Up in the Clouds: Where to Find Enhanced Learning

Natália Fernandes Gomes
Research Unit for Inland Development
Guarda Polytechnic Institute, Portugal;
Av. Francisco Sá Carneiro, 50 6300-
560, Portugal
(+351) 271220100
ngomes@ipg.pt

María del carmen Arau Ribeiro
Research Unit for Inland Development
Guarda Polytechnic Institute, Portugal;
Av. Francisco Sá Carneiro, 50 6300-
560, Portugal
(+351) 271220100
maricarmen@ipg.pt

María José Hernández Serrano
Universidad de Salamanca
Facultad de Educación. Departamento
de Teoría e Historia de la Educación
C/ Paseo de Canalejas, 169. 37008
Salamanca, Spain
mjhs@usal.es

ABSTRACT

This research review reports on articles presenting empirical research in the area of how the learning and teaching process, involving teachers, students, and learning institutions, can be enhanced by the use of technology, particularly through the use of the new opportunities offered by cloud services. Some studies have demonstrated that the implementation of blended and mobile learning can modify and create new and successful e-learning projects. Their success depends, essentially, on two components: teacher training and student characteristics. A focus on these two components will contribute to create powerful opportunities for the improvement of learning in higher education. For most learning institutions, although the implementation of successful e-learning projects is still a long way off, it is possible as long as innovative processes and the learning approaches to integrate technologies in teaching practices are both created and evaluated.

CCS Concepts

• **Applied computing → Interactive learning environments → Collaborative learning →E-learning → Distance learning**

Keywords

Learning, Learning technology, Emerging models of learning, Cloud computing.

1. INTRODUCTION

The swift and growing development of technology, the existence of new types of collaborative networks, and global connectivity together require that higher education institutions urgently develop innovative and creative approaches and models for teaching and learning. These changes provide a unique opportunity for higher education to thrive under the new paradigm of access to information. Current technology means that students, faculty members, and researchers can carry their work wherever they go, access it instantly, and collaborate with colleagues in a private and secure digital environment while simultaneously providing them with information to monitor their performance.

All over the world, there is a growing interest and equally intense

debate about new ways of learning that present alternative views on the use of information and communication technologies in education. On analyzing some of these visions of the future published in studies conducted within the past ten years [1] [2] [3] [4] [5], it appears that the authors believe, in general, that the use of technologies and related services can be a creative, innovative, and differentiating factor in the academic context. As daily consumers, as teachers, and as students, we all recognize that technologies are increasingly used in society and in the economy, transforming the way we work, study (understood here as lifelong learning), communicate, access information, and spend our free time, among other activities. Other studies in the same period [6] [7] have shown that the evolution of the World Wide Web and ICT have the potential to enable creative and innovative practices in schools. Today, the entire process of learning and teaching is present both inside and outside the school campus, creating a large diversity of possibilities and learning concepts, such as e-learning, blended learning, mobile learning, and cloud learning. We live an exponential growth period of the information era, where teachers and students are no longer located physically on a school campus but rather living and studying in a virtual world that is more real than ever before. This is a new world, one which can be conducive to creative and collaborative participation in the process of learning. In this context, new terms have been defined and introduced, such as "Learning 2.0", "Web-based learning", and "Internet-based instruction", to refer to the learning/teaching process that takes place with the use of ICT and Web 2.0 tools [8] [9]. The increasing diversity of learning environments is related to a series of external factors, including the evolution of ICT, individual student characteristics, Web 2.0, the knowledge of needs, and the influence of the overall academic environment. The integration of media, or technology-mediated resources, should lead to the optimal combination of advantageous aspects of both online and offline instruction in order to provide more effective learning experiences [10]. The combined effect of this constant innovation with the associated new requirements makes the search for other models of learning that might facilitate interaction between teachers and students all the more urgent. However, it is important to point out that a successful e-learning program entails more than simply deploying technologies and services – it requires institutional commitment and engagement, new policies, and more.

In the context of higher education, the European Higher Education Area (EHEA) bears witness to the current development of combined, complementary, and integrated forms of education, from traditional teaching to online education or e-learning. The main challenges from this new scenario have required original formulas that combine teaching in the classroom with activities online, as is the case of blended learning and/or mobile learning and cloud learning. In this vein, perhaps the metaphor that best represents the understanding of this new learning method is

hybridization. In this case, hybridization refers to a teaching and learning process whereby two energies are complemented so that, when the potential of face-to-face learning decreases, the potential offered by virtual spaces comes into effect and vice versa; throughout the process, none of the participants perceive a change in their effective performance. However, the current approach to higher education teaching and learning processes is not just changing because of the growth of the Internet and its social and collaborative potential. The democratization of information technologies means that teachers and students not only desire this change but also that they have the means to reshape the way they use the technologies throughout the educational process.

Indeed, the technology potential in education seems to be so favorable that, over the past decade, major global companies, such as IBM, Samsung, Cisco, and Intel, have been involved with researching and developing new technology products, called "emerging technologies", that not only facilitate but also improve the teaching and learning process while promoting greater participation of the educational agents. This research by technology companies has enabled the development of new means and methods of connectivity as well as the design and construction of new types of hardware and software that will improve the teaching and learning process in the near future.

This research on the use of technology in the area of higher education has additionally helped to coin and adapt some new terminology to the context of learning, such as: "cloud computing", the "Internet of Things", and "smart technologies", developed in the business domain with the goal of improving the quality of life, including learning, teaching, socializing, and communicating, among other activities.

2. TECHNOLOGY AS A DRIVER OF CHANGE

Despite the benefits that technology can offer to its users, in this case, students, teachers, and higher education institutions, it is important to note that the current technological infrastructures developed for the process of teaching and learning can sometimes be complex, involving different types of hardware and software, whether digital or face-to-face. This complexity urges, on the part of the educational institutions, the development of new solutions and new management strategies to better provide students and teachers with systems and information platforms suited to these updated forms of learning. Bringing together the real needs of students and the financial and human ability of higher education institutions presents a new dilemma in terms of economic and institutional sustainability, which in turn implies a knowledge problem that must be solved and understood.

However, it is important to note that the changing approach to the higher education teaching and learning process is not simply the result of the growth of the Internet and its potential with regard to social and collaborative aspects. The democratization of information technologies also means that teachers and students have not only the desire but also the means to reshape the way technologies are use throughout the educational process. In this sense, Grajek (2014) has stated that technology users and organizations now have new needs, seeking access to content and people in a ubiquitous manner [11].

2.1 Technologies and Emerging Models of Learning

In order to understand these changes and the way in which new emerging technologies can benefit the teaching and learning

process, some of the above concepts are briefly presented along with the current and emerging teaching models that have been developed using these technologies [12]. In this context, Figure 1 aims to represent the beginnings of emerging trends in learning.
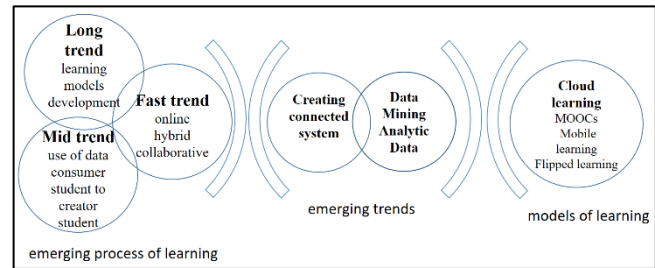

Figure 1. Technologies and emerging models of learning

Starting from the interconnected circles at the core of the figure, the trend stems from the creation or adoption of an integrated connected system and the use of data mining and data analytics to empower the institutions so that they can track and improve the performance of not only students but also their online and offline courses, academic departments, and the institution as a whole. From this integrated connected system and global connectivity, new trends are set from which two new opportunities arise that are temporal and experimental. The temporal part of the model (the three circles to the left of the nucleus) identifies the processes of change in learning while the experimental opportunity (to the right) facilitates the analysis and verification of current experiences and/or progress made in the context of higher education, which facilitates the development of new learning models using the technologies.

2.1.1 Emerging Trends

Creating a connected system is based on the philosophy of the Internet of Things, which aims to connect all types of objects or contents to the worldwide network of computers, thereby creating global connectivity between people and objects, regardless of their technological level. This connected system between organizations, people, and objects, idealized through the use of nanotechnology, also aims to embody the possibility of new learning paradigms, enabling humans to develop new solutions that will certainly support schools at all levels and influence the future of teaching and learning. All users, for example, should eventually be able to access the largest library in the world through a telescope lens or even interact virtually with any other object at their disposal. The Internet of Things will allow for increasing availability of and access to information, an essential factor in gaining knowledge about anything, thus empowering and engaging students in learning with new tools.

At an educational level, smart technologies like the Internet of Things make interactive and collaborative sharing possible, regardless of physical distance, infrastructures used, or the knowledge between the different agents in the teaching and learning process. Burke (2008) affirms that these new solutions enable the creation of learning environments where everything can be taught and learned because they are rich in media elements (e.g. interactive whiteboards, interactive tables, video cameras, software for mobile devices) and subsequently promote innovation and facilitate integration and involvement of all the educational agents in the teaching and learning process [13]. What is more, the integration of different systems and users through intelligent technologies potentially allows for the creation of more

efficient education systems that are able to identify and analyze learning processes. This analysis, defined as data mining for data analysis and visualization, assists educational institutions by identifying learning methods and potential at-risk students. As such, data analysis and visualization for education contribute significant information that can empower institutions that opt for the opportunity to track and improve the performance of students, online and offline courses, academic departments, and institutions as a whole. From a student perspective and supporting greater levels of engagement, this data provides them with information to monitor their performance in courses and to compare themselves to their peers. This data analysis and visualization further enables the teacher to understand and identify students who have more difficulties or even the root causes of their lack of success.

Essentially, solutions based on machines data may increasingly help humans (teachers and students) and academic institutions in making decisions about how they work. By learning about each student individually, a customized learning pathway can be constructed (i.e. according to student characteristics, learning styles, and learning difficulties and/or skills). Through data analysis, or "big data analytics", institutions will be able to understand and analyze methods of student learning so that they can offer a posteriori new learning experiences according to the needs and characteristics of their students.

2.1.2 Emerging Processes of Learning

The increasing development of technology, along with its storage and information processing abilities, and further developments in computer networks, the Internet, and the services associated with it, have resulted in the development of new methodologies and innovative teaching and learning, re-inventing the way we teach and how we learn.

As presented in figure 1 above, some of the key trends characterizing the emerging process of learning with the greatest potential impact on higher education are as follows:

- ubiquitous growth of social and collaborative networking;

- integration of online, hybrid, and collaborative learning environments;

- connected systems (the Internet of Things), cloud storage and collaboration services;

- the use of data deriving from the learning process to personalize and optimize learning;

- a changing perspective from "consumer" student to "creator" student;

- cloud computing.

These trends have introduced new opportunities for how teachers and students collaborate and how academic assignments are conceived, completed, and submitted given that these technologies can accompany the learner almost anywhere. Some of the new features, for example, are associated with the social web and Web 2.0 technologies, such as discussion forums, YouTube, Google drive, and Dropbox, simultaneously providing a new means of communication between students and teachers while enabling the creation of new pedagogical activities, where the exchange of information and sharing of knowledge is convenient, transparent, and ubiquitous. These user-friendly tools allow their users to relate to one another and share a variety of information far beyond the physical space of the school. This multitude of possibilities allows teachers, students, prospective students, and leaders of learning and other institutions to exchange interests, gain new experiences and new skills, and expand relationships that foster a new kind of learning that is social and collaborative.

Collaborative environments facilitate simultaneous learning among a number of students, regardless of the setting in which it happens (face-to-face or virtual). The diversity of environments and students supports the collaborative development, based on a set of differing ideas and skills, of shared and enriched learning. In this context, interactive tools and collaborative environments facilitate contact between students and teachers, allowing them to prepare and participate in educational activities that are based on their online interaction and practice. This not only increases student interest but also the overall understanding and level of participation in the teaching and learning process. As mentioned earlier, it is expected that data analysis (big data analytics) of the smart technologies used for the students' learning processes will shed light on how and when students actually learn. In addition, it is extremely important that universities should include data analytics applications to better understand learner styles and behaviors to measure what is happening and transform data into actionable information so that it can be used to improve teaching and learning. Quality in teaching and learning, efficient use of resources, and student engagement are critical. Nevertheless, the definition of trends, impacts, and challenges that these emerging technologies can bring to higher education must above all be accompanied by solutions for how higher learning can best implement and use ICT in an educational context.

2.1.3 Models of Learning

As has been demonstrated thus far, the use of technologies in the educational process has significantly altered the way students and teachers not only communicate, access, and produce information but also the way students prepare and carry out their projects.

In fact, the use of technology in the teaching and learning process enables users to access, modify, or supplement information collaboratively in order to construct their own knowledge. This ease of access, sharing and information construction provides a unique opportunity to make new methodologies for innovative and creative teaching.

Encouraged by the potential of what these technologies may offer, some researchers have developed new models for the teaching and learning process which could improve teaching practices by using these same technologies according to current and emerging trends. Among these new models, the most talked about are Flipped Learning, Mobile Learning, Personal Learning Environments, Massive Open Online Courses, and cloud learning. As stated in the objective for this paper, we will next describe in more detail a cloud learning model.

2.1.3.1 Cloud Learning

Cloud computing, often referred to as simply "the cloud," is the delivery of on-demand computing resources – everything from applications to data centers – over the Internet on a pay-for-use basis [14]. Cloud computing refers to not only the applications delivered as services over the Internet but also the hardware and systems software in the data centers that provide public and private services. The services themselves have long been referred to as Software as a Service (SaaS) whileome literature uses terms such as PaaS (Platform as a Service) to describe their products and IaaS (Infrastructure as a Service) to refer to providing companies with computing resources including servers,

networking, storage, and data center space on a pay-per-use basis. Public clouds today may appear to be the default choice for deployment of new applications but most organizations experience difficulties or resistance towards migrating data to the cloud.

Figure 2 presents a learning ecosystem based on a cloud computing infrastructure composed of different and emerging learning trends and processes where the center and the success of this application must be human – teachers and students – rather than machines.
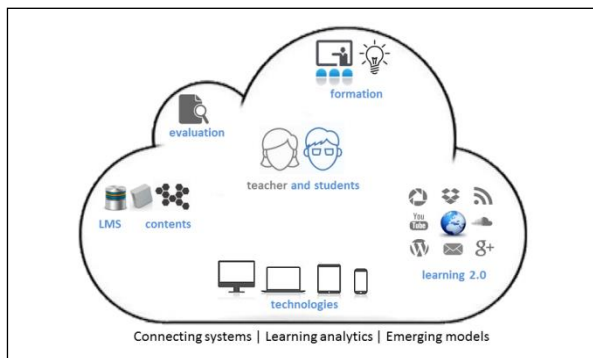

Figure 2. Cloud Learning

Cloud learning is user-centered to provide secure, rapid, and convenient data-storing and network services to enhance the process of learning, providing new ways of working, communicating, distributing, and analyzing data as well as student characteristics and learning pathways. Though the use of a cloud learning model, teachers and students can easily scale services to fit their needs, customize applications, and access cloud services from anywhere with a simple Internet connection. Clearly, the integration in a cloud service is currently the best environment to gain competitive advantage in learning environments since the solution can improve the most innovative technology available. In this sense, figure 3 below summarizes some of the benefits:

- Cloud infrastructure easily scales according to the needs of each institution;

- Teachers and students can develop activities, selecting from public, private, or hybrid services and tools available through Web 2.0;

- Cloud-based applications and data are accessible from virtually any Internet-connected device, available 24 hours a day, 7 days per week;

- Worldwide (campus, bus station, home) access means students and teachers can learn, teach, collaborate, and distribute information from widespread locations.

- Hardware failures do not result in data loss;

- The online presence of the learning institution makes it immediately recognizable.

For authors to be able to effectively and efficiently carry out a successful learning project, a life cycle model must be defined (see Figure 3). If it is true that we presently have new LMS (e.g., Moodle and/or Blackboard), new digital environments where all

possible features are included providing, as already mentioned, new technological solutions and aiming to improve new innovative learning approaches, the most important feature in an e-learning project is not necessarily the most up-to-date LMS or ICT solution but rather the human resources involved. These students and teachers are the key to improving and creating new innovative learning and developing new teaching and learning skills in order to obtain maximum benefits from a given learning project.
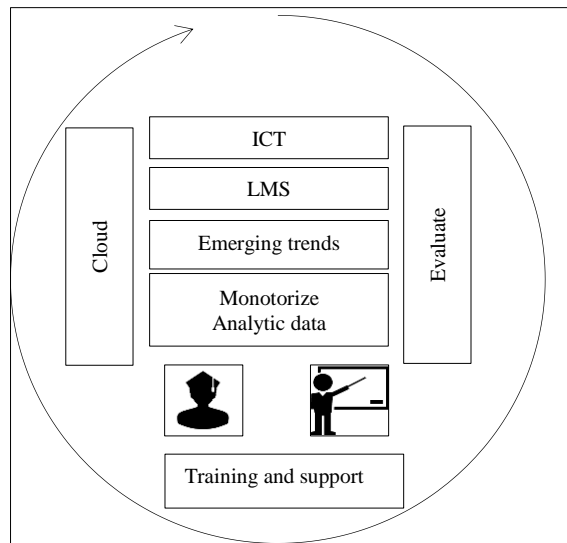

Figure 3. Life cycle – Learning Project

As a result, the first priority is to offer support and pedagogical training to teachers in line with the new technological potential and according to the approaches of Learning 2.0. With regard to the students, it is important, and now easier, to analyze learner characteristics and student feedback. Implementing and maintaining an e-learning project should be conceived as an ongoing cycle.

3. CONCLUSIONS

While technologies must be able to offer users flexible, collaborative, and interactive environments that adapt to how students and teachers interact with other users and systems, these technologies should also be able to provide data to system administrators, related to how interaction and collaboration between users and systems is carried out. This potential database will optimize the teaching and learning process and will improve future decision-making regarding the way training courses are planned and structured. These changes, within a connected system, will allow teachers to gain insight into the characteristics and learning pathways traced by their students, thus identifying expectations, needs, and at-risk students in a more timely fashion. This early identification can serve as a measuring device of the progress based on learning, producing high-quality learning outcomes and offering learning opportunities throughout a student's lifetime as well as arousing the student's curiosity and desire to learn. In this paper, a cloud learning model based on the efficiency, security and flexibility of a cloud computing infrastructure is presented. The use of this kind of model as an infrastructure provides mechanisms to guarantee and further develop teaching and learning activities. If colleges and universities want to continue to succeed economically, they must

adapt and compete. They must make changes that will allow them to be better equipped for thriving in this era of the technological revolution in higher education [15].

4. REFERENCES

[1] Alexander, B. (2016). A new wave of innovation for teaching and learning. In Innovation for teaching and learning, Educause, (March 2006), 32-44.

[2] OECD. (2007). Participative Web and User-Created Content - WEB 2.0, and Social Networking. OECD, 2007. DOI= 10.1787/9789264037472-en

[3] Ala-Mutka, K., M. Bacigalupo, S. Kluzer, C. Pascu, Y. Punie and C. Redecker (2009). Learning 2.0: The Impact of Web2.0 Innovation on Education and Training in Europe. JRC Scientific and Technical Report, EUR 23786 EN. Retrieved September 05, 2016, from JCR: http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=2139

[4] C. S. Arasa. (2009). Didactic methods through ICT – case study. Valencia, Spain: Nau libres.

[5] UNESCO. (2014). ICT in Education – Mobile Learning. Retrieved September 09, 2016, from UNESCO: http://www.unesco.org/new/en/unesco/themes/icts/m4ed

[6] K. Ala-Mutka. (2011). Mapping Digital Competence: Towards a Conceptual Understanding. European Commission - Joint Research Centre - Institute for Prospective Technological Studies.

[7] G. Siemens. (2006). Knowing Knowledge. Retrieved October 04, 2016, from Elearnspace: http://www.elearnspace.org/KnowingKnowledge_LowRes.pdf

[8] J. J. McKimm. (2003). ABC of learning and teaching in medicine: Web based learning. BMJ 326(7394), 870-873.

[9] S. Downes. (2005). E-learning 2.0. eLearn Magazine. Retrieved October 10, 2016, from eLearn Magazine: http://elearnmag.acm.org/featured.cfm?aid=1104968

[10] B. Akkoyunlu and Yılmaz, M. 2006. A study on students' views on blended learning environment. Turkish Online Journal of Distance Education, 7(3), 43-56.

[11] S. Grajek. (2014). Higher Education's Top-Ten Strategic Technologies in 2014. Retrieved October 10, 2016, from Educause:
https://library.educause.edu/resources/2014/2/higher-educations-topten-strategic-technologies-in-2014

[12] N. Gomes and M. J. Hernández. (2014). Pedagogical Activity @Learning: a case study. University of Salamanca, Spain.

[13] Burke, M., & Kraut, R. E. (2014). Growing closer on Facebook: Changes in tie strength through social network site use. CHI'14: Proceedings of the ACM Conference on Human Factors in Computing Systems. NY: ACM. Best paper. Retrieved October 10, 2016, from kraut.hciresearch.: http://kraut.hciresearch.org/sites/kraut.hciresearch.org/files/open/burke14-GrowingCloserOnFacebook.pdf

[14] IBM. (2016). IBM Cloud. Retrieved October 15, 2016, from IBM: https://www.ibm.com/cloud-computing/learn-more/what-iscloud-computing

[15] J. Merisotis. (2016). Credentials Reform: How Technology and the Changing Needs of the Workforce Will Create the Higher Education System of the Future. Retrieved September 05, 2016, from https://er.educause.edu/articles/2016/5/credentials-reform-how-technology-and-the-changing-needs-of-the-workforce-will-create-the-higher-ed