participation of AICC (CBT), IMS Global Learning Consortium, IEEE13 and Ariadne1. Also, SCORM, specifies how learning content can be "Packaged" in a compressed file (.zip). This compressed file contains the records of learning objects and resources, but also a file header that is called manifest.xml. In it, there are all the information - metadata - that are necessary for complete identification of the material present in the compressed file, that is the SCORM object.
Another specification of packaging learning content is that of the IMS, the IMS content packaging. As shown in Figure 4, each IMS packet consists of two key elements. The first is the file manifest, which is an XML file is named imsmanifest.xml. This file, as in SCORM contains information about the content and metadata of the learning materials. The second consists of all resources included in the packet.

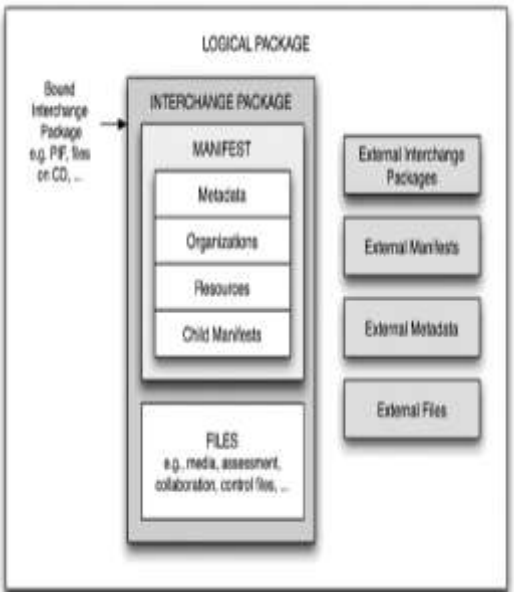

Fig. 4. IMS content packaging [13]

The packets whether in SCORM or IMS content package standard, can be created and managed in accordance with the corresponding specifications, through appropriate software that is developed. Typically, this software offers tools not only for the creation and management of such objects, but generally is used for e-learning activities.
As a software to create and manage SCORM packages we mention the Reload Editor developed by Reload Project [9]. This is open source software. It can create SCORM or IMS packages through graphical interface. The corresponding program Reload Player, can handle such objects.

8 Learning Management Systems

An LMS (learning management system) is software used for planning, implementing and supporting learning processes.
The above definition is very general and applies to processes and interactions of Figure 1 and Figure 2. As it is already explained, the

DOI: 10.12948/issn14531305/18.4.2014.02

learning components are grouped into two categories. In the first category fall people who are involved, that is teachers, with different roles and learners. In the second category fall educational material and learning objects.

8.1 Users and Roles

People who use an LMS, teachers and learners, are the main users of the system. Teachers can use the system in different ways, depending on their position. That is, in a course can be involved more than one faculty but each of them can have a different role. For example, in a course of distance learning, a teacher may be the one who monitors educational process and guides students. Someone else, the author, may have designed and placed the learning material. Finally a third teacher can be the coordinator of the entire process. These roles are distinct but this does not mean that for every role there is necessarily a different user. Most LMS give teachers the ability to access almost all the tools and decide themselves which of them will use.

An LMS provides functions to teachers to create or to manage learning material and to monitor and control the progress of learners. Also it enables learners to interact with educational material and communicate with their teachers and with each other either directly or indirectly.

8.2 Key features of LMS

In this section we discuss the key characteristics of a learning management system or an asynchronous e-learning platform that verge on learning processes. The developed LMS vary depending on the type of e-learning they support [10]. The asynchronous e-learning systems are based on client - server software architecture. A client is connected to a server in which LMS software and the necessary material are installed. Access to the LMS is usually achieved via a web browser. The client computer does not require any special software except perhaps a plug in or some additional tools such as flash player, which are handy available.

A learner, during the study of a subject comes into contact with learning objects. It may be necessary to take notes, to exercise, to think, to read, to try to create and answer questions and discuss with other learners or to contact the teacher. The teacher prepares the teaching approach using the digital material he finds ready or creates himself and incorporates instructions, creates learning paths - sequences for each learner. Before starting the learning process separates learners into groups based on specific criteria. He also monitors the learning progress of each learner and intervenes accordingly either by changing the learning sequence, or by giving some instructions. Finally, he collects data and makes observations to evaluate the learning process and amend or alter the required learning objects.

According to the above discussion, an LMS should be able to perform the following functions:

Course and learning material management:

1. Create material – resources
2. Convert material to LO
3. Create LOS
4. Position the LOS in a proper structure (sequential - branch - iterative)
5. Create courses
6. Monitor courses
7. Guidance of learners according to their individual needs
8. Communicate with learners

Learner management

1. Create, manage learners
2. Create; manage classes - groups of learners

Database functions

1. Record data
2. Analyze Data

Thus, an LMS should have:

1. Tools for the construction and management of LO.
2. Tools to create and manage courses. These tools should have an appropriate interface for both the side of the teacher and also the learner's side.
3. Communication tools or access to communication tools such as forums, bulletin boards, e-mail, chat, etc.
4. Tools for keeping notes.
5. Database functions.

In terms of system management tools have to

DOI: 10.12948/issn14531305/18.4.2014.02

be provided for management, monitoring, security and user access classification. Optionally tools for backup, recovery and helpdesk should be provided.

9 Definitions

During operation of an LMS that has these characteristics interactions between its components take place and its services are used In most LMS the structure of teaching activity corresponds to the one is shown in Figure 5.

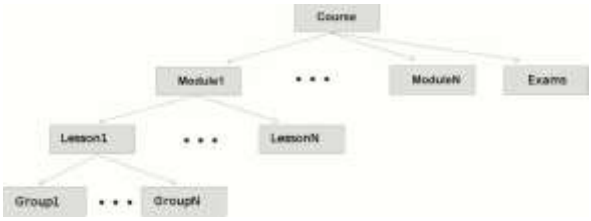

Fig. 5. Structure if teaching activity

As already mentioned a learning object (LO) is any digital material intended to be used for learning. Any action (task) that aims on learning and has a learning effect is a learning task (LT).

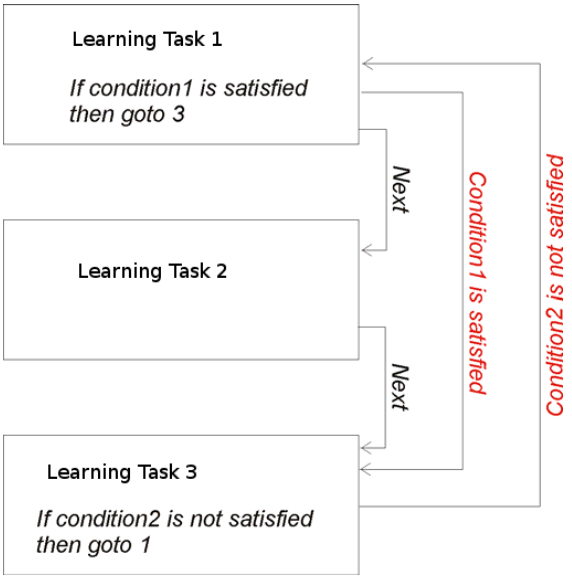

Fig. 6. Structures of learning activities

A learning activity is a pair (LO, LT). Transitional Condition (TC) is a proposal that can be converted into logical proposal according to the state variables of the time of execution. The values that can take the condition as reasonable proposal are either 'true' or 'false'. The learning activities in accordance with the design of the teacher are performed sequentially one after the other. The transitions from one learning activity to another take place through the transitional conditions and possibly by the path followed by a learner, whether he belongs to a group or not. In the general case this is different from any other that might be followed by someone else. This is ensured by the use of transitional conditions.

The transitional conditions receive data from the system or by the users of the system during execution. These data can be produced by:

• An exterior fact to the learning process:
a. Time: Time limits may be set by the design of a learning sequence. For example, statements of the form "Trigger the learning activity n for date > 15/10/20014" where n is the proposed solution of a project or "close the learning activity n one hour after activation of learning activity" where n is a test multiple choice question, can be transitional conditions with time control.
b. Instructor directive: In some parts of the learning sequence, depending on the course, learner may be directed to different path based on the teacher's directive.

• Results obtained from the execution of an LO: The results are internal to the learning process, in the sense that they are stored in the database system. Moreover they are used directly by the system, without the intervention of either the teacher or the learner. Results for example may be:
a. Results of a test: e.g. "if the degree is <5 then repeat the study in Chapter 2"
b. Complete a self-assessment exercise (successfully or unsuccessfully): e.g. "if success rate> 50 then continue in the learning activity n otherwise go to the learning activity m".
c. Annotated exercise by the teacher: e.g. "if the answer to Question 1 is different from the target solution, then repeat the study section 2"

•Subjective mood, such as:
a. Interested in a topic: "If you find interesting the X then go to learning activity n"
b. Understanding: "if you have not understood the X then study the Learning object m".

DOI: 10.12948/issn14531305/18.4.2014.02

• Purpose–learners identity: "If the student is a freshman then perform the learning activity n otherwise perform learning activity m".

If we design the set of possible paths with transitional conditions then a flow chart will result. In the general case, there will be sequential structures, branching structures and looping constructs in it.

Figure 7 shows a portion of a set of learning activities, which is composed of distinguished, sequential, branching and iteration structures.

Learning Environment (LE) is a directed graph (LAs, P) which LAs is a set of LA and P: LA → LA is a set of transitional conditions.

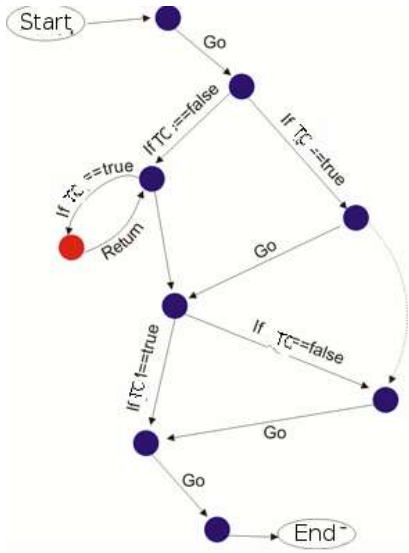

Fig. 7. Learning environment graph

In the above figure, nodes represent learning activities and the edges transitions from one learning activity to another. The transitions are not random but made by a condition, the transitional condition (TC). TC is shown as label at the top of edge.

10 Open source LMS - Functional requirements

The asynchronous e-learning is usually based on the internet (web). Access to learning material and services is through a simple web browser for all users. For these purposes asynchronous e-learning, platforms have been developed.

These platforms should satisfy the characteristics mentioned above. Some of those are targeted at specific user groups but most of them are for general use. The e-learning platforms are divided into two major categories that is commercial and open source.

The open source LMS platforms are those in which the source code is available for use and modification. These are mainly used by educational institutions at all levels of education and training. They are quite attractive mainly because they have minimum initial cost and evolve rapidly.

In the following are given a few key features bundled for learner, teacher and system administrator These features can be regarded as functional requirements for open source Learning Management Systems :

Tools for learner:

1. Interface setup
2. "Notepad" and general store.

Tools for the teacher;

1. Interface setup
2. Create and manage course material
    a. Support of various file formats (text, image, multimedia, etc.)
    b. Integrate metadata – LO
3. Tools supporting learning material (e.g. programs, etc.)
4. Integration of external tools (e.g. Web browser, search engine, etc.)
5. Ability to create learning tasks
    a. Sequential structures
    b. Transitional Conditions (branches).
6. Ability to create benchmark assessments for learners
    a. Multiple choice Questions
    b. Tests
7. Management tools for group of learners (grades, etc.)
8. Monitoring tools for learners' paths.
9. Automatic data collection
10. Tools and performance monitoring (e.g. grading)

Communication tools:

1. Asynchronous (e-mail, forums, etc.)
2. Synchronous (Chat, VoIP, video conferencing, etc.)

Management Tools:

1. Roles: Ability role assignment to users (actors) of the system. The users of the system are

DOI: 10.12948/issn14531305/18.4.2014.02

learners, teachers, system administrators and optionally auxiliary personnel.
2. Safety: Ability to have graded access according to their roles as users of the system.
3. Database:
    a. Ability to import and manage data of learners, faculty and staff.
    b. Records learners' activities on line
    c. Evaluation data for learners.
    d. Tools for statistical analysis of these data
4. Installation
    a. Learning material required.
    b. Additional software required to run the system
5. Monitoring resources, backup, recovery
6. Helpdesk for
    a. Learners
    b. Teachers

11 Cloud computing

The term cloud computing [11] refers to an architecture that makes possible the access and use of web applications. The name is derived from the way the Internet is often represented in network diagrams. No special locally installed software a client needs, except for a web browser, to accept various services. The following categories of service are identified:

A. SaaS which stands for Software as a Service: This type of application is one which lies on a cloud server and the user can access it via a simple internet connection. The software belongs to an owner and the user pays depending on the use and the resources needed. The main advantage of the model "software as service" is that the manufacturer is responsible for the costs of software maintenance and hosting in a cloud server. The user pays only for the use he made. We mention though that there are cloud applications which are free. Also SaaS model is crafted with a keen eye to the proper functioning of the software application using only a browser. Regarding the safety of various applications, commonly is used the SSL protocol (Secure Sockets Layer) which is recognized worldwide.
B. PaaS which stands for Platform as a Service. This model is very similar to the previous one. Its main feature is that it provides the platform which the user uses to create something, for example a web application, without having to install anyhing." PaaS model is used mainly for creating web interfaces, web applications, etc.
C. IaaS which stands for Infrastructure as a service. In this model there is an online storage-provider who actually rents hardware resources. These resources can be disk space, CPU, memory, or even dedicated servers. Users pay some fee depending on the amount of resources they rent.

11.1 Basic models of Cloud Computing Applications

Public Cloud

This model is created by hundreds of web servers and too many datacenters running in different parts of the world. That way the user is able to use a service by selecting the preferable location of the application. Usually chooses the closest to him datacenter. Companies that offer the public cloud model are: Google, Amazon, Rackspace etc. The implementation of public cloud is backed by robust economically companies because the development and maintenance of webserver and datacenter worldwide costs a lot of money.

Private Cloud

This model of cloud technology is applied in organizations where an internal network exists and the cloud service is offered only internally Community Cloud.

There are cases though where specific groups of users belong to different organizations but share common computing concerns. From the one hand they want added security but on the other hand they want the benefits of a public cloud. In this case the community cloud model is appropriate.

Hybrid cloud

In the hybrid cloud model some resources are provided internal to an organization and some others are provided externally. It can be seen as a composition of two or more clouds.

DOI: 10.12948/issn14531305/18.4.2014.02

11.2 Benefits for e-learning

E-learning systems can benefit from cloud computing in terms of infrastructure, platform and software applications [6].

The cost is low: The e-learning applications run on provider's infrastructure so the need to keep high end computers and highly qualified technicians is eliminated.

There is no burden of maintenance. Software updates are done by the providers. Moreover providers make possible hardware failures transparent to users.

Although security is always a concern for the user's one can note that:

a. The physical position of the resources that host platform, applications and data is unknown to the users. This makes harder possible attempts of abuse.
b. System backup and recovery processes fall in the side of provider.

Learners and teachers benefit from cloud computing since they gain independence from time and space. They focus on learning processes instead of dealing with computer technicalities.

Performance matters again fall in the side of provider. The communication bandwidth can be an obstacle for an institution when the number of users that access an e-learning system increases.

Monitoring is easier since central control takes place and there is a unique entry point in the system.

On the other hand users are concerned with the quality of service that the providers offer. The services have to be reliable, robust and available any time the user needs them.

Another concern is security and privacy matters. The risks of hacking make many users think twice about storing their data outside their organization.

12 Conclusions

In this paper we review e-learning and its elements. Special report is made on a computational model for e-learning, emphasizing on learning graphs and conditions passing from one node to another. We also elaborate on cloud computing and how e-learning benefits from it.

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DOI: 10.12948/issn14531305/18.4.2014.02