An e-Learning Theoretical Framework

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ABSTRACT

E-learning systems have witnessed a usage and research increase in the past decade. This article presents the e-learning concepts ecosystem. It summarizes the various scopes on e-learning studies. Here we propose an e-learning theoretical framework. This theory framework is based upon three principal dimensions: users, technology, and services related to e-learning. This article presents an in-depth literature review on those dimensions. The article first presents the related concepts of computer use in learning across time, revealing the emergence of new trends on e-learning. The theoretical framework is a contribution for guiding e-learning studies. The article classifies the stakeholder groups and their relationship with e-learning systems. The framework shows a typology of e-learning systems' services. This theoretical approach integrates learning strategies, technologies and stakeholders.

Keywords

E-learning, e-Learning concept evolution, e-Learning systems dimensions, MOOC, e-Learning literature review, e-Learning framework

Introduction

E-learning unites two main areas, learning and technology. Learning is a cognitive process for achieving knowledge, and technology is an enabler of the learning process, meaning that technology is used like any other tool in the education praxis, as is a pencil or a notebook, for example. Although this seems quite simplistic and logical, a pencil is more technologically transparent tool, and its use may therefore seem more natural to many. Furthermore, technology underpins other problematic situations because it includes various dimensions. E-learning systems aggregate various tools, such as writing technologies, communication technologies, visualization, and storage. For these reasons, researchers and scientists have sought to transform e-learning systems into technically transparent tool, like a pencil or notebook. The e-learning literature is vast and continues to grow steadily (Aparicio, Bacao, & Oliveira, 2014b). Investigating e-learning systems' adoption and usage reveals that continuous growth everywhere in the world, as well (OECD, 2012). The growth rate of on-line courses stands at 65% (Means, Toyama, Murphy, Bakia, & Jones, 2009), and some researchers suggest that at a governmental level, policies should be advocated enabling the e-learning usage (Kong et al., 2014).

As Hart (2009, p. 28) says "reviewing the work of others you will be able to identify the methodological assumptions and the research strategies." For these reasons, a holistic literature review is a valuable guide for researchers. However, no such overall view exists in the current literature. Consequently, the contribution of this article is threefold. First, we identify e-learning concepts ecosystem. Second, e-learning is examined from different angles; some studies are focused on how platforms operate to deliver information; others focus on the classes' pedagogical content development, others focus on the user interaction. This article presents a broad literature review. Finally, based on the literature review we present a theoretical framework on e-learning systems.

The paper is structured in six sections: the first presents a discussion of the e-learning concept; the second presents a literature review on e-learning related concepts; the third presents the trends of the concepts, based on a bibliometric study; the fourth summarizes various e-learning studies. Several dimensions of e-learning systems, such as stakeholders, pedagogical models, instructional strategies and learning technologies, make up the fifth section. In the last section, we present the main result of this literature review, a theoretical framework for e-learning.

E-Learning systems related concepts

E-Learning systems are an evolving concept, rooted in the concept of Computer-Assisted Instruction (CAI) (Zinn, 2000). The concept of CAI first appeared in 1955 as a means of teaching problem-solving (Zinn, 2000). Table 1 presents concepts related to e-learning. Computer assisted learning definitions have been studied in various ways. Some studies stress the technology while others have focused on communication (Mason & Rennie, 2006), as shown in Table 2. Our research reveals 23 concepts that belong to the use of computers in learning activities, used especially for learning purposes. The following table is arranged in ascending order according to the number of appearances of concepts in scholarly publications from 1960 to 2014.

Table 1. E-learning related concepts based on Aparicio & Bacao (2013)

Acronym	Description	Concept Focus	Authors
CAI	Computer-Assisted Instruction	Computer usage focused on programming teaching used in various fields: mathematics, engineering, psychology, physics, business administration, statistics.	(Bernhardt, 1960) (Kemeny & Kurtz, 1967) (Anderson, 2008)
CBE	Computer-Based Education	Concept that focuses on the variety of computer uses in education.	(Barson, Levine, Smith, Scholl, & Scholl, 1963) (Zinn, 2000)
CAL	Computer-Assisted Learning	Focused on individuals rather than tasks. The use of computers to assist problem-solving.	(Lanier, 1966) (Hart, 1981) (Levy, 1997) (Zinn, 2000)
LMS	Learning Management Systems	Supports registering services, tracks and delivering content to learners. It also reports learner progress and assessing results. LMS focuses on contents and teacher/student interaction.	(Becker, 1968) (Ismail, 2001) (Lee & Lee, 2008)
CMI	Computer-Managed Instruction	CMI stresses the teacher´s tasks.	(Molnar & Sherman, 1969) (Zinn, 2000)
CAE	Computer-Assisted Education	CAE concept refers to the use of computer for materials' production and focuses on the students' use of the computer in learning.	(Bitzer & Others, 1970) (Zinn, 2000)
e-Learning	Electronic Learning	E-Learning concept refers to learning via electronic sources, providing interactive distance learning. Use of a Web System as a way to access information available, disregarding time and space.	(White, 1983) (Morri, 1997) (Dorai, Kermani, & Stewart, 2001) (M. Rosenberg, 2000) (Piccoli, Ahmad, & Ives, 2001)
ALE	Artificial Learning Environments	Artifacts' usage as a mediator in learning within a specific environment.	(Fiol & Lyles, 1985)
m-Learning	Mobile Learning	The first way to fight illiteracy. Pessanelli (1993) gives a futuristic approach to how learning could be in the 21st century, focusing the concept as modular plug-in school. Drumm & Groom used the concept to conceptualize a cyber mobile library. m-Learning is the focus of flexibilization in the learning class environment and the use of various learning sources.	(Darazsdi & May, 1989) (Pesanelli, 1993) (Drumm & Groom, 1997) (Rushby, 1998)
SRE	Self-Regulatory Efficacy	Concept focused on learner's independent assessment of self-regulatory learning ability.	(Bandura, 1994) (Joo, Bong, & Choi, 2000)
CSCL	Computer Support for	Concept that focuses on computers as a way to facilitate, augment, and redefine support	(Koschmann, 1994) (Sthal, Koschmann, & Suthers,

	Collaborative Learning	learning in groups.	2006) (Ludvigsen & Morch, 2010) (Morch, 2013)
REAL	Rich Environments for Active Learning	Use of computer focused on student responsibility and initiative. Generative learning activities within authentic learning contexts. Providing assessment strategies and co-operative support.	(Grabinger & Dunlap, 1995)
Mega-University	Mega-University	Concept that combines distance learning, higher education, size and use of technology	(Daniel, 1996)
CFL	Computer-Facilitated Learning	Concept focused on the emulation of teacher-driven learning episodes contrasting with the constructivist approach. CFL groups the applications into functional categories and highlights the learning processes outcomes.	(Bain, McNaught, Mills, & Lueckenhausen, 1998)
LCMS	Learning Content Management Systems	Content Management launch pads for third party content that the organization would purchase or outsource	(Ismail, 2001)
B-Learning	Blended Learning	Blended learning combines multimedia for learning purposes. This form of learning mixes different learning environments (face-to-face and distance). The aim is to complement distance learning with face-to-face classes.	(Singh, 2003)
c-MOOC	Connective MOOC	Massive open online courses based on the philosophy of connectivism and networking, autonomy, diversity, and openness. Content made by motivated and autonomous learners.	(Siemens, 2005) (Downes, 2008) (Downes, 2006) (Rodriguez, 2013) (Rodriguez, 2012)
SDL	Self-Directed Learning	Focus on the teaching–learning method. SDL refers to the use of individual ways of learning, using self-strategies of learning. These strategies may occur using a computer, although SDL may occur without a computer.	(Rovai, 2004) (Lee & Lee, 2008)
ILM	Internet-based Learning Medium	ILM is focused in supporting and improving student learning.	(Lee et al., 2005)
MOOC	Massive Open Online Course	Free diffusion of content courses to a global audience through the Web. Integrates the connectivity of social networking, the Facilitation of an acknowledged expert in the field of study, and a collection of freely accessible online resources.	(Fini, 2009) (McAuley, Stewart, Siemens, & Cormie, 2010) (Godwin-Jones, 2012) (Peter & Deimann, 2013)
x-MOOC	MITx & EDX MOOC	Based on behaviorist pedagogy, relies on content diffusion, assignments, and peer assessment. Learning management systems with high-quality content.	(Rodriguez, 2012) (Rodriguez, 2013) (Bates, 2012)
LOOC	Little Open Online Course.	Focus on the directed instructions from the teacher to the students.	(Kolowich, 2012)
SPOC	Small Private Online Course	MOOC usage as a supplement to classroom learning, not as a substitute to the traditional way of teaching.	(Fox, 2013)

From Table 1 we see that e-learning concept was not the first term to be used in conceptualizing the use of computerized systems to enable or facilitate the learning process. In the 1960s, this concept focused on task accomplishment and thereafter focused more on the students. Mary Alice White coined the term “e-learning” in

1983, in a journal article entitled "Synthesis of Research on Electronic Learning." E-learning was defined as "*learning via electronic sources, such as television, computer, videodisk, teletext, videotext*." (White, 1983, p. 13). In 1997, e-learning meant an abbreviation of electronic learning, in turn meaning "an interactive distance learning" environment (Morri, 1997). Despite the use of the e-learning term, another author referred to the capacity of technologies combined with distance learning and with universities, which was named "mega-university" (Daniel, 1996). Online learning is another concept related to e-learning. Online learning can be defined as learning that takes place partially or entirely over the internet making information or knowledge available to users disregarding time restrictions or geographic proximity (Sun, Tsai, Finger, Chen, & Yeh, 2008). E-learning systems' concepts include a technological and a functional focus, regarding the Internet possibilities in overcoming time and space issues. Figure 1 shows a timeline of the main e-learning concepts. Concepts are shown according to the first publication date.

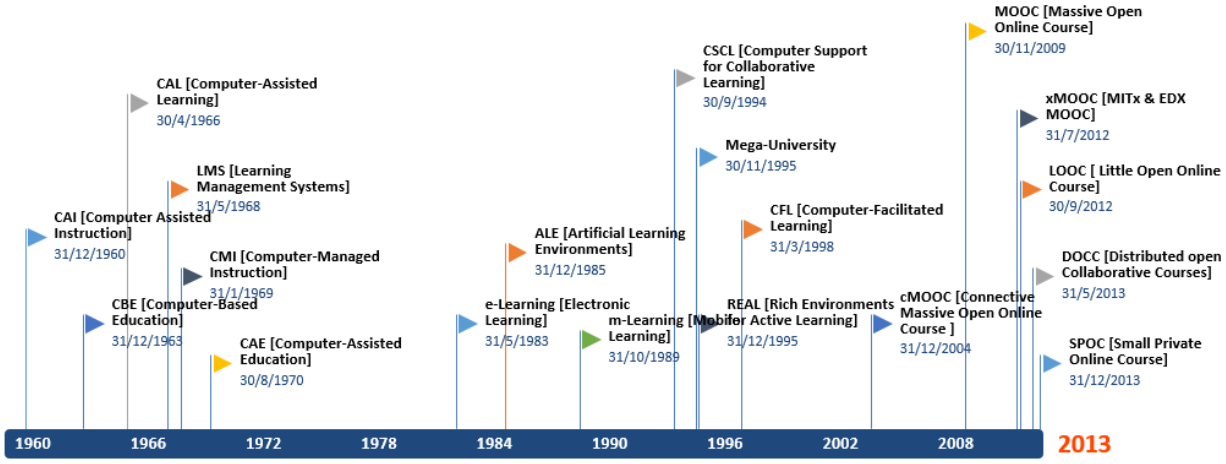

Figure 1. Timeline of E-learning related concepts (Aparicio, Bacao, & Oliveira, 2014b)

E-Learning concept trends

Today the e-learning concept, apart from technology, includes learning strategies, learning methods, and lately is very much directed to the vast possibilities of content diffusion and connection. The concept trend no longer means simply the use of a computer as an artifact in the learning process. Figure 2 illustrates the evolution and frequency of each concept, according to searches made with the Google Scholar search engine. Each search was performed at five-year intervals, from 1960 to 2014, for each exact term, using double quotation operator (Figure 2). The chart gives a clear visualization of the evolution and trends since 1960 of the most used concepts, in terms of publication in scholarly conference papers and journal articles. In order to visualize these variables we construct a circle using an information aesthetic software (Krzywinski et al., 2009). The figure can be read as follows: if we divide the circle into semicircles we have the left hand part, with the concepts and the related publications per each concept and the right hand part with the time intervals (from 1960 to 2014). To connect these two sides of the circle we have colored ribbons, which relate each concept publication amount with the correspondent time interval. From this figure we gain the overall picture of the publication history on e-learning related concepts over time. The colored ribbons have different widths – wider indicating a greater number of publications in each concept per each time period.

Figure 2 was constructed with the bibliometric study of the publications, indexed in Google Scholar, for the most frequent e-learning-related concepts (on the left-hand side of the semicircle): CAI, CAL, SDL, e-learning, LMS, CSCL, among others (Aparicio et al., 2014b). CAI concept is the most used, because it appeared first and is still widely used today. From Figure 2 we can also see that CAI is the most mentioned concept; we can see the yellow relationship between the concept and all time intervals. CAI ribbons (yellow colored) are balanced across time, except in the 1960s and '70s, when the concept was introduced. The other four concepts, SDL (red ribbon), CAL (pink ribbon), e-learning (blue ribbon), and LMS (orange ribbon), are of equal importance, although some of them appeared later. SDL, in red, is predominantly connected from 2005 until 2014 (Y05-09 and Y10-14). The most important CAL connections were formed from 2000 to 2014, even though the concept was used earlier. The e-learning concept, in blue, is mainly connected from 2000 until 2014. Other concepts show a relationship with the time intervals but these connections are not as strong as the others. Regarding the right-hand semicircle, it clearly

shows that the earliest years, from 1960 to 1999, account for only one-third of the publications, with approximately two-thirds of all publications produced thereafter. This leads to the idea that the computers' presence in the learning process has been explored and studied more in the last 14 years than it had been in the previous 40.

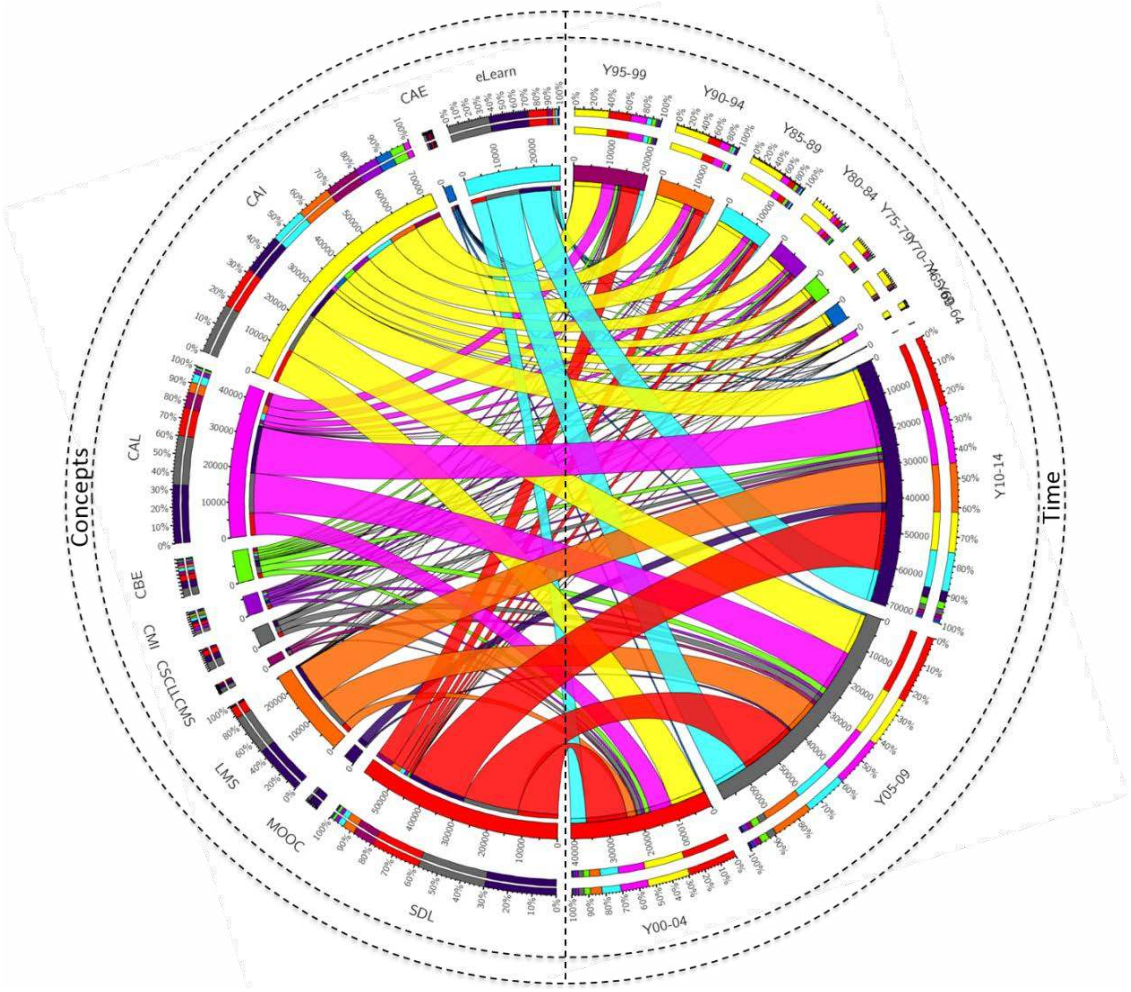

Figure 2. E-learning concepts related to the time reference

The most often 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 computers; except the SDL concept, which derives from psychology (Bandura, 1994) and does not necessarily apply to computer usage. We found three concepts: small private online course (SPOC); little open online course (LOOC), and distributed open collaborative courses (DOCC). These concepts are yet to be studied in scientific research, and stand in contrast to MOOCs. SPOC focuses on a private audience, and is defined as a supplementary way of learning apart from regular face-to-face classes. LOOC differentiates itself from MOOC as it is based on a different pedagogical model; it provides direct instructions to students. DOCC also differentiates from MOOC in its focus on the pedagogic engagement of all actors, underlining on one hand the invisible work of teachers, and on the other the collective intelligence of scholars. The graphic that illustrates the evolution concept indicates a tendency from the individual learning to a global learning. Nowadays, e-learning can also mean massive distribution of content and global classes for all the Internet users.

E-Learning studies

E-learning studies focus on several areas. Table 2 summarizes various examples of e-learning according to three main groups, people, technology, and services. As Leidner & Jarvenpaa (1995) say, IT impact on learning does not

solve all problems, we have to take into account people and models of learning. Some studies seek to understand the adoption of e-learning systems; others assess the success of course contents; others evaluate the perceived student satisfaction of specific e-learning course environments.

Table 2. e-Learning studies

e-Learning studies	People	Technology	Services	Authors
Studies on course contents and activities		√	√	(Brox, Painho, Bação, & Kuhn, 2004; Piccoli et al., 2001; Rosenberg, 2005; Zinn, 2000)
Studies on augmented reality in e-learning		√		(Bacca, Baldiris, Fabregat, Graf, & Kinshuk, 2014; Lee, Choi, & Park, 2009)
Studies about students' interaction in collaborative learning environments	√		√	(Bain et al., 1998; Ludvigsen & Morch, 2010)
Study on cultural differences in learning	√		√	(McLoughlin & Oliver, 1999; Yang, Kinshuk, Yu, Chen, & Huang, 2014)
Studies on the success of e-learning systems courses and modules	√	√		(Aggelidis & Chatzoglou, 2012; Kassim, Jailani, Hairuddin, & Zamzuri, 2012; M. K. O. Lee et al., 2005; S. H. Lee et al., 2009; Wang, Wang, & Shee, 2007)
Study on the Internet-based learning medium in a motivational perspective	√			(D. Lee, Chung, & Kim, 2013; J. Lee, Bharosa, Yang, Janssen, & Rao, 2011)
Studies on e-learning systems adoption	√	√		(Chen & Liu, 2013; J. Lee et al., 2011)
Studies on the satisfaction level of e-learning systems usage.	√	√		(Aggelidis & Chatzoglou, 2012; Sun, Tsai, Finger, Chen, & Yeh, 2008)
Studies on e-learning and digital divide	√	√		(Chen & Liu, 2013; Cruz-Jesus, Oliveira, & Bacao, 2012)
Studies about trust level, satisfaction, and adoption of e-learning.	√	√		(Kassim et al., 2012; Thoms, Garrett, Herrera, & Ryan, 2008)
Studies on e-learning evaluation processes	√		√	(Oliver & Herrington, 2003; Vavpotič, Žvanut, & Trobec, 2013)
Studies on MOOCs' business models	√		√	(Aparicio, Bacao, & Oliveira, 2014a; Belleflamme & Jacqmin, 2014; Dellarocas & Van Alstyne, 2013)

From Table 2 we see that even if the study addresses students' adoption or satisfaction, the contents, or even the way courses are designed and distributed, we can group those studies and find overlaps among them. This leads to the idea that when studying e-learning, researchers have to include variables other than technology. According to the studies examined, the way contents are delivered and the underlying learning strategies also play important roles in e-learning studies.

Apart from these dimensions, recent disruptive conditions have brought a massive diffusion of online learning through various formats, from closed to open learning, and the massification of open online courses (MOOCs) has been verified. McAuley et al. (2010, p. 4) define massive online open courses as "An online phenomenon gathering momentum over the past few years; an MOOC integrates the connectivity of social networking, the facilitation of an acknowledged expert in the field of study, and a collection of freely accessible online resources." Allison et al. (2012) stated that MOOCs are disrupting the learning environment due to the global free adoption and use of these open courses. Although according to a study done by Jordan (2013), students or simply public users are enrolling in different courses by the thousands, for example, one of the largest (measured by the number of enrolled students) has 180,000 and one of the smallest has 20,000. These figures demonstrate a massive quantity of students enrolled, comparing to a face-to-face university course that never reaches such numbers of students; nor does a teacher reach such a high number of students in her/his entire career.

From the above-mentioned studies one could believe that adoption is no longer a problem in e-learning, but a study by Jordan (2013) of the disruptive potential of MOOCs compares the enrolment rates with the completion rates per

each course and for all of them, finding that completion rates are very low. Motivation studies can also enlighten us with the disruptive potential of MOOCs, such as, "the individuals the MOOC revolution is supposed to help the most – those without access to higher education in developing countries – are conspicuously underrepresented among the early adopters" (Christensen et al., 2013, p. 8). MOOCs allow for a massive distribution of expressed knowledge, especially for those who cannot reach universities courses, due to economic, geographic, or political reasons. As a matter of fact, according to an empirical study (Christensen et al., 2013) MOOC attracts mainly young, well-educated and employed people from developed countries.

This summary of e-learning studies maps the various areas when studying e-learning and exposes the idea that e-learning should be studied using a combination of various dimensions.

E-learning systems dimensions

Information systems are composed of various dimensions. From a conceptual point of view the system is an artifact (Beckman, 2002), and this author considers the use of computers in education an "artificialization." Artifacts are not only technology, but also and mostly "a complex and changing combination of people and technology" (Dahlbom, 1996, p. 43). Technology implements artifacts and information technology serves human purposes, providing support to several tasks (March & Smith, 1995). Within this context, we present in this section the e-learning systems dimensions, in order to prepare our e-learning theory framework.

E-learning systems stakeholders

Stakeholder analysis entails the identification of internal and external groups or individuals that can directly and indirectly affect an organization (Freeman, 2010; Stoner, Freeman, & Gilbert, 1995). Stakeholder theory can be applied to other fields beyond management (Phillips, Freeman, & Wicks, 2003). Stakeholders analysis has been used in information studies to identify the systems' users and their direct or indirect interaction (Papazafeiropoulou, Pouloudi, & Currie, 2001; Wagner, Hassanein, & Head, 2008). We summarize the stakeholders of e-learning systems in Table 3.

Table 3. e-Learning systems stakeholders

Stakeholders	Group	Direct Action	Internal	External
Students	Customers	√		√
Employers	Customers	√		√
Educational Institutions	Suppliers	√	√	√
Accreditation Bodies	Suppliers	√		√
Teachers	Suppliers	√	√	√
Content Providers	Suppliers	√	√	√
Education Ministry	Board and Shareholders	√		√
Teachers' Association	Professional Associations	√		√
Students' Commissions	Special Interest Groups	√		√
Technology Providers	Suppliers	√		√

Customers are the ultimate users of the system for learning since e-learning systems are an important communication channel between learners and instructors. Learners can be individual students or company employees who are using these systems according to the development policies of their employees. In their case they are external users but they interact directly with the system. Suppliers can be schools, universities, or educational institutions in general; this stakeholder group is an internal group of users who interact directly with the system. Accreditation bodies are external; they interact directly with the system for auditing purposes. Teachers are part of the supplier group; they are internal users and interact directly with the e-learning platforms. Content providers can be internal or external users but they interact directly with the system. Other external stakeholders that interact directly with the e-learning systems are: education ministry, teachers' associations, students' commissions and technology providers. Education ministry is considered as a board and shareholder because public institutions are funded by this ministry. They have a

direct interaction with the systems in order to accompany the instructional institutions in their teaching role. Teachers and student groups can also interact directly with the system if they promote learning or research activities. Although technology providers are external to the system, they can provide maintenance services to the technological part of the system by giving technical support. Each stakeholders group interacts differently with the system, although all of the stakeholders play an important role within the e-learning system activities.

Elements of an e-learning system

E-Learning theory comprises three elements. According to Dabbagh (2005) e-learning can be defined through a theory-based framework that relates learning technologies, instructional strategies, and pedagogical models or constructs. Dabbagh's framework (2005) includes multiple dimensions, such as the way people learn (open/flexible way), with the learning strategy (collaboration, exploration, problem-solving) and also with technology. It is a pedagogical model, and "cognitive models or theoretical constructs [are] derived from knowledge acquisition models or views about cognition and knowledge, which form the basis for learning theory. In other words, they are the mechanism by which we link theory to practice" (Mehlenbacher, 2010, p. 146). Instructional strategies facilitate learning, such as, collaboration, articulation, reflection, and role-playing among others. Although they are pedagogical models, our main objective in this study is to review the literature on e-learning systems. Subsequent to Table 1, which presents the concepts of the context of the e-learning systems, we constructed Table, Table 4 in which those concepts are classified according to two ways of e-learning definitional dimensions. First, the concepts are classified according to Dabbagh's (2005) framework, according to whether the concepts reflect a pedagogical model, instructional strategy, or a learning technology. Second, we also identify the concepts according to Mason & Rennie's (2006) classification of e-learning perspectives, whether concepts are content driven, communication focused, or technologically oriented.

Table 4. e-Learning concept perspectives overlapping

Year	Acronym	Dabbagh's Theory Based Framework (2005)			e-Learning Perspectives of Mason & Rennie (2006)		
		Pedagogical models	Instructional strategies	Learning technologies	Content	Communication	Technology
1960	CAI		√	√			√
1963	CBE		√	√			√
1966	CAL	√	√	√			√
1968	LMS			√	√	√	√
1969	CMI			√		√	√
1970	CAE			√	√		√
1983	e-Learning	√	√	√	√	√	√
1985	ALE			√			√
1989	m-Learning			√	√	√	√
1994	SRE	√	√	√		√	√
1994	CSCL	√	√	√	√	√	√
1995	REAL		√	√	√	√	√
1996	Mega-University		√	√		√	√
1998	CFL	√		√	√		√
2001	LCMS		√	√	√		√
2003	B-Learning	√	√	√	√	√	√
2004	SDL	√	√	√		√	√
2004	c-MOOC	√		√	√	√	√
2005	ILM		√	√	√		√
2009	MOOC	√	√	√	√	√	√
2012	x-MOOC	√	√	√	√	√	√
2012	LOOC	√	√	√		√	√
2013	SPOC		√	√	√	√	√

Pedagogical models, instructional strategies, and learning technologies, combined together, form a framework applicable to e-learning (Dabbagh, 2005). These three components enable the linkage between who (open learning, distributed learning, or communities of practice, among others) is participating in the learning process, with the way in which these features interact (collaborating, articulation, reflecting, exploring) and the technologies through which the communication occurs (synchronous, asynchronous, communication tools, course management tools, among others).

Pedagogical models in e-learning

Pedagogical models are the basis of learning theory, as they derive from knowledge acquisition. From a pedagogical point of view these models are mechanisms that link e-learning theory to e-learning practice (Dabbagh, 2005). The pedagogical models in e-learning are open learning, distributed learning, learning communities, communities of practice, and knowledge building communities. The open learning can take several forms, for example, it can be a workshop, a seminar, a night course, or a distance course. Some examples on the Web are: "knowledge networks, knowledge portals, asynchronous learning networks, virtual classrooms, and telelearning" (Dabbagh, 2005, p. 30). Distributed learning is focused on the learning distribution resulting in a combined channels situation that allows learners to access education through technology or not in a way that can be obtained synchronously or asynchronously anywhere (Dabbagh, 2005). In many situations learning communities are composed of students in universities who "tend to feel more self-confident and to feel supported by peers, by instructors, and by the college" (Patterson, 2011, p. 20). Communities of practice (CoP) are defined by Wenger (1999) as informal groups of people who share the same interests on a subject. Communities of practice share interests and best practices and collaborate not only in academia but also in industry. These communities usually have regularly scheduled meetings, CoP meet face-to-face or in virtual environments (Liu, Chen, Sun, Wible, & Kuo, 2010; Wenger, 1999). A knowledge building community is perceived as a group having "commitment among its members to invest their resources in the collective, upgrading of knowledge" (Hewitt & Scardamalia, 1998, p. 82). These communities pursue the creation of knowledge by sharing individual knowledge in order to achieve learning. The pedagogical models applied to e-learning are supported in the following attributes: learning is a social process, learning in group is fundamental to achieve knowledge; distance is unimportant (space questions are blurred); teaching and learning can be segregated in time and space.

Instructional strategies

Instructional strategies operationalize the pedagogical models, since strategies consist of general approaches to a learning model, which is to say, the instructional. Jonassen et al. (1997) present five instructional strategies that, in fact, are plans and techniques that the instructor uses in order to engage the learners – in other words; instructional strategies are enablers to learning. The authors state that instructional strategies differ from learning strategies, as learning strategies are mental tools that students use to understand and learn more (Jonassen et al., 1997). The authors state that each instructional condition should meet a different instructional strategy.

Learning technologies

Many authors have defined the characteristics of the learning technologies to support a learning environment of collaboration and supported learning, and have left room for various perspectives (Dabbagh, 2005; Hsieh & Cho, 2011; McLoughlin & Oliver, 1999; Oliver & Herrington, 2003; Rourke & Anderson, 2002). A constructivist epistemological point of view (Hannafin, Hannafin, Land, & Oliver, 1997) requires integrated strategies, aligning several foundations and environments: psychological, pedagogical, cultural, pragmatic, and technological, since according to the characteristics of this vision "knowledge depends on the knower's frame of reference" (Dabbagh, 2005, p. 29). Oliver and Herrigton (2003) construct an e-learning framework composed of technological elements grouped into three main areas in learning: resources, supports, and activities. Table 5 summarizes these instructional strategies and the correspondent technologies' functionalities.

Table 5. Instructional strategies and learning technologies

Technologies \ Strategies	Authentic activities	Problem solving	Role playing	Articulation & reflection	Collaboration & negotiation	Multi-perspectives	Modeling & explaining	Scaffolding	Authors
Graphics	√								(Dabbagh, 2005; Hannafin et al., 1997)
Digital audio & video components	√								
Animation	√								
Hypermedia	√								
Authoring tools	√								
Synchronous discussion area		√							(Dabbagh, 2005; McLoughlin & Oliver, 1999)
Online databases/ knowledge repositories		√							
Search engines		√				√			
Multi-user dialog			√						(Dabbagh, 2005; McLoughlin & Oliver, 1999)
Virtual reality			√						
Forums				√	√	√			
Learner web-post area				√			√		
Learner online journal				√					
Sharing tool					√				
Video conferencing					√			√	
Chat					√		√	√	
Web links manager						√		√	
"Ask the expert" area/link						√			
Solution/problems area							√		(Dabbagh, 2005; Jonassen et al., 1997)
Digital area audio/video capturing							√		
One-on-one mentoring								√	(Dabbagh, 2005; McLoughlin & Oliver, 1999; Vygotsky, 1978)
Glossary								√	
Assessment		√		√				√	

E-learning theory framework

A framework "classifies the important factors in information systems development can imply that these factors are causally connected with successful systems development" (Gregor, Martin, Fernandez, Stern, & Vitale, 2006, p. 619). In this framework (Figure 3), we present the main information systems dimensions adapted to e-learning systems. This framework is a theoretical generalization (Carroll & Swatman, 2000; Lee & Baskerville, 2003) resulting from the literature review on e-learning dimensions.

The e-learning systems' theoretical framework contains the three main components of information systems. These components are people, technologies, and services. People interact with e-learning systems. E-learning technologies enable the direct or indirect interaction of the different groups of users. Technologies provide support to integrate content, enable communication, and provide collaboration tools. E-learning services integrate all the activities corresponding to pedagogical models and to instructional strategies. The complex interaction combination is the direct or indirect action with e-learning systems. At the same time, systems provide services according to the specified strategies for activities. In other words, service specifications are e-learning activities aligned with the e-learning pedagogical models and the instructional strategies.

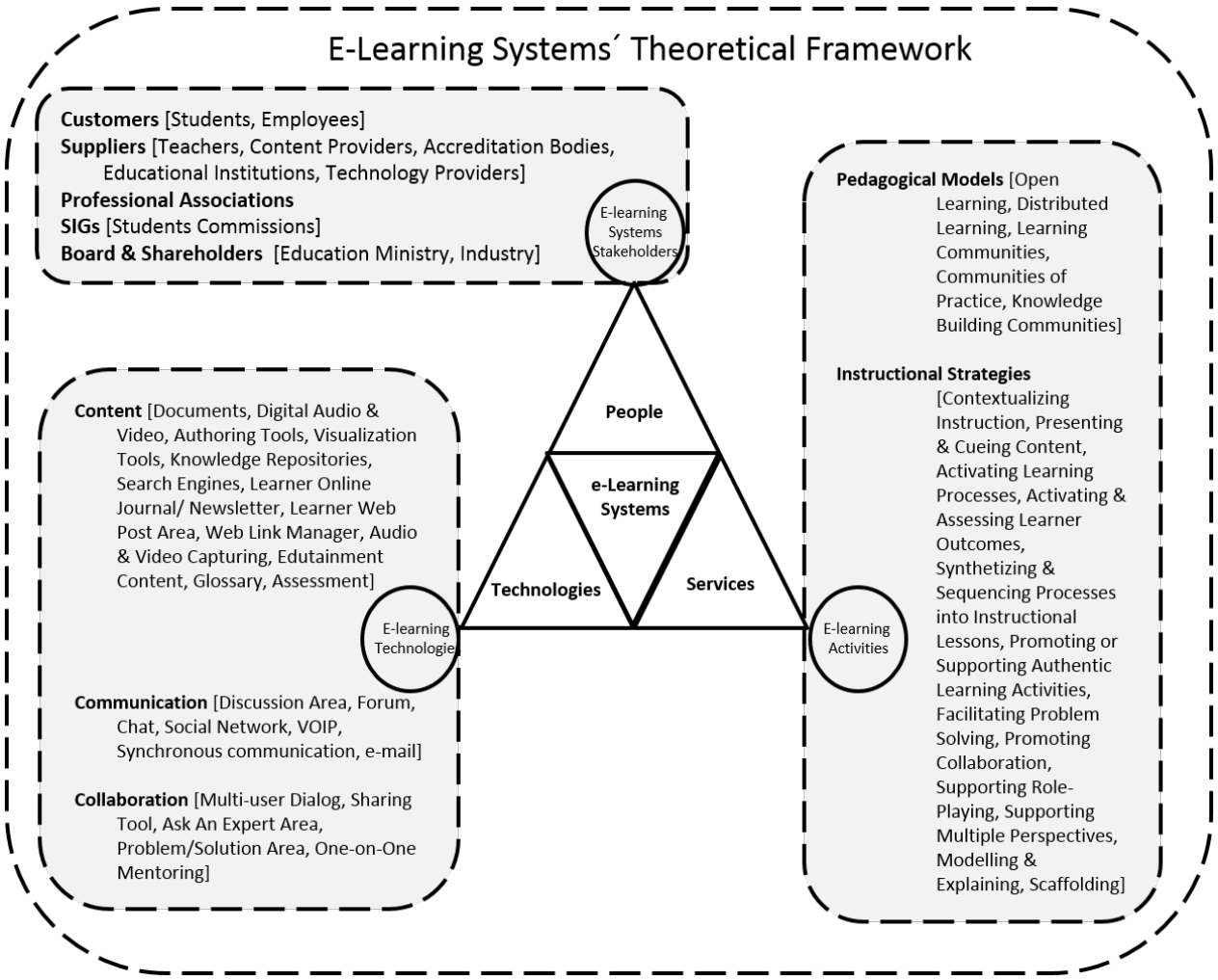

Figure 3. Holistic e-learning systems theoretical framework

Conclusions and future work

In this study we construct an e-learning systems theory framework. The goal is to identify the participants, technology, and services related to e-learning.

We present a literature review on e-learning, searching for the various concepts related to the use of computers in learning contexts. This study reveals that e-learning is not the most used concept in research. In fact, researchers refer to other concepts (e.g., CAL, CFL, CAE, CBE, LMS or MOOCs). After identifying those concepts, we then report the results of a bibliometric study of the e-learning related concepts indexed by an academic search engine. We also review the e-learning dimensions, which are: the e-learning systems stakeholders, the pedagogical models, the instructional strategies, and the learning technologies. Using these dimensions we construct a theoretical e-learning conceptual framework. The resulting framework for e-learning has three dimensions: people, technology ,and services. These dimensions provide our theoretical framework with a more holistic view. The main contribution of this critical literature review is to provide the theoretical background for e-learning research strategies.

The e-learning systems theory framework was constructed upon the three main components of an information system: people, technology, and services provided by technology itself. Guided by these main pillars we revise and identify the stakeholders groups and their interaction with e-learning systems. We then present the classification of the technological considerations to these kinds of system, focusing more on the contents type and ways of communication, than on providing a list of the platforms existing in the market. This is an important feature of the

framework, because apart from the commercial platforms we identify technological specifications that can be applied to any technological artifact. The third pillar corresponds to services provided by an e-learning system. Services are considered here as the main output, as they operationalize instructional strategies and several pedagogical models. The framework provides the theoretical structure for multiple studies in e-learning systems.

For future work we intend to use this framework as a cornerstone to guide our e-learning systems research. We intend to propose a model for assessing the success of e-learning systems.

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