

Study Cases on eLearning Technologies Used by Universities in Romania and Worldwide

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Abstract: - eLearning is a term broadly used to describe the process of learning with the use of informational technologies and tools, usually through a web page. Nowadays it is hard to speak about eLearning without implicitly including an eLearning management system and new informational technologies. A learning management system (LMS or LCMS) is used to deliver educational material and manage interaction between students and tutors. LMSs can be open source, commercial or developed in-house by the universities. Tools like audio/ video conferencing, streaming, podcasting, social software, RSS feeds, can be incorporated into the LMS or can be subsequently added to the learning system as individual modules. This present paper seeks to establish the current state of eLearning technologies, both worldwide as well as in Romania.

Key-Words: - LMS, CMS, LCMS, VLE, eLearning, informational technologies, podcasting, RSS

1 Introduction

A short presentation of the most important eLearning systems is in order before describing the ones implemented by universities worldwide. These Content Management Systems (CMS), Learning Management Systems (LMS) or Learning Content Management Systems (LCMS) are available in different types: open source, commercial or developed in-house. Institutions opt for the most suitable variant, according to its requirements/ financial possibilities ratio.

In Kaplan-Leiserson revised glossary CMS has the following definition: a software application or a set of applications that facilitate the process of designing, testing and publishing of educational content, usually on Web pages [1].

LMS is a term used to describe a wide range of systems which organize and provide access to online learning services to tutors, students and administrators. These services usually include access control, delivery of learning content, communication tools and organizations of user groups. Another term that is often used as a synonym to LMS is learning system [2]. A LMS is usually designed to handle courses by multiple publishers and providers. It usually does not contain its own authoring tools. It focuses instead on managing courses created by their sources [1].

LCMS is a software application which allows tutors to manage both administrative and content related

aspects of the training process. A LCMS combines the management capabilities of a LMS with the content creation and storing features of a CMS.

VLE (Virtual Learning Environment) is to some extent synonym to LMS, with the difference that VLE concentrates less on the characteristics related to the management of learning. A learning environment is a software product designed as a complete solution for online learning.

Further on I will refer to all of the systems presented above as learning management systems or LMS.

Tools like: podcasting, streaming, audio/ video conferencing, social software, blog, wiki, RSS feeds, TV, radio, and so on, can be built-in the LMS or can be later added to the learning system, as independent modules. Universities have also the possibility to use external platforms with educational purposes such as iTunes U and Second Life Grid.

The present paper seeks to determine the current worldwide situation of eLearning. It starts with the presentation of eLearning on different continents, continues with a couple of case studies on various LMSs and their use in universities worldwide as well as in Romanian universities, followed by a study on informational technologies included in the eLearning process of a few of the most prestigious universities in the world and finished with a set of conclusions regarding the presented work.

2 Worldwide eLearning

At the end of 2004, the Organization for Economic Co-operation and Development (OECD), a unique forum comprised of governments from 30 democracies, conducted a study on the use of eLearning as an alternative or complementary method to improve learning in universities. The study involved 19 institutions from 13 countries and it sought information on institutional strategies and activities, students' access to eLearning, available material and staff and government financing. The result of the study, published in 2005, show that in most of the campus-based institutions, eLearning is not a challenge for the traditional learning process, which requires face-to-face meeting between tutors and students. As for delivering educational content to students abroad, this often remains a small scale experiment, mostly conducted by departments of prestigious universities. Nevertheless, the use of eLearning technologies in the higher education institutions is rising to meet the individual needs of students. Governmental financing and the availability of tutors to teach using new methods is higher every year [3].

E-Learning finds its best usability in distance learning, where sometimes it is the only way of delivering learning material. The starting point of distance learning was the establishment of the first university with learning delivered entirely from the distance. This happened in 1960 in UK and the University has been known since then as the Open University (OU). The University was founded on the belief that communication technology can bring a high quality education to individuals that cannot attend traditional courses. The concept spread rapidly all over the world and it developed especially in countries with problems concerning the long distances that students had to cross in order to attend traditional courses. This is the case of Australia, Canada and northern European countries. Virtual communities are the distance learning's backbone, mainly because they are means of delivering interaction between students and tutors. In order to achieve this, universities can opt for any of the LMSs described in the next section.

Further, I shall present a few of the most important eLearning initiatives on the following continents: Europe, Australia, North America, South America, Asia and Africa.

The biggest provider of eLearning is **North America**, with universities like: OU Athabasca from Canada, Stanford, Harvard, Princeton, Purdue, Duke, John Hopkins and so on. Amongst these, Duke University from North Carolina distinguishes

herself in the eLearning field, due to the 2004 Duke Digital Initiative (DDI) which consisted of free distribution of iPods to first year students. The purpose was to ease the students' access to online educational content. Starting with 2007, DDI has been supporting audio and video recordings of the courses. Tutors and students could access teaching material after authentication on the following web page: <http://itunes.duke.edu/> [4].

Europe became the cradle of Distance Learning in 1960 with the establishment of the first OU. Nowadays, the OU is the biggest and the most innovative university in UK, currently with over 200.000 enrolled students from all over the world. Open universities are also a part of the Finnish educational system. A number of 19 universities supply educational material and courses for the OU portal, accessible to students from the following address: <http://www.avoinyliopisto.fi/en-GB>.

Nevertheless there is still a considerable difference between the North American eLearning system and the European one.

Australia is also an important supplier of distance learning through Open University Australia. OUA - <https://www.open.edu.au/wps/portal> - is a corporation formed by a few Australian universities and colleges, seven of these being also the owners of the corporation. The following universities are among the course providers: Curtin, Griffith, Monash, RMIT, Swinburne, South Australia.

Open universities from **Asia** have common goals, namely to offer a greater access to educational materials through multimedia technologies to those who cannot attend higher education traditional courses [5]. China has, since 1979, the CRTVU system (China Central Radio and TV University), a distance learning institution which offers multimedia courses through radio, television, print and audio/video materials (<http://www.edu.cn/20010101/21803.shtml>).

Besides China, a few other Asian countries distinguish themselves by offering distance learning to their students: Thailand (OU Sukhothai Thammathirat and Cybernetic University of Thailand), Singapore (Open Distance Learning Programs), Korea (Korea National OU and Digital University Seoul), Sri Lanka (OU Sri Lanka), Iran (Payame Noor University), India (Indira Gandhi National OU), Japan (GLAD and NICER) and Hong Kong (OU Hong Kong) [5].

Africa has only a few countries with universities that offer distance learning. OU Zimbabwe is a young university (established in 1999) and the only one that offers distance learning in Zimbabwe. In a

country with very rudimentary Internet presence, the first step was to develop a wide area network between the regional centres of OU Zimbabwe. The second step was to acquire a powerful learning management system. This was solved with the donation of Synapse system by Lance Technologies [6].

University of South Africa (UNISA) is involved in an international initiative for developing Sakai, an open source learning environment, also used in its portal – myUNISA (<https://my.unisa.ac.za/portal>).

Unlike Europe, which loosened its rules, **Latin America** as a whole and Brazil in particular, haven't evolved very much over the last years. Nevertheless recent public initiatives, like the creation of OU Brazil in 2005, promise a growth in the use and development of distance learning [7]. Bates, writing about the eLearning strategies adopted in South America, also mentions the private University Tec of Monterrey from Mexico and Virtual Library from Brazil [8].

A different perspective on eLearning is that offered from the companies' point of view. Using data published in a study at the end of 2008 by The Learning Circuits and eLearning News journals [9],

education and informational technologies go hand in hand. eLearning, as a mixture of computers, pedagogy, Internet, informational technologies, is a field which can not be desconsidered when it comes to educational curricula. Nowadays students are digital ones and regardless of the fact that they are attending traditional courses or distance learning courses, technology is a part of their daily lives. By including new, „trendy” ways of delivering knowledge, universities can attract and raise students' interest and thus improve educational results. Some of the most prestigious universities worldwide have already started the process of redefining and reorganizing the educational process, setting thus an examples for all the others to follow. Over the last years eLearning developed rather as an additional method to the traditional teaching, than as a stand alone one, inside distance learning centers. This is mainly due to the fact that most countries still have a legislation which stipulates a number of face-to-face meetings between students and tutors. Nevertheless progress in eLearning has been made on every continent, especially as soon as the Internet connection ceased to be a problem for the common student.

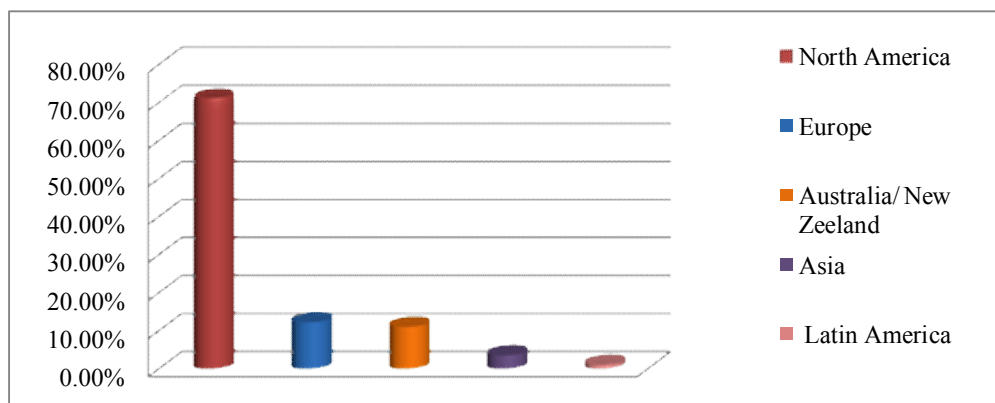


Fig.1: eLearning into organizations at the end of 2008

we could build the graph from Fig. 1.

As it can be observed from the above graphic, eLearning into organizations has mostly the same structure as eLearning into universities. North America is by far the greatest consumer of eLearning technologies, occupying 71.30% of the global organizational eLearning market, followed at a rather considerable distance by Europe (12.5%) and Australia/ New Zealand (11%). Asia, with 3.80%, and Latin America, with 1.30% occupy the last places.

There are a few conclusion which result from this study. The first and most important one is that

3 LMS examples

The educational market consists nowadays of a variety of educational systems, commercial, open source or developed in-house by the universities. The following ones are merely a few examples of the choices a university has when it comes to learning management system.

Moodle is one of the most used VLEs. It is a free technology, which allows universities to create online courses in a simple manner. The software can be downloaded and used on any computer, having the ability to adapt to different needs, from sites

with only one tutor, to universities with thousands of students [10].

Atutor is an open source, web based LCMS, which was designed having in mind accessibility and adaptability aspects. Administrators can install and update Atutor in a few minutes. Tutors can quickly assemble, package and redistribute educational content [11].

Caroline is an eLearning and eWorking open source system which allows tutors to build online courses and to manage online learning activities and collaborations. Translated into 35 languages and used in 93 countries, the portal offers a set of tools for each course; these tools allow tutors to write course descriptions, to publish documents in any format, to manage private and public forums, to develop learning directions, to create student groups, to prepare online exercises, to manage an agenda of assignments and deadlines, to publish announcements, to check user statistics, to use wiki to write collaborative documents [12].

Blackboard is an eLearning commercial solutions' supplier for primary and secondary schools, universities, corporations and governmental agencies. Blackboard Learning System is made of a series of soft applications dedicated to improving the teaching - learning process; it helps tutors to build online courses and to interact with students [13].

WebCT, a Blackboard property since 2006, is a virtual learning system which allows tutors to extend their WebCT courses by adding the following tools: live discussions, discussion boards, mail systems and the possibility to include documents and web pages. WebCT has to be mentioned mainly because it was the first VLE. During its first 4-5 years of existence, it allegedly was a *de facto* standard in higher education, being available in 14 languages and serving a population higher than any of its competitors [14].

The Collaboration and Learning Environment Sakai was built in and for the academic environment. It was equipped with a backbone and modules for managing, delivering and evaluating the students' learning process. Sakai was meant to create an environment where students and tutors could meet in order to discuss and share knowledge [15].

uPortal is a free portal, developed by and for universities. uPortal is built using open source technologies like Java, XML, JSP and J2EE and enables, among other features, web-based content and campus applications [16].

Elluminate offers solutions for real-time online learning and collaboration, increasing thus the retention and completion rates. Elluminate has been

used by more than 3 million tutors and students from 185 countries [17].

Wimba offers collaborative learning software solutions for the educational environment. These solutions allow tutors and students to easily teach and learn online, to start live discussions, to instantly exchange messages. Tutors can use Wimba to transform online Word documents into online courses and to create and manage tests and exams. The following institutions are amongst the ones that have chosen Wimba as their LMS: State University Arizona, State Colleges in California, EDUCAUSE, Princeton University, Georgia University and British Columbia University [18].

ANGEL Learning is comprised of a set of learning management tools used to create VLEs for online learning and hybrid classrooms from K-12 schools, higher education and enterprise trainings. Compatible with all standards, Angel is supposed to be a portal which offers instructors more tools and flexibility to personalize the learning environments, to make them compatible with personal preferences, teaching methods and styles. Angel Learning offers the following facilities: content management, syllabus creation, lessons development, podcasting, wiki, blog, online journals, chat and instant messaging. [19]. In May 2007 ANGEL Learning launched the ANGEL Learning Island, as an effort with the Second Life Community Educators (SLED). The island is meant to offer a virtual world for educational experiments inside the popular application [20].

Dokeos, eFront, Fle3, ILIAS, OLAT, KEWL, LON-CAPA, eCollege, Desire2Learn are merely a few of the other examples of LMSs developed nowadays for educational purposes.

Lately the interest towards the adoption and implementation of 3D virtual environments and games into the learning process has considerably increased. Second Life is the most popular online 3D environment, that found international recognition at the end of year 2006, when it reached 1 million users [21]. Developed by Linden Labs, Second Life is a virtual world with multiple players, built by every user and simultaneously accessed by people from all over the world. According to the affirmations of Educause organization, Second Life is a suitable tool for eLearning due to the fact that passivity is excluded in this case, of games and simulations; students that are engaged into educational games and simulation programs deploy actions of interpretation, analysis, discovery, evaluation and problem solving. Universities like Harvard, Princeton and Stanford use the Second Life Grid platform, designed for education [22].

Apple's service, iTunes U, offers access to language lessons, courses, audiobooks and materials that can be downloaded and subsequently listened or watched from mobile devices [23]. Yale, Berkeley, Carnegie Mellon, Stanford, Duke, MIT, UCLA, OU are solely a few of the universities that use this software to deliver courses.

4 LMSs used by Universities worldwide – case study

This chapter covers a case study of the LMSs used by eLearning supplying universities worldwide. The results of this study are presented in Table 1.

TABLE 1: LMSS USED BY UNIVERSITIES WORLDWIDE

	Moodle	uPortal	Sakai	Blackboard	WebCT	Elluminate	In-house
Open University (OU)	X						
OU Athabasca	X	X					
University of Toronto				X			
Princeton University				X			
Purdue University				X			X
John Hopkins University		X					
Duke University		X		X			
Harvard University	X						
Columbia University		X					
Cornell University		X		X			
Stanford University			X				
University of British Columbia					X		
Yale University			X				
John F. Kenedy University	X						
Virginia Tech			X				
University of Canterbury	X						
Stockholm University			X				
University of Alberta, Canada	X				X	X	
Cambridge University			X				X
University of Washington	X						
University of New England			X				
University of Cape Town			X				
Durham University				X			
University of Glasgow	X						
University of York	X						
University of Belgrade	X						
Salzburg University				X			
University of Helsinki	X						
University Sophia-Antipolis, Nice	X						
University Descartes Paris	X						
University Spiru Haret Bucuresti				X			
Politehnica University Bucuresti	X						
City University of Hong Kong				X			

The study included a few of the most prestigious universities in the world and the LMSs they use. The data in the Table 1 illustrate the current situation of eLearning portals around the world, at a smaller scale. One can notice that there is a definite preference for open source systems (Moodle, uPortal, Sakai), in comparison to commercial or in-house developed software for delivering online educational content.

Considering the fact that the number of free learning systems' solutions is continuously growing, the availability of universities to develop their own system is considerably diminished. Universities prefer adapting and using existing online systems.

In order to offer a correct analysis of the above study, we took into consideration the fact that the Open University is not a single institution, but a concept implemented and adopted by universities all over the world.

Fig. 1 consists of a graph that visually illustrates the relation between open source and commercial systems used by the universities mentioned above:

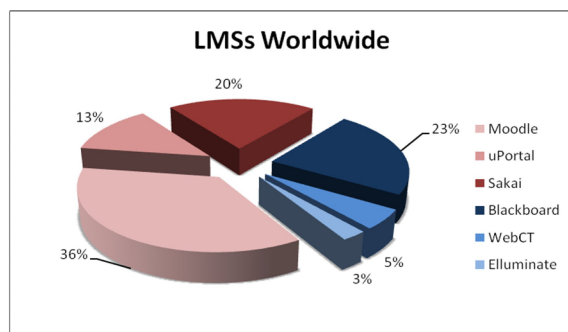


FIG. 2: OPEN SOURCE VERSUS COMMERCIAL LMSs IN UNIVERSITIES WORLDWIDE

The blue colours are used to represent the commercial eLearning systems, while the red shades are for the open source systems. The difference between the two colours is considerable, open source systems leading the LMS competition. Moodle occupies a fairly distanced number one place, with 36%, while Blackboard, a commercial LMS is on the second place, with 23%. The third place is occupied by Sakai, an open-source portal designed for university use. This study included over 30 of the most prestigious universities worldwide, including Open University and the LMSs they use.

During the last years the use of open source software has considerably increased among higher education institutions all over the world [24], encouraging thus the development and consolidation of the open source community.

5 eLearning in Romania

Reforms in the higher technical education started in Romania in the year 1990 with changes in the curricula, specializations' profiles, the number of students enrolled and the enrolment methods. The improvements continued in 1995 with a growth of the interest towards the new educational methods, mostly due to European projects. The European Union offered support through Phare Tempus and Socrates programs [25].

A considerable progress in eLearning was determined by a number of initiatives launched by companies and state institutions. One of the first programs was SEI (Computer Based Educational System) initiated in 2001 by the Educational and Research Board; it was meant to support the teaching process in secondary education by using modern technologies [26].

Siveco is one of the most important developers of online solutions in Romania. AeL (Advanced Learning), the system they have developed, won the first prize at the World Summit for Information Society. It is a complex portal which offers tools for learning and teaching, evaluating, content and learning management [27]. It was implemented into corporations, secondary and higher education [28].

Softwin is a company involved in the delivery of eLearning solutions since 1993. Its eLearning department, INTUITEXT, is the first Romanian organization to develop software products compatible with the SCORM 2004 standard [29].

TEHNE – The Centre for Development and Innovation in Education – is an organization active in the field of education, developing eLearning projects [30].

The first Romanian educational portal, www.leducat.ro, developed in 2001 by the Academy for Excellency in Career, was a great success, leading to the launch of Academia On-line eLearning system, in 2003 [31].

Timsoft is a Romanian company, listed in the European eLearning Directory 2003.

Etrainer is a free eLearning application that offers the following functionalities to institutions and private companies: management of courses, users, tests and reports. All tools are available with a simple registration.

The higher educational system in Romania is currently in a reforming process to make it compatible with the Bologna declaration. Beginning with 2005, higher education consists of: bachelor degree, master and PhD [32].

The amount of new informational technologies, implemented mainly by the universities' distance

learning centres, is considerable. This was possible due to Romanian Government, European and international projects' financing [33].

Universities in Romania, following the international examples, opted for LMSs for organizing eLearning. They chose open source, commercial or in-house systems.

The following are a few examples of Romanian universities and the LMSs they use:

Credis is the distance learning centre of "Bucharest" University. It uses *Unibuc virtual Campus* as an educational portal. This university also includes *The Credis Academy*, the biggest CISCO Academy in the country, and Microsoft IT Academy CREDIS, the first Microsoft Academy in Romania.

The "Politehnica" University of Bucharest uses Moodle to deliver on-line courses for the following faculties - Automation and Computers Faculty (<https://www.cpru.pub.ro/moodle/>), Faculty of Engineering with teaching in foreign languages (<http://fils.curs.ncit.pub.ro/>), Faculty of Engineering and Technological Systems Management (<http://www.ctanm.pub.ro/dev/moodle/>) and Faculty of Mechanics (<http://www.ctanm.pub.ro/dev/moodle/>).

"Carol I" National Defense University Bucharest has a Department for Advanced Distributed Learning (<http://adl.unap.ro/modules/news/>) which uses Pfp LMS portal for delivering online courses to its students.

Faculty of Communications and Public Relations "David Ogilvy" from Bucharest launched, as a premier in Romania, the first online Master programs [34]. Students can collaborate online using a set of communication and collaboration tools known as Google Apps.

"Vasile Goldis" University from Arad uses Moodle to build its online learning environment and to deliver courses (<http://bb.uvvg.ro/online/index.php>). The Open and Continuing Learning Department from West University Timisoara, founded in 1999, offers both academic and post-graduate courses. As a learning system, the centre uses Lotus LearningSpace, a product of IBM Lotus software.

In 1998, The "Politehnica" University of Timisoara founded The Distance Learning Centre CSID, which supplied learning material both through Internet and traditional ways. The portal (<http://www.cm.upt.ro/>) was internally developed.

In the same university, there is also the Microsoft Student Partners (<http://ms.upt.ro/elearning/>), which organizes online courses addressed mainly to the University's students. The virtual community uses the Community Server commercial portal for the students' interaction.

The Faculty of Veterinary Medicine from Timisoara uses Moodle to offer its students a virtual environment where they can interact and access online materials (<http://193.230.235.21/moodle/>).

The "Transilvania" University in Brasov [35], uses its own portal (<http://portal.unitbv.ro/>) for unifying all the services the University offers to its teachers and students, among which: courses, forums, grades, "on-demand applications". The Faculty of Economics uses Moodle as a LMS.

The Technical University of Cluj-Napoca also uses Moodle for delivering its online courses (<http://moodle.utcluj.ro/>).

Unlike the universities mentioned so far, "Spiru Haret" University in Bucharest and "Alexandru Ioan Cuza" University of Iasi (Faculty of Chemistry) opted for a commercial LMS: Blackboard: <http://spiruharet.blackboard.com/> and <http://www.chem.uaic.ro/ro/resurse/blackboard.htm>.

The conclusion drawn from the examples presented above is that universities prefer open-source educational systems. The main reason is the commercial systems' high prices and the fact that eLearning is still in an incipient phase in Romania. The most common open source CMS used is also Moodle. In-house developed systems are the least used method of implementing eLearning solutions in universities.

The possibility of combining features appertaining to different systems, in order to obtain the most suitable solution, is also an option. A university can adapt Moodle and also develop other modules and integrate all of them to its learning system.

Fig. 2 presents a graph depicting the use of LMSs among universities in Romania, depending on the character of the system: open-source, commercial or developed in-house.

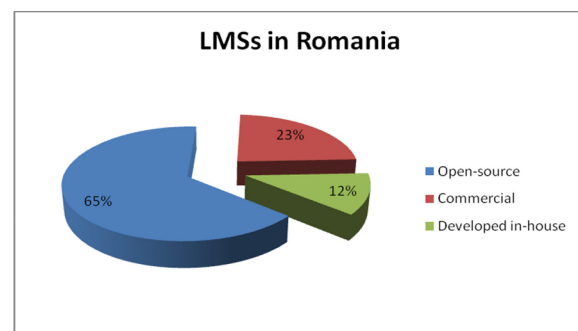


FIG.3: THE LMSs USED IN THE ROMANIAN UNIVERSITIES

As in the case of universities worldwide, the preferred systems are open source ones (predominantly Moodle), with 64%, followed, at a

considerable distance, by commercial systems (mostly Blackboard) – 24%. On the last place there are the LMSs developed by the universities themselves.

This case study involved 17 Romanian higher institutions that use LMS as a means of delivering learning content to their students.

A similar study, regarding the use of LMSs, in this case in the Italian Universities, was published in 2008 [36]. The difference resides in the fact that, in case of the Italian study, the researchers considered open source systems and Moodle to be two different categories, whilst the current study included Moodle in the open source systems. After comparing the results of the current study with those of the Italian Universities, one can draw the conclusion that, while in Italy open source and commercial systems are on the same level, in Romania there is a considerable gap between the two types of systems, open source being by far the system of choice for most universities.

6 Informational technologies used by Universities

The studies presented so far were supplemented by the portals' testing of a few of the most renowned universities worldwide. The goal was to establish the degree of integration of eLearning technologies like podcasting, RSS, streaming and so on, into the educational process. The results are presented into Table 2.

As it can be seen in this table, RSS and podcasting are the most used technologies, closely followed by a considerable interest towards the Second Life portal. Blogs, forums, wikis are methods of raising the interaction between students and teachers, needed in the case of distance learning. Universities like Princeton, Cambridge and South Australia also use audio/ video conferencing as a pedagogical method. Streaming and TV/ audio technologies are used only by a few of the universities included in this study.

TABLE 2: UNIVERSITIES' USE OF INFORMATIONAL TECHNOLOGIES

	Online Courses	Podcasting (iTunes U)	Streaming	Audio/video conferencing	Second Life	Social Software	Blog, Wiki	RSS	TV, radio
Open University	X	X			X			X	X
Athabasca Univ. Canada	X			X	X			X	
Alberta Univ. Canada	X	X		X			X		
Duke Univ.	X	X					X	X	
Harvard Univ.	X	X			X		X	X	
Stanford Univ.	X	X	X		X	X		X	
Princeton Univ.	X	X	X	X	X	X	X	X	
Cambridge Univ.	X	X		X	X		X	X	
Drexel Univ.	X	X					X	X	
John Hopkins Univ.	X	X							
Purdue Univ.	X	X	X		X	X		X	
British Columbia Univ.	X	X					X	X	X
South Australia Univ.	X			X	X	X		X	
China Central Radio and TV University	X								X
OU Korea	X			X					X

7 Conclusions

The studies presented in this paper were conducted in order to establish the current direction of content management systems and informational tools in the field of eLearning. Similar work concerning the LMSs used by universities and their characteristics was carried on by a research team from Spain [37]. The major difference consists in the fact that their work was mainly focused on four LMSs and a comparison between the technical features, while the current study includes more than a dozen LMSs. The results of these case studies revealed the fact that open-source systems are preferred by most of the universities worldwide, as well as by the Romanian Universities. The second place is occupied by commercial systems like Blackboard and the third and last place by software developed in-house. Besides the virtual environment and means of delivering courses, more and more universities also opt for informational technologies, which can be included into the LMS or can added later on. These technologies are: podcasting, streaming, RSS feeds, audio/ video conferencing, blogs, wikis, forums and so on.

A rather new tendency in education appears to be the incursion of universities into virtual 3D worlds/ systems, like Second Life, which offer free virtual space, tools and tutoring, eliminating thus the necessity of adapting and installing a portal on the university's server.

Slowly but steadily Romania is also directing its attention and efforts towards adopting new technologies into the educational process. The Distance Learning Centers are the promoters of these technologies into the universities.

Although considerable progress has been made during the last years in the direction of adopting, adapting and developing eLearning technologies in Romania, nevertheless there are still a set of shortcomings that have to be mentioned: the lack of a methodology for recognizing certifications obtained by attending online courses and also the absence of a special legal framework for attesting the status of eLearning workers (tutors, virtual professors and online shapers) [38].

The future of education lays in the informational and technological advances, which will lead to more and more online simulations, experiments and environments. Marc A. Rosen says it best, simply and concisely, in the following lines: "Engineering education will evolve to make greater use of information and communication technologies, as tools can help improve teaching and learning." [39]

And educators and universities' administrators must be ready and willing to embrace the changes.

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