Trends in the E-Learning Ecosystem:

A Bibliometric Study

Research-in-Progress

Manuela Aparicio
ISEGI, Universidade Nova de Lisboa
University Institute of Lisbon
ISCTE-IUL, Adetti-IUL
D2012092@isegi.unl.pt

Fernando Bacao
ISEGI, Universidade Nova de Lisboa
bacao@isegi.unl.pt

Tiago Oliveira
ISEGI, Universidade Nova de Lisboa
toliveira@isegi.unl.pt

Abstract

E-Learning systems play an important role in our society; they facilitate instructors in the teaching process and also enable learners to access knowledge. Although, e-learning is not the first concept that refers to the use computerized systems in the learning process. This paper describes a bibliometric study. In this paper, we present the e-learning related concepts and position them in time. This study describes an evolutional systematic search study in various scientific digital libraries and compared the results. We also present the new e-learning growth trends and identified concepts that are emerging in the ecosystem of e-learning.

Keywords

Bibliometric study, e-learning, CAI, CAL, LMS, MOOC.

Introduction

The use of computers and systems as part of learning process comes as far as the sixties (Bernhardt, 1960). From then until today the use of computerized systems have registered a significant increase. According to a study from the US Department Education (2010) the attendance of on-line courses increased 65%. Electronic learning courses are used for life-long learning in universities and training within organizational contexts. Learning markets are growing throughout the world (OECD, 2012). In order to understand how it evolved, we performed a study of the electronic learning concept. Electronic-learning (e-learning) is a multidimensional concept (Dabbagh, 2005) it can be studied in various fields, from technology to social science scope. E-learning integrates learning technologies and their functional characteristics, it also includes pedagogical models and instructional strategies. Our research question is: what are the emerging e-learning new trends? From this starting point we analyzed the e-learning concept and the related terms used in research studies in order to understand the importance of the subject according to the Web of Science Search engine return on the "electronic learning" term, we decided to do a search engine e-learning concept return from 1960 to 2013. In order to understand the e-learning new trends, we performed a bibliometric study.

This paper is organized in three sections. The first section presents a literature review on e-learning related concepts and these concepts are presented in a timeline. The second section describes the search study in each of the concepts according to an evolutional point of view. The third section presents the e-learning new trends.
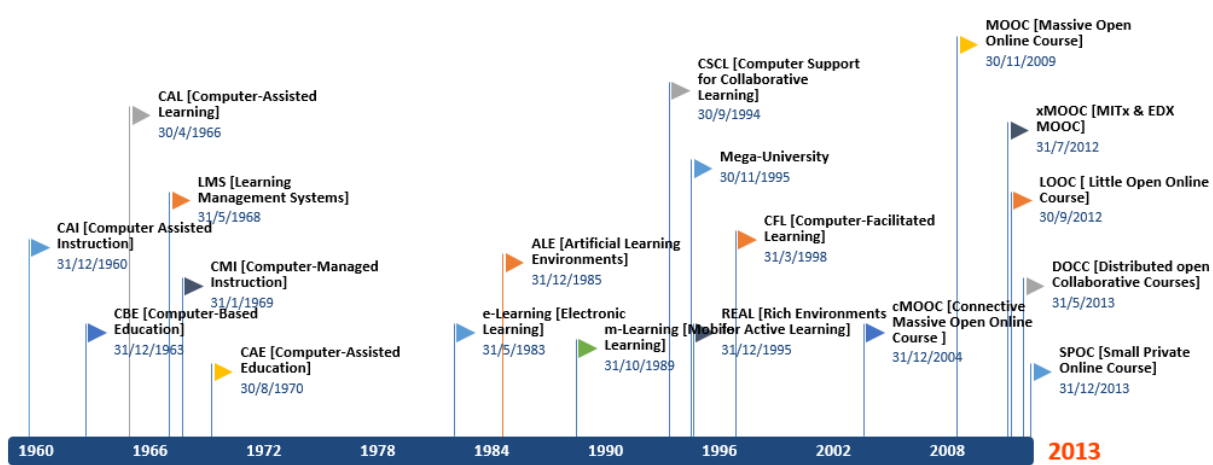
E-Learning related concepts

E-Learning is not the first concept that includes the use of computers in learning, nor is the first that is related with distance learning (Barson, Levine, Smith, Scholl, & Scholl, 1963; Bernhardt, 1960; Bitzer & Others, 1970; Lanier, 1966; Molnar & Sherman, 1969). According to Zinn (2000, p. 331) computer assisted instruction (CAI) "refers to the use of computers to present drills, practice exercises, and tutorial sequences to the student, and perhaps to engage the student in dialogue about the substance of the instruction." The concept of computer-assisted instruction appeared as a result of the way of teaching problem solving (Zinn, 2000). Computer-Assisted Learning (CAL) is also a concept from the sixties, although not so frequently used as CAI.

Computers played an important role in the learning process, since the appearance of the Web (Berners-Lee, Cailliau, & Groff, 1992). The concept evolutes from an artifact that enabled instruction face-to-face to another level, computers and Web together formed new paradigms to learning. By the beginnings of nineties, the concept started to include the idea of supporting learning remotely (Daniel, 1996). Figure 1 presents concepts related to e-learning. Computer-assisted learning and teaching have their focus on contents; other are focused on communication or even on technology (Mason & Rennie, 2006).

The first "electronic-learning" written concept appeared in the first time in 1983 in an article entitled "Synthesis of Research on Electronic Learning", by Mary Alice White, as "learning via electronic sources, such as television, computer, videodisc, teletext, videotext." (White, 1983, p. 13). Fourteen years, later, another author defines e-learning as an abbreviation of electronic learning meaning "an interactive distance learning" environment (Morri, 1997). Despite the use of the e-learning term, another author used the same concept to refer the capacity of technologies combined with distance learning and with universities, which was named "mega-university" (Daniel & Daniel, 1995). Since the exact term was already defined in 1983, one can state that Mary White coined the e-learning term in 1983. Another concept related to e-learning is the concept of online learning. Online learning can be defined as learning that takes place partially or entirely over the internet that makes information or knowledge available to users disregarding time restrictions or geographic proximity (Sun, Tsai, Finger, Chen, & Yeh, 2008). However, e-learning systems have also included the technological and functional driven focus, regarding the Internet possibilities in overcoming time and space issues (Ludvigsen & Morch, 2010; McAuley, Stewart, Siemens, & Cormie, 2010; Piccoli, Rami, & Ives, 2001). In this paper, we will consider the following e-learning concept "as a medium that assists learners to gather/construct/share knowledge." (Lin & Wang, 2012, p. 88) From the concepts definition, we understood that the first perspectives of e-learning focused more on technology rather than in students. Nowadays the e-learning concept definition is focused on students' collaboration.

The concepts identification was performed by extracting the related e-learning keywords of multiple research articles available at the three main computer science international associations: the Association for Computing Machinery (ACM) (2014); the Association for Information Systems (AIS) (2014); the Institute of Electrical and Electronics Engineers (IEEE) (2014) and available on several meta-search scientific engines, specified in the following section. Figure 1 represents a timeline of the main concepts that are related with the e-learning term, each of them was the object of the empirical study related in this paper. The found e-learning related concepts were ordered according to the first publication date of appearance.

Figure 1- e-learning related timeline concepts

From these systematic searches, we infer that an e-learning system is a concept in evolution. e-learning systems had their roots in the concept of Computer-Assisted Instruction (CAI) (Anderson, 2008; Bernhardt, 1960; Kemeny & Kurtz, 1967; Zinn, 2000).

In the first years, when CAI term appeared, the usage of systems was focused in tasks accomplishment, and afterwards with computer-assisted learning (CAL) systems were more focused in the students. The concept trend is nowadays more focused on the learning methods and the massive possibilities of content diffusion and connection, than in the use of a computer as an artifact in the learning process.

The most frequent returned terms were: CAI, CAL, computer based education (CBE), e-learning, learning management systems (LMS), self-directed learning (SDL) and massive open online courses (MOOC). All these concepts have two aspects in common: learning and the use of computer systems; except the SDL concept that derives from psychology (Bandura, 1994) and do not necessarily apply to computers usage. Another result from the search consisted in the identification of new concepts small private online course (SPOC); little open online course (LOOC) and distributed open collaborative courses (DOCC). These concepts, SPOC, LOOC and DOCC contrast MOOC´s concept. SPOC focus on a private audience, this course type, is defined as a supplement way of learning apart from regular face-to-face classes and can be applied in an organizational context (Fox, 2013). LOOC´s distinguish from MOOC´s because it is based on different pedagogical model, it provides direct instructions to students, instead on indirect feedback from teachers to students (Kolowich, 2012), because LOOC´s have a smaller audience even if they are open courses. DOCC´s also differentiate from MOOC´s, because they intend to focus on the pedagogic engagement of all intervenient, underlining on one hand the invisible work of teachers and on the other the collective intelligence of scholars (Balsamo et al., 2013).

Figure 1 illustrates the concept evolution. From 2008 until 2013 five new concepts related to e-learning appear in publications of the education field. These new concepts are still in their early stage, although their existence indicates a tendency from the individual learning to a global learning. As a parallel reality, e-learning can also mean, massive distribution of content and global classes for all the Internet users

Evolutional and systematic search study

In this section, we present the methodological approach and the results of the study. This paper presents a bibliometric study (Lawani, 1981; Pritchard, 1981) on e-learning concept trends. According to Pitchard (1969, p. 349) bibliometrics "will be used explicitly in all studies which seek to quantify the processes of written communication". A bibliometric study is a quantitative method used to find trends in publications. Mainly used in libraries for characterizing written publications collections in libraries. We performed a study of 22 concepts related to e-learning. We made systematic searches and organized the results according to publications frequency per digital library and per time-intervals of 5 years.

Methodology

This study was conducted from January to February of 2014. We collected data from four meta-search engines and also from two digital libraries of the main international associations of information systems. We made searches for 22 concepts related to e-learning. The data was collected in six different scientific search engines: (1) Web of Science (Thomson Reuters, 2014); (2) Google Scholar (Google, 2014); (3) ACM Digital Library (Association for Computing Machinery, 2014); (4) Scopus (Elsevier, 2014); (5) Association for Information Systems Research (AIS eLibrary, 2014) and (6) b-on (Online Knowledge Library) (B-On, 2014). These digital libraries only two of the sources are from information systems and computer science. The meta-search engines were used in order to seek for publications related to e-learning in all fields and not only directly linked with computer science or more specifically to information systems.

Table 1 contains the list of the concepts and the exact searched terms. For each term, we used a double quotation operator. For the concept of e-learning, we used the following notation "electronic learning" or "e-learning". We used both terms, because we verified the return was different if we used only "electronic learning", from the literature review of the concepts; we noticed that authors tended to use only e-learning without referring that it is an abbreviation of electronic learning. We performed the searches within 5 years' time-interval, from 1960 until 2014 (February), data was grouped in 11 time intervals: 1960-1964; 1965-1969; 1970-1974; 1975-1979; 1980-1984; 1985-1989; 1990-1994; 1995-1999; 2000-2004; 2005-2009 and 2010-2014. Figure 2 summarizes the followed methodology.
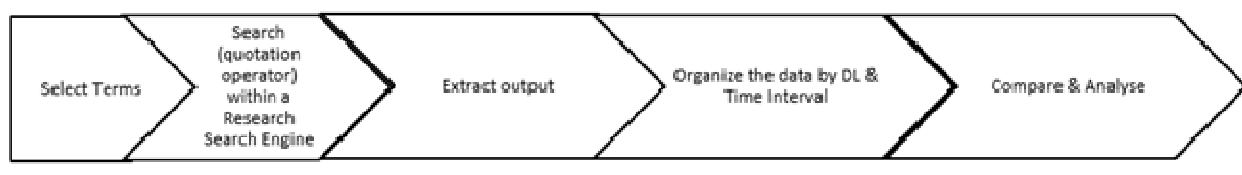
Figure 2. Data collection methodology

The returned data, of each searched term, was organized by each digital library (DL) and according to the time intervals. We made the first evaluation on the concepts frequency in order to extract the most frequent concepts per digital library. From that extraction, we analyzed the six more referred terms per library. Then we used the timeline, Figure 1, and made the same steps to the newest concepts, since they are still in an early stage of the study, the results do not reveal so many publications returned in the digital libraries.

Acronym	Concept	Search Terms
CAI	Computer-Assisted Instruction	"Computer-Assisted Instruction!"
ALE	Artificial Learning Environments	"Artificial Learning Environments"
CAL	Computer-Assisted Learning	"Computer-Assisted Learning"
REAL	Rich Environments for Active Learning	"Rich Environments for Active Learning"
Mega-University	Mega-University	"Mega-University"
CFL	Computer-Facilitated Learning	"Computer-Facilitated Learning"
SRE	Self-Regulatory Efficacy	"Self-Regulatory Efficacy"
CAE	Computer-Assisted Education	"Computer-Assisted Education"
CBE	Computer-Based Education	"Computer-Based Education"
CMI	Computer-Managed Instruction	"Computer-Managed Instruction"
e-learning	Electronic Learning	"e-learning" OR "Electronic Learning"
LMS	Learning Management Systems	"Learning Management Systems"
LCMS	Learning Content Management Systems	"Learning Content Management Systems"
SDL	Self-Directed Learning	"Self-Directed Learning"
ILM	Internet-based Learning Medium	"Internet-based Learning Medium"

Acronym	Concept	Search Terms
CSCL	Computer Support for Collaborative Learning	"Computer Support for Collaborative Learning"
MOOC	Massive Open Online Course	"Massive Open Online Course"
cMOOC	Connective MOOC	"cMOOC" OR "Connective MOOC"
xMOOC	MITx & EDX MOOC	"xMOOC" OR "MITx & EDX MOOC"
SPOC	Small Private Online Course	"Small Private Online Course"
LOOC	Little Open Online Course	"Little Open Online Course"
DOCC	Distributed open Collaborative Courses	"Distributed open Collaborative Courses"

Table 1. E-learning related concepts search terms

Bibliometric Study Results

Figure 3 gives a result overview from of the relative importance of the concepts. CAI counts 27% of the total publications, SDL represents 20%, e-learning is referred in 17%, CAL 16%, LMS 9%. We also could infer that the newest terms related to e-learning represent 1% of the total publications in the searched digital libraries.
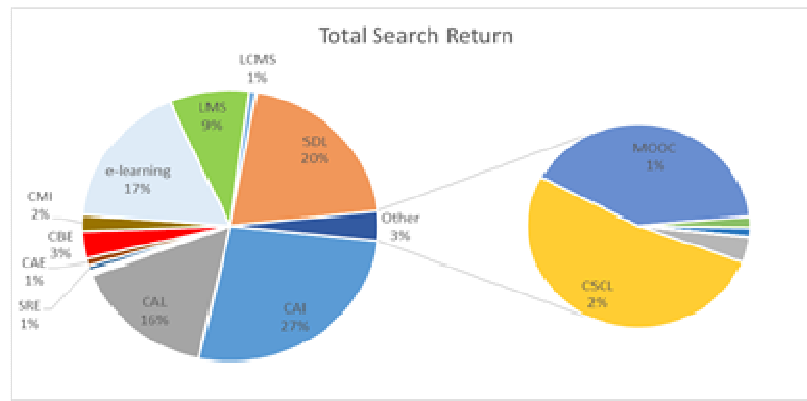

Figure 3- General overview of the related concepts

Total	CA	A.E	CAL	REA.	oge-Univers	C.	SRE	CAE	CSE	CM	e-earning	.NE	.CME	SD.	.M	CSC.
Web of Sci	1,875	1	910	2	6	2	32	32	209	47	11,639	542	35	1,294	1	11
Google Scholar	72,328	105	43,417	700	770	458	1,898	2,335	9,208	5,765	37,273	25,190	2,330	53,960	366	5,335
ACM D.	1,637	1	508	1	2	1	1	24	121	317	4,145	351	41	283	4	675
Scopus IeD	3,255	13	2,475	22	43	9	133	204	848	193	9,974	1,194	32	3,201	55	244
A I	342	4	420	21	17	14	45	14	109	35	273	423	15	1,194	25	34
BCP	13,034	6	6,916	4	76	43	194	313	383	415	6,945	2,927	239	6,743	35	13
Total	92,320	120	54,643	772	913	525	2,062	2,977	11,392	6,775	69,243	30,757	2,744	71,050	492	6,315

Table 2. E-learning related concepts

The results from the Web of Science (2014) show the return of publications referred to each of the searched terms. We can verify that some of the terms have no return, such as connective MOOC (cMOOC); MITx & EDX MOOC (xMOOC); small private online course (SPOC) and distributed open collaborative courses (DOCC). Also verified that CAI; CAL; e-learning; LMS and SDL prevail upon the rest, especially e-learning. The results showed a significant increase in the publications on these terms. The results from the Google Scholar (2014) had significant returns. From these results, we can infer that the publications are in a large number, mainly from 2000 and for CAI, CAL, e-learning and SDL. The ACM Digital Library (2014) show a great boundary between CAI and e-learning and the rest of the terms. The Scopus results (2014) indicate that e-learning is the most used concept used by the authors and shows a growth of usage along the years. CAI, CAL and SDL represent a significant return comparing to REAL,

SRE, LCMS, ILM or MOOC. SPOC and DOCC have no returned publications. AIS search return (2014) was similar to other digital libraries SDL, LMS, CAI and CAL. E-learning prevails in terms of returned publications. These terms also show an increasing tendency. Finally, the B-On results (2014) scores more publications in e-learning term followed by CAI, SDL and CAL. Table 2 and Table 3 summarize the absolute values retrieved of the result searches from the mentioned digital libraries. There is a clear evidence of the emerging new concepts that define a new learning paradigm. These concepts are derived from massive online open courses (MOOC´s). Specially cMooc and xMooc are emerging in a similar way according to Table 3.

Totals	MOOC	cMOOC	xMOOC	SPOC	DOCC
s WebKn	54	0	0	0	0
Googe Schoar	3.224	204	158	2	2
ACMDL	1.526	9	4	0	0
Scopus/ScD	44	2	1	0	0
A S	24	1	1	0	0
B-On	38	1	5	3	0
Tota	4.910	217	169	5	2

Table 3. New concepts related to e-learning

SPOC and DOCC results indicate to be in an early stage. Their concept evolution is considered as a new trend from the individual learning to a global learning.

Comparison of the main returned concepts

Figure 4 represents the time publication evolution in six digital libraries (4 meta-search engines in research and 2 information systems associations). CAI is the first concept related to the computers systems usage in learning and is the most used in the research studies until 2000. SDL is the most used term from 2000 to 2004. Though this concept does not include only learning to use information systems or computers, as referred earlier in the paper. From 2000 to 2009 we may see the use of e-learning accompanied by a high increase comparing to other concepts. It demonstrates that is in a technology trigger phase, as Linden & Fenn call (2003), it is characterized by a positive hype. CAL and LMS are terms that are slightly below the e-learning, in terms of usage. CAI is the only term that registers a negative hype from 2009 until 2014. This negative hype in CAI can be a result of the searches return until the first two months of 2014, it can raise or maintain until the end of 2014.
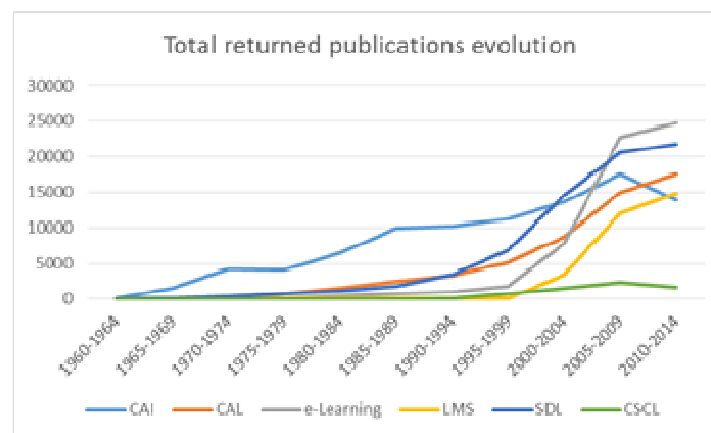

Figure 4. Total number publications in six digital libraries

Figure 5 compares the publication return on searches in ISI web of Knowledge (Thomson Reuters, 2014). LMS and e-learning are the concepts with more publications in this index. They reveal a similar development along the years. From 2000 until 2009 these two concepts were in positive hype. Comparing the last 5 years it appears to be in a negative hype, although the return in 2014 only has the results until February. This fact can explain a different evolution. CAI, CAL and SDL do not have so many publications.
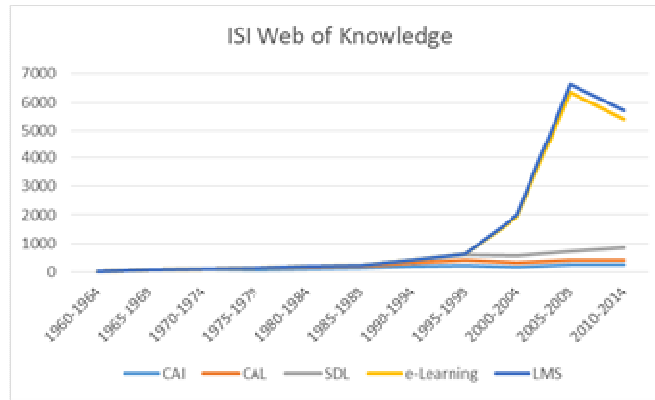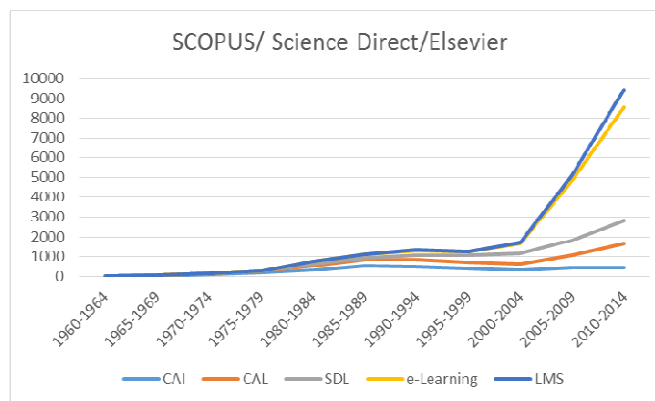
Figure 5. Publications comparison in ISI Web of Knowledge

Figure 6 depicts the publications evolution in ACM DL (Association for Computing Machinery, 2014) the keywords evolution are very similar to the ISI Web of Knowledge. LMS and e-learning leads the publication number and with a higher results comparing to other concepts. SDL, CAL and CAI have less publication studies and reveal stabilization.
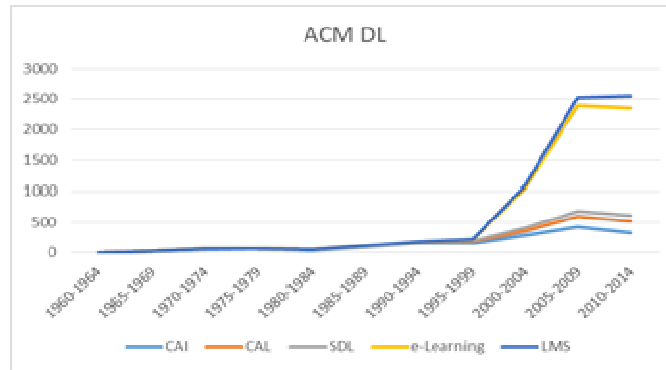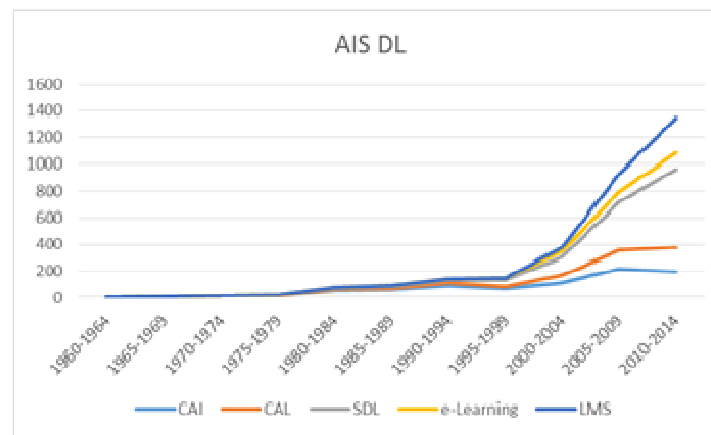

Figure 6. Publications comparison in ACM DL

In Scopus (Elsevier, 2014), all of the concepts show a crescent trend. LMS and e-learning show a clear increase tendency comparing to other keywords SDL, CAL and CAI. Although SDL, CAL and CAI, also show an increasing number of publications.

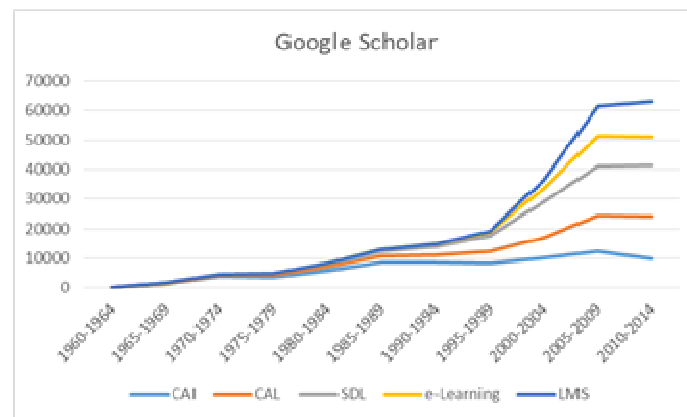**Figure 7.Publications comparison in SCOPUS**

In AIS e-library (2014) publications on LMS are most frequent, followed by e-learning and SDL. In this digital library, SDL is very near to the publication number of e-learning. These three concepts registered a

high increase since 2004. On the other hand, CAL and CAI are in a lesser proportion and do not reveal growth since 2009.

Figure 8.Publications comparison in AIS e-Library

Figure 9 presents the evolution of the referred concepts demonstrating that every term registered growth in publication studies. LMS publications have the most return on the searches and with increasing tendency. E-Learning and SDL also reveal an increase in publication numbers mainly since 1999. CAL and CAI are still growing too but do not have as many publications as the other three concepts.


Figure 9.Publications comparison in Google Scholar

From presented digital libraries and from the three meta-search engines and indexes we can infer that the e-learning related concepts follow the same tendencies in each of the results.

## New growth trends to the e-learning

We compared the growth rates of information systems publications to the e-learning growth rate since 1993 until 2103 Figure 10. These searches were performed on Google Scholar (2014), using the exact search terms: "Information Systems"; "e-learning" OR "electronic learning". The results indicate a smooth growth rate of the information systems publication along 1993 to 2013. E-learning reveals some slopes in the growth rates until 1999, but from that year until 2013 reveals a growth tendency. From 1999 to year 2000 the e-learning publication growth rate was the higher rate ever, with 550% of growth. In 2001 the growth rate was 178%. In the first decade of 2000, the e-learning publications never ceased growing. From 2011, both concepts registered decrease in publications; this decrease is much stronger in information systems than in e-learning.
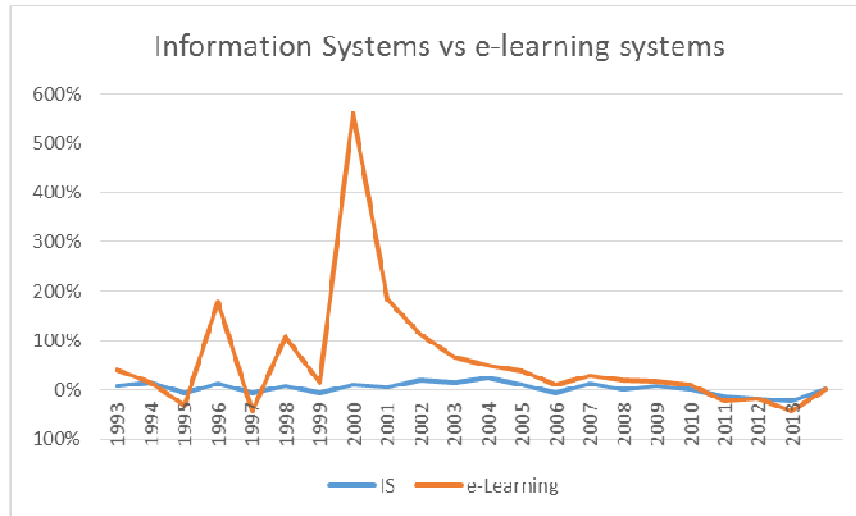
Figure 10.Growth rate of IS and e-learning in Google Scholar

Afterwards, we compared the growth rates of IS, e-learning with the new concept massive online open course (MOOC), using to Google Scholar search results. So, we compared the evolution of the growth rate of these three concepts and the results revealed a new concept trend related to e-learning. MOOC´s publication studies increased enormously from 2010 to 2013, from 33% (in 2010) to 293% (in 2013) growth rate only in four years as in Figure 11.
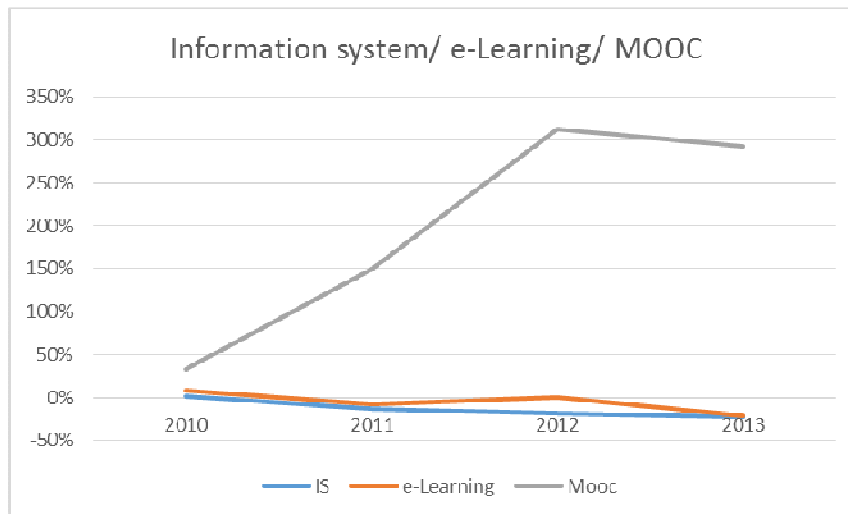
Figure 11.Growth rate of IS and e-learning in Google Scholar

Conclusions

In this study, we identified 22 related e-learning used in literature and organized these concepts in a chronological way. Several systematic searches according to certain time interval revealed the publication frequency per concept. We used scientific digital libraries to perform the searches and to do the bibliometric study. We compared the evolution of the main concepts according to the publication number in the different digital libraries'. We identified new concepts trends in e-learning and compared their publication growth rate with e-learning growth rate from 2010 to 2013.

Our findings show that LMS leads the scientific publications in a number, in the last years. The leading place accompanied by the e-learning concept. The results show that SDL is in third place. Although, in ISI, ACM DL and Scopus, the number of studies of SDL reveals a greater gap comparing to LMS and e-learning. CAL and CAI are two concepts that show similar trends. CAI and CAL are the first concepts related to e-learning. Although these concepts come from the sixties, the results still show an increase tendency. The trends results and the related concept meanings call our attention. Studying new ways of communication and of learning. Our findings show that e-learning studies are still in a positive hype. E-learning studies are remarkably increasing in publications number. This growth does not only applies to the information systems field or only to computer science. This growth was also found when using other digital libraries. This may conduct our studies on new paradigms. New studies on the dematerialization study resources and to the Web appearance in our lives. Now we face a new paradigm. The mass diffusion of knowledge and collaboration are made possible with the use of MOOCs. MOOC´s bring new opportunities, to every student, to professionals and to organizations. Since any of us can learn anywhere anytime on any subject with anyone. We can conclude that MOOCs will be the next big topic in e-learning.

Acknowledgements

REFERENCES

AIS eLibrary. 2014. AIS Electronic Library (AISeL) | Association for Information Systems Research. Retrieved February 18, 2014, from http://aisel.aisnet.org/

Anderson, T. 2008. The Theory and Practice of Online Learning: Second Edition. Athabasca University Press.

Association for Computing Machinery. 2014. ACM Digital Library. Retrieved February 18, 2014, from http://dl.acm.org/

Balsamo, A., Boyer, P., Fernandes, M., Gajjala,, R., Irish,, S., Juhasz,, A., … Wexler,, L. 2013. FemTechNet Whitepaper | FemTechNet. Retrieved from http://femtechnet.newschool.edu/femtechnet-whitepaper/

Barson, J., Levine, D., Smith, R., Scholl, M., & Scholl, P. 1963. UNIVERSITY-LEVEL CAl IN FRENCH.

Bernhardt, K. S. 1960. Review of The Undirected Society and Automatic Teaching: The State of the Art.

Bitzer, D. L., & Others, A. 1970. The Plato System and Science Education. Retrieved from http://eric.ed.gov/?id=ED042624

B-On. 2014. b-on - Biblioteca do Conhecimento Online. Retrieved February 18, 2014, from http://b-on.pt/

Dabbagh, N. 2005. Pedagogical models for E-Learning: A theory-based design framework. International Journal of Technology in Teaching and Learning, 1(1), 25–44.

Daniel, J. S., & Daniel, J. S. 1995. The mega-universities and the knowledge media : implications of new technologies for large distance teaching universities (masters). Concordia University. Retrieved from http://spectrum.library.concordia.ca/132/

Elsevier. 2014. Elsevier/ Scopus. Retrieved February 18, 2014, from http://www.elsevier.com/advanced-search

Fox, A. 2013. From MOOCs to SPOCs. Communications of the ACM, 56(12), 38–40. doi:10.1145/2535918

Google. 2014. Google Scholar. Retrieved February 18, 2014, from http://scholar.google.com

IEEE. 2014. IEEE Xplore Digital Library. Institute of Electrical and Electronics Engineers. Retrieved from http://ieeexplore.ieee.org/Xplore/home.jsp

Kemeny, J., & Kurtz, T. E. 1967. Dartmouth Time Sharing. Science, 162, 223–238.

Kolowich, S. 2012. U. of Maine campus experiments with small-scale, high-touch open courses | Inside Higher Ed. Retrieved February 13, 2014, from http://www.insidehighered.com/news/2012/09/06/u-maine-campus-experiments-small-scale-high-touch-open-courses

Lanier, V. 1966. Newer Media and the Teaching of Art. Art Education, 19(4), 4. doi:10.2307/3190788

Lawani, S. M. 1981. Bibliometrics: its theoretical foundations, methods and applications. Libri, 31(1), 294–315.

Lin, W.-S., & Wang, C.-H. 2012. Antecedences to continued intentions of adopting e-learning system in blended learning instruction: A contingency framework based on models of information system success and task-technology fit. Computers & Education, 58(1), 88–99. doi:10.1016/j.compedu.2011.07.008

Linden, A., & Fenn, J. 2003. Understanding Gartner's hype cycles. Strategic Analysis Report No R-20-1971. Gartner, Inc.

Ludvigsen, S., & Morch, A. I. 2010. Computer-Supported Collaborative Learning: Basic Concepts, Multiple Perspectives, and Emerging Trends, in (B. McGaw, P. Peterson and E. Baker., Vol. 5). Oxford: Elsevier.

McAuley, A., Stewart, B., Siemens, G., & Cormie, D. 2010. The MOOC Model for Digital Practice. Retrieved from www.elearnspace.org/Articles/MOOC_Final.pdf

Molnar, A. R., & Sherman, B. 1969. US Office of Education Support of Computer Activities.

Morri, A. 1997. A bright future for distance learning: One Touch/Hughes alliance promotes interactive "e-learning" service. Connected Planet Online. Retrieved from http://connectedplanetonline.com/mag/telecom_bright_future_distance/

OECD. 2012. Education at a Glance 2012: Highlights. OECD Publishing. Retrieved from http://dx.doi.org/10.1787/eag_highlights-2012-en

Piccoli, G., Rami, A., & Ives, B. 2001. Web-Based Virtual Learning Environments: A Research Framekwork and a Preliminary Assessment of Effectiveness in Basic IT Skills Training. MIS Quarterly, 25(4), 401–426.

Pritchard, A. 1969. Statistical bibliography or bibliometrics. Journal of Documentation, 25(4), 348–349.

Pritchard, A. 1981. Bibliometrics: a bibliography and index. Volume 1: 1874-1959 by Alan Pritchard in collaboration with Glenn R. Wittig. Retrieved February 26, 2014, from https://www.academia.edu/4627771/Bibliometrics_a_bibliography_and_index._Volume_1_1874-1959_by_Alan_Pritchard_in_collaboration_with_Glenn_R._Wittig

Sun, P.-C., Tsai, R. J., Finger, G., Chen, Y.-Y., & Yeh, D. 2008. What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction. Computers & Education, 50(4), 1183–1202. doi:10.1016/j.compedu.2006.11.007

Thomson Reuters. 2014. Web of Science [v5.13]. Retrieved February 18, 2014, from http://sub3.webofknowledge.com/

U.S. Department of Education. 2010. Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies. Retrieved from www.ed.gov/about/offices/list/opepd/ppss/reports.html

White, M. A. 198. Synthesis of Research on Electronic Learning. Educational Leadership, 40(8), 13.

Zinn, K. L. 2000. Computer-assisted learning and teaching. In Encyclopedia of Computer Science (pp. 328–336). Chichester, UK: John Wiley and Sons Ltd. Retrieved from http://dl.acm.org/citation.cfm?id=1074100.1074248.