# TRACING THE USE OF COMMUNICATION TECHNOLOGY IN HIGHER EDUCATION: A LITERATURE REVIEW

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## Abstract

Communication Technologies are used in Higher Education Institutions worldwide, producing changes in the design of teaching and learning practices, giving rise to learning paradigms such as e-learning, b-learning, m-learning and cloud learning. Research embraces different perspectives, emphasizing that Internet and Communication Technologies use is not potentiating innovation or disruptiveness of more traditional forms of education, while another perspective argues that there is disruptiveness that is becoming ever more powerful, promoting changes in the roles and way teachers and students work. The present review suggests that web 2.0 technologies has promoted new forms of communication, interaction and sharing between users and content in formal education settings. Furthermore, the realization of how vast and disperse the body of literature is, concerning the use of Communication Technologies in HE, revealed as significant the main goals of the project "Portuguese Public Higher Education Use of Communication Technologies", that aims to characterize Portuguese higher education institutions according to their use and best practices, disseminating the information obtained through an online visualization information tool. The ultimate goal of the project is to contribute towards making valuable and up-to-date information available to Higher Education Institutions and users, facilitating and potentiating research in the area.

Keywords: Communication Technology, Higher Education, Teaching, Learning.

## 1 INTRODUCTION

The adoption and promotion of Communication Technology (CT) is happening throughout the world of Higher Education Institutions (HEI), especially because CTs are taking an increasing role in people's life. Now embedded in people's lives, CTs are shifting into more ubiquitous and networked participations. This is estimated to further contribute towards the future of economy, society and personal quality of life, by simultaneously demanding HEI to compete in the globalised economy, cooperating among themselves, and resorting to a variety of technological services, adding to their capacity to potentiate best practices and innovation.  As to the existing impact of CTs in Higher Education (HE), programs such as i2010 and entities like UNESCO and OECD report that students are mostly using the web to interact, communicate and produce content, being increasingly influenced by Web intelligent services that empower user to distribute content and customize Internet applications. In this article CTs are defined as the hardware and software that allow and promote communication and information distribution supported by the Internet [1, 2].

Research concerning CTs and their use in HEI, embraces different perspectives. Some research concerns the study of specific uses of CTs by students in the learning process [3] and the approaches to teaching and learning that include their use [4]. Other studies present the institutional perspective of the current strategies and practices of academic and administrative use of a specific set of emerging tools covered by web 2.0 [1, 5], as well as best teaching practices developed in regions like Europe, or studying the impact of emerging technologies in HE environments. As Pratt and Palloff [6] state, the knowledge of how wired HEIs are is determining for the students to choose the institution they want to apply to and attend –making the availability of this information of interest for both institutions and users.

The vast emerging and disperse body of literature justifies the relevance of the present literature review, aiming to provide a synthesis of the research conducted in the field, and to draw the impact of

these technologies in teaching and learning contexts, illustrated with empirical examples of CTs use in HEI. In this context, it enhances the challenges of the "Portuguese Public Higher Education Use of Communication Technologies" project [7], under development at the University of Aveiro, that aims to trace the information expected to characterize the Portuguese Public Higher Education Institutions (PPHEI) as to their adoption and use of CT. Contributing to making information of interest to institutions and users, available and up-to-date, the ultimate goal of the project is to develop an online information visualization tool that will allow to visualize information related to the use of CTs in Portuguese Public Higher Education Institutions (PPHEI), and propose the dissemination of best practices.

This paper is divided into 5 sections, each summarizing a component of research on distance education: 1)   Introduction; 2) Literature review methodology; 3) CTs use in Higher Education to support teaching and learning, divided into the learning paradigms and tools being used to support and enhance teaching and learning; 4) Discussion and summary of research aims; 5) Final considerations.

## 2   LITERATURE REVIEW METHODOLOGY

The literature review focused on evidence retrieved from both large and small scale relevant international reports [1, 8], conference papers and journal articles regarding the use of CTs in HE learning contexts and their impact on educational structures and processes. PhD and Master theses, as well as peer reviewed articles have also been reviewed as to practices developed in HEIs. In a second phase, after devising an initial structure and respective subcategories, each topic was studied in detail, in order to find reference articles in peer-reviewed journals and in books, within the 2004-2011 timeframe.

The search was performed directly in the UNESCO and OECD websites, and in databases that included Scopus, Eric, B-On and Google Scholar. The keywords used – e.g. higher education, communication technologies, information and communication technology – were combined using appropriate Boolean operators. After identifying a preliminary set of articles, bibliography sections were analysed in order to identify additional studies of interest. The additional keywords used were web2.0, web1.0, mobile learning, e-learning, blended learning, cloud learning, immersive worlds, and personal learning environments.

## 3   COMMUNICATION TECHNOLOGIES USED IN HIGHER EDUCATION TO SUPPORT TEACHING AND LEARNING PRACTICES

The use of CTs in HE has evolved, alongside the evolution of the web and web technologies, from web 1.0 tools – void of interactive components –  to web 2.0 tools, which embrace interaction and promote social network media tools and applications, driving new web experiences that potentiate connection and collaboration between users. This has given rise to a massive transformation of educational organizations and institutions, leading them to rapidly adapt.

As Selwyn [9] points out, Information and Communication Technologies (ICTs) have become "an icon of early 21st century higher education provision" in developed and developing countries, and as universities attempt to "'blend' ICTs into all aspects of face-to-face teaching and learning, as well as into students' independent study", investments of the universities on computer infrastructures have increased over the last decade.

Research with an international range concerning the specific use of web 2.0 in HE identifies the broadband infrastructure and teacher training having disparities between and within developed countries, mostly noted between developed and developing countries [10]. In addition, the need of faculty training in HE to effectively integrate CTs is identified in both established and emerging teaching and learning methodologies, as well as in the use of those technologies [10] such as the use of mobile devices for mobile learning.

The emergence of those multimedia environments and technologies has simultaneously driven change to occur, and has contributed towards the disruption of teaching methods, in a HE teaching and learning environments need to innovate, where the teacher continuously negotiates authority and where it becomes important for students to be able to create knowledge and manage information in different ways [11]. Garrison & Anderson [12] also state that teaching methods and interactions are

changing as a result of the adoption of CTs and the Internet, transforming teaching and learning into a more student centred experience.

Conversely, Blin & Munro [13] contested the idea that disruption had happened as a result of the impact of technologies in HE. Their conclusion was drawn from the pattern analysis of usage of one institutional Virtual Learning Environment in Dublin City University, between 2005 and 2006, where the three most relevant results were: i) the main use of the VLE did not go beyond replication of existing practices, such as the dissemination of resources and information, stating that "the main types of learning materials added to the VLE are ''static'' content-based resources such as web pages and lecture notes" [13]; ii) there was no disruptive change in the assessment methods and activities; web tools which demand either collaboration or reflection are less used than face-to-face teaching [13].

On the perspective of disruption, Bielaczyc & Blake [14] defend that the roles of teachers and students have changed dramatically from a teacher determined construction of learning into a shared process of scaffolding of learning where students gain more autonomy, due to the integration of CTs, web services and tools into the pedagogical practice and goals. New roles are adopted in new learning environments: by teachers who position themselves as facilitators, mentors and coaches [12]; and by students [4], with greater autonomy and empowered to create spaces where learning can take place and skills are built [4].

According to Downes [15], the "future learning environment" is more centred in learning and in the learners' needs and interests, where content can be used and transformed, having its confirmation in the exponential development and use of web 2.0 and Social Networking software for communication, interaction, collaboration, establishing connections, and sharing information.

## 3.1 Teaching and learning supported by CTs

How is learning supported by the use of CTs? All the systems referred to teaching and learning as being supported by CTs in both the delivery of face-to-face and distance modes – largely delivered at distance in a classical mode or in online approaches –, may be defined as Distance Learning (DL) [16-18]. In this context, teachers and students communicate resorting to several online tools and media. When referring to distance learning we have to understand distance education from which it derives. Distance education (DE) is defined as being institutionally based, where teacher and student can be separate geographically or in time, and CTs contribute to diminish those distances [19]. The effort to develop Distance Education supported by CTs is extended to developed and developing countries, as the UNESCO incentives African countries to invest in the applications of CTs in HE, despite the need of faculty training and the need to cooperate internationally.

The literature shows that within learning supported by CTs, the concept of distance learning comprises four learning paradigms, which intersect: e-leaning, blended learning, mobile learning and cloud learning. For the purpose of this article, the definitions of the learning paradigms will only contemplate the formal learning context.

### 3.1.1   E-learning

E-learning can be understood as a significant part of the learning content made available via the Internet [20], "the use of new multimedia technologies and Internet, to improve the quality of learning by facilitating access to resources and services, as well as remote exchanges and collaboration" [European21]. E-learning in European HEIs is considered to be strategic for the education and training systems to become more competitive and dynamic within a knowledge-based economy (CEC, 2003). It reflects the European recommendations as to the Bologna Process and in terms of the i2010 Program which encourages the creation of a Single European Information Space.

E-learning technologies, namely Learning Management Systems (LMSs), dominantly employed to organize and deliver online courses, as well as Virtual Learning Systems (VLS) [15], enrich the pedagogical processes, because they facilitate access to information and communication, increase cooperation and collaboration, and allow access to virtual experiences [22]. HEIs have invested in VLEs to support e-learning, mainly for "administrative purposes, to disseminate resources or information and to complement or replicate existing practices" [13]. It is expected that every HEI in the OECD area uses a learning management platform, justifying the results of the OECD report on Millennium Learners, which identifies the use of VLEs by students (82.3% several times a week) as one of the largest technologies used for academic purposes [23].

### 3.1.2 Blended learning

Blended learning is considered to be a mix of face-to-face and online learning [24, 25], requiring a restructuring of the class, contact hours and approach although "it is not clear how much or how little, online learning is inherent to blended learning", and its instructional design must be flexible [25]. By practicing blended learning the conveniences of online courses are gained without the loss of face-to-face contact, thus creating a richer learning environment. According to the ECAR national study for 2011 (USA), today's students, of which 36%, prefer a blended learning environment and classes with some online components, believing they tend to learn more this way [26].

### 3.1.3 Mobile learning

Mobile learning as a theory encompasses learning in a society characterized by mobility of people and knowledge supported by mobile devices [27], application software and networking technology. The accessibility of mobile technology to the average person is leading towards a shift in learning locations and learner access to information [28]. With this comes the mobile-learning movement, which brings the discussion of equitable access to education for socially or economically excluded individuals, and in regard of the developing countries [29, 30].

Giorgieva [30] states that mobile learning is a new trend in the development of e-learning, in which mobile devices help students get access to course materials anytime anywhere. This is important to HEIs because today's faculty members and students are arriving at universities with easy-to-use devices such as laptops or mobile computers, fully equipped with web development environments, music and video displayers, productivity tools, maybe open software and prepared for broadband web connections [31]. However, this phenomenon may also cause learning to be chaotic, although recognizing the possibility for learners to maximize their productive time, enhancing and balancing work-life-education [29]. Motiwalla [29] makes a comparison between classrooms using computers and e-learning as a complement to learning activities, with classrooms using mobile devices and m-learning, emphasizing that features such as alerts and permanent access to interact and communicate may help users be more productive; however, such results also show that differences reside in the tools used while the pedagogies remain similar. Mobile learning is considered disruptive, particularly for supporting learning outside the classroom, making education an integrated activity of learning with life and work, facilitating the learning process [32, 33].

### 3.1.4 Cloud learning

Finally, cloud learning, a concept inspired by cloud computing [34] which is understood to be defined "as clusters of distributed computers (largely vast data centers and server farms) providing on-demand resources and services over a networked medium (usually the Internet)" [35]. The main types of services that can be offered by cloud computing, according to Sultan [35], are Infrastructure/Platform/Software as a Service, some of which are Google Apps, the Google cloud platform.

HEIs are becoming more aware of the potentialities of cloud computing for improving efficiency and cost for the educational sector [35]. Also, for improving teachers and students time consuming continuous task of upgrading technology and software, allowing them to dedicate more time to the development of higher levels of thinking and group intelligence [34]. In cloud learning, learners are at the centre of learning, giving them more responsibility and opportunities to actively engage in their own learning and offering them a richer experience [34]. This interconnects with other learning modes such as blended and mobile learning, which emphasize that learners become active in sharing and collaborating, creating content and personalizing their learning environment.

## 3.2 Communication technologies used in HEIs to support teaching and learning

Aiming to find patterns and obtain an understanding of the wider adoption and use of communication technologies in HE, a range of empirical studies, articles and series of reports that outline the international development were reviewed, supporting the empirical example to illustrate the use of CTs in HEIs, in teaching and learning contexts as support structures. The questions attempted to answer in this section are: a) which CTs are being used in HE? b) how are CTs being used in HE?

The need to answer these questions relates to the development of the research project entitled "Portuguese Public Higher Education Use of Communication Technologies", at the University of Aveiro, which objective is to characterize PPHE institutions as to their adoption and use of CTs, in

support for existing technological processes and structures of teaching and learning (project details will be developed further in this article). Therefore, to understand which and how CTs are being used, we have looked specifically for publications concerning web 2.0 tools, services and platforms use in HE. Our aim is to reveal some of the empirical evidence on the use of web 2.0 tools in HE in learning and teaching contexts, as well as the use of libraries as a support to the learning processes. Looking at web 2.0 means looking beyond technologies themselves; it means referring to a culture of collaboration, sharing, communication and interaction between users in a participatory online social environment [2, 3], where users are becoming more and more consumers and producers of content [1]. Longitudinal studies show the considerably patchy [1] and diverse use of web 2.0 social media technologies in formal learning and change of practices [3], at the levels of teaching and learning. This makes it relevant to understand which technological solutions are being adopted at educational institutions, in order to better understand the institutions' view of education and of the teaching and learning processes [36].

To sustain the review analysis we have adopted the major categories of web 2.0 activity and tools proposed in the BECTA Report [8], also adopted in other reports [3, 5], accordingly, 13 activities were categorized: "1) Trading - Buying, selling or exchanging through user transactions mediated by internet communications; 2) Media Sharing - Uploading and downloading media files for purposes of audience or exchange; 3) Media manipulation - Using web-accessible tools to design and edit digital media files; 4) Data/web mash-ups - Using web-accessible tools to design and edit digital media files; 5) Conversational arenas - One-to-one or one-to-many conversations between internet users; 6) Online games and virtual worlds - Rule-governed games or themed environments that invite live interaction with other internet users; 7) Social networking - Websites that structure social interaction between members who form subgroups of 'friends'; 8) Blogging - An internet-based journal or diary in which a user can post text and digital material while others can comment; 9) Social bookmarking - Users submit their bookmarked web pages to a central site where they can be tagged and found by other users; 10) Recommender systems - Websites aggregate and tag user preferences for items in some domain and thereby make novel recommendations; 11) Collaborative editing - Web tools are used collaboratively to design, construct and distribute some digital product; 12) Wikis - A web-based service allowing users unrestricted access to create, edit and link pages; 13) Syndication - Users can 'subscribe' to RSS feed enabled websites so that they are automatically notified of any changes or updates in content via an aggregator".

Another categorization has been proposed by Grodeka [2], integrated in a handbook to encourage innovative educational practices and of web 2.0 technologies within European HE, dividing CT into 6 categories of uses:1) communication; 2) publishing and sharing; 3) collaboration; 4) self-organization of the learning process; 5) social networking; 6) searching the net.

Therefore the choice fell over the categorization proposed by Crook, et al [8], considering it to be more complete by contemplating additional tools and activities which are not considered in Grodekas' [2] categorization.

### 3.2.1  Web2.0 activities and tools used in HE

In result of the review, the only category for which there was no evidence in the literature concerns trading in educational contexts. Web mash-up sites was verified to be a set of tools and environments of emerging interest in the potential educational use in HE, by faculty teachers [11]. Mash-up sites are websites composed by data from different sources into a new Web service [37]. Increasing use of services such as Netvibes, by HE students and teachers, are creating ideal learning environments that maximize the exchange of ideas and interaction, individually or in a community, to connect, collaborate and interact [38].

Personal Learning Environments (PLEs) may be understood as an aggregation kind of tool, through which learners may build their own learning environment, connecting to resources and services, by consuming and producing those resources [39]. PLEs can be understood as tools which help the learner have greater control over i) the work produced, ii) the activities they participate in and iii) the resources involved in their learning experience [40, 41]. The learner can connect and coordinate connections for which he/she uses several services and tools and combining devices in different contexts [42]. Tools such as web 2.0 aggregation, once they allow the use of multiple sources to create a new application or service [8] can be interactive environments. SAPO Campus is an example of a technological platform offered by University of Aveiro since 2009 that offer its community aggregation facilities supported by widgets, integrated web 2.0 tools for video and photo sharing, a cross-institutional wiki and a blog platform promoting a PLE construction culture [36, 43].

Evidence that universities are opening up to the idea of integration of web 2.0 tools and principles, are multiple [1, 31]. Blogging, wikis, RSS and social networking are commonly offered by HEI, being integrated in social networking sites such as Ning and Elgg, frequently used as VLEs [3, 44]. Many HEIs opt to invest in the institutions VLEs, concerning mostly the management and sustaining of various kinds of online interactions between students and teachers, containing a large range of institutional information [44]. In a more recent evolution, institutional VLEs are also supporting individual and personal learning [44], aiming to create research and learning communities in a more informal manner [2]. Social networking sites such as Facebook, Ning or Elgg, are also frequently used to create communities of practice in HE [3].

Wikis have become well-known web 2.0 tools for education. A wiki is user constructed, allowing for collaborative writing in a peer group wiki, where students reflect, share ideas, improve their communication skills and comment on their writing [1]. Wikis are also a support to teachers in their design for learning, a single place where they can put all the materials for a lecture [1].

Media sharing tools, allow sharing content in open access and open participation contexts. Video media sharing tools, in an open access and open participation context, are being used by HEIs to have an official presence in video sharing services such as YouTube Education or iTunesU. As Reuben [45] demonstrated as a result of the 148 universities and Colleges she surveyed (USA), over half of those institutions had an official presence in YouTube. YouTube Education is a space to support academia, where education is a strong category and where Universities set their official channels, make lectures available and use technology to record and distribute video online, allowing students to keep up with the lectures, and also as a form of advertising, widening their audiences [1].

Social networking sites are used by students to communicate with colleagues and teachers about coursework [26]. Tools such as Facebook are popular and commonly used by students [26], and faculty teachers are using it to: include group settings in formal learning; communicate easily the school community [46]; to easily communicate and to market school events.

Related to immersive worlds, the 2007 Horizon Report classified virtual worlds as an emerging trend likely to impact HE.Virtual worlds are increasingly being used in HE, enabling authentic and scenario-based learning contexts and, according to Conole and Alevizou [3], over 250 HEIs worldwide are teaching using Second Life, given the opportunities to interact in new ways, to add value to HE teaching and learning in supporting interactions in virtual lectures, and supporting activities like seminar and lectures, social interactions with realistic contexts [48]. The ECAR national report identified that more than one in seven students are involved in activities in virtual worlds, mainly through geotagging activities [26]. The high usage of 3D immersive virtual worlds by teachers in HE is reflected on the numbers Dalgarno [49] presents, indicating that from a total of 125 HE teachers from Australia and New Zeland, 62 use 3D immersive virtual worlds in their teaching, employing Second Life (78.0%) and Active Worlds (5.0%), the most commonly used platforms, followed by OpenSim (4.0%) and There.com (1.0%). Immersive world applications are being used in health training, business, science, languages, supporting diverse disciplinary areas of interest [48, 50]. In UK most universities have a presence in Second Life as a marketing strategy [5] revealing the potential of its use.

## 4   DISCUSSION AND SUMMARY OF RESEARCH AIMS

Tracing information concerning the use of CTs in educational practices and structures of HEIs is a complex and time-consuming task. The disperse and overwhelming amount of information published results in an "information overload", and making sense of that information, translating the insights into activities of value, is a challenge for academia [51]. As Pratt and Palloff [6] state, the knowledge of how HEIs are wired is important because it is determining how students choose which institutions to attend. Therefore it is of crucial importance to have the insight on how the learning theories have evolved and emerged along with the creation of CTs. The realization of the learning paradigms being intertwined shows that the impact of CTs such as web 2.0 over the teaching and learning practices already supported by web 1.0 is not disruptive but adaptive. What the review also shows is that emerging CTs are nowadays rapidly explored as to their educational use, and driving towards the creation of learning paradigms. Mobile learning and cloud learning are two examples where the technologies gave the name to the learning modes they support.

By choosing to approach this review from the categorization of web 2.0 activities, it is important to be aware of the philosophy behind the creation of web 2.0. participatory actions always present to some

extent in all web 2.0 environments, as illustrated. CTs have been understood by some authors to be disruptive of the more traditional teaching and learning practices. But by focusing in a family of CTs, as the web 2.0, there is no clear evidence of an educational disruptive use, although we believe that in order to have this understanding, a deeper inquiry is needed. Mapping the specific HEIs in which the practices identified related to was an option abandoned in this review, because it was not possible to be consistent in mapping an institution for every teaching and learning activity supported by CTs, even though making this information systematically available is of interest to institutions and to users who want to know how wired the institutions are in order to choose which one to attend [6].

One of the main objectives of the project this article pertains to, is to characterize, as stated earlier, the adoption and use of CT in PPHEI, in order to understand which CT tools are used. For this objective to be achieved, an exploratory study will take place by applying an online questionnaire addressing key elements of the HEIs, with the aim of gaining an overall institutional view of CTs made available and their support mechanisms (social, academic, logistic). The information visualization tool will serve the purpose of giving visibility to data, allowing for visualization of filtered data, under the specification requirements of its users. The choice for proposing to develop an Information Visualization web tool results from it being an emerging research area, approaching the problem of making sense of a vast quantity of information now available [51], which becomes crucial for analysts in many fields of application, and helps individuals understand and analyse data [52]. The aim is to contribute towards making information of interest to institutions and users, available and up-to-date, facilitating and potentiating research in the area.

## 5    FINAL CONSIDERATIONS

As this literature review has revealed, the use of CTs in HE implies information concerning which technologies are being used and how they are being used; which technologies are emerging in the educational contexts and how they are emerging; which are the concepts and methodologies involved as part of the integration of technologies in the educational processes. The complexity of obtaining a clear overview of how and which CTs are being used also concerns the massive amount and different nature of publications: national and international reports from governmental and non-governmental entities; studies with diverse methodological approaches, contexts and samples of study; statistical reports; conference papers and proceedings, and so on. Despite this it is possible to conclude that this review shows that HE is highly aware of the great impact of CTs in the life of societies, and is committed to integrating them into their educational practices. Social web tools and environments and their ubiquitous nature through mobile devices are producing great impact in the challenge to change educational practices. Learning experiences in face-to-face classes are integrating virtual and web 2.0 environments. Collaboration, communication, interaction and participation between teachers and students is being extended to after class time, and driving a change in the roles adopted by teachers and students and in the contexts in which learning may happen.

E-learning, b-learning and m-learning are intertwined. Communication technologies are not exclusive to one methodology but transversal to them, to the extent of the methodologies being supportive of each other, as m-learning can be supportive of e-learning [29]. The expectation is for practices in teaching and learning to change along with the effective integration and innovative use of CTs in education, although there is still a need for continuous teacher training. Web 2.0 applications which promote networking, collaboration, participation and interaction within the community, are being integrated into the VLE systems services, some of which are allowing students to build their own PLEs [42]. Yet, HEI are working with emerging technologies such as Virtual worlds, including serious games and simulations in immersive 3D worlds, and cloud computing. Cloud computing is being differently developed by universities in developed and developing countries, bringing considerable benefits in the lowering of costs and in the development of digital delivery services. All are gaining high levels of use in HE and placing challenges as to presentation and delivery of content.

Keeping up-to-date with the all information related to the adoption of CTs by HEI and to its' impact in teaching and learning practices, has become more and more difficult due to the vast and diverse publications, leading to information overload in need of serious and expedite systematising. That is the ultimate goal of the online information visualization tool proposed by the ongoing project.

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