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TECHNOLOGICAL INNOVATIONS IN LARGE-SCALE TEACHING: FIVE ROOTS OF MOOCS

Abstract

There are millions of people worldwide — of all ages, conditions, backgrounds and motivations — with significant learning needs. Unfortunately, traditional education is not efficient enough to meet these needs. That is, the available educational resources are not fully exploited to help cover the demand. There is an increasing need for large-scale access to cost-effective and high quality education. The use of technological innovations for large-scale teaching might be part of the solution. In this context, the goals of this study were to identify technological innovations that can be considered historical milestones in large-scale teaching, to systematize experts' opinions about the topic, and to propose strategies for the successful implementation of massive open online courses (MOOCs). The researchers identified and analyzed a documentary corpus and found that, in the use of technologies for large-scale teaching, there has been a parallel evolution that have led to the emergence of MOOCs and includes five roots: distance education and online learning; testing/teaching machines and computer-assisted instruction (CAI); learning management systems (LMS); open education (OE) and open educational resources (OER); and online massive teaching. The researchers propose three strategies for the successful implementation of MOOCs: careful consideration of the c/xMOOC pedagogical spectrum characteristics, selection of an appropriate MOOC model, and management of implementation challenges.

Keywords

Online learning environments, large-scale teaching, massive open online courses, MOOC

Introduction

There are more people in the world than ever before, and a far greater part of them want an education. The demand cannot be met simply by building more schools and training more teachers. Education must become more efficient (Skinner, 1958, p.1).

After 60 years, Skinner's opinions about education remain relevant in 2017. There are millions of people worldwide with significant learning needs. Unfortunately, traditional education is not

efficient enough to meet these needs. That is, the available educational resources are not fully exploited to help cover the demand. There is an increasing need for large-scale access to cost-effective and high quality education. The use of technological innovations might be part of the solution. Nevertheless, there has been resistance to these technologies and — in most cases — the results have not been what were expected. Cuban (1986) noted that in the initial wave of enthusiasm for each new educational innovation there were predictions of extraordinary changes in teacher practice and student learning. However, most attempts failed to make a long-lasting impact on teaching, e.g., educational films and instructional radio in the 1920's, instructional television in the 1950's and 1960's; and computer-assisted instruction in the 1970's and 1980's (Bower & Hardy, 2004). Nevertheless, Bernard, Borokhovski, Schmid, Tamim, & Abrami (2014) reported that technological innovations have had a modest but overall positive impact on learning. In this context, the purpose of this study was to produce an historical review and analysis of the technological innovations in large-scale teaching that have led to the emergence of massive open online courses (MOOCs) and to propose strategies for their successful implementation.

The rest of this paper is structured as follows: Section two presents the research method. Section three presents the results organised along five roots of technological innovation for large-scale teaching and complemented with experts' opinions. Section four presents a discussion of three proposed strategies for the implementation of MOOCs and Section five presents the conclusions and future work.

Method

The method used in this study is a qualitative literature review, based on the guidelines proposed by Kitchenham and Charters (2007). The method includes planning, execution and result analysis. The planning involved defining the research questions and the search process. The execution and result analysis are detailed in sections three and four of this study.

The three research questions that guided the study and their motivations are presented below. The research questions cover from the gathering of factual historical information and experts' opinions to the definition of strategies for the implementation of MOOCs in large-scale teaching.

RQ1. What are the technological innovations that can be considered historical milestones in large-scale teaching? This question is meant to ascertain factual historical information about large-scale teaching.

RQ2. Historically, what have experts thought about large-scale teaching? This question is meant to summarise the evolution of thinking about technological innovations in large-scale teaching and understand future directions.

RQ3. What are the strategies for the implementation of MOOCs in large-scale teaching that can be devised from historical milestones and previous opinions? This question is meant to contribute to discussions surrounding the successful implementation of MOOCs in large-scale teaching.

For the search process, the researchers identified a set of keywords related to education and technology. These keywords formed the first part of the search string. The second part of the search string limited the search process to published research about large-scale or massive teaching. The complete search string is shown below.

(“technology-enhanced learning” or “technology-based learning” or “educational technology” or “distance education” or “online learning” or “learning management system” or “LMS” or “open education” or “open educational resource” or “OER”)
AND (“large-scale” or “massive”)

The researchers used two bibliographic databases as data sources: Scopus and Web of Science. All the entries found in the bibliographic databases that met the inclusion criteria in their title, abstract or keywords were included in the initial documentary corpus. The exclusion criteria limited the language to English. By doing so, the researchers obtained a set of peer-reviewed publications that were then filtered for relevance.

The relevant publications were reviewed using a qualitative content analysis technique, as explained by Krippendorff (2004). A content analysis technique takes in account the context relative to the facts and opinions being analysed by the researchers. This facilitated the development of a set of potential evolutionary roots that have led to the appearance of MOOCs. These potential roots were then submitted to a synthesising process to merge several of them into a final set of five roots described in the section three. In parallel, the researchers performed a chronological systematisation of the opinions of experts in the field. Both roots and opinions were used as inputs for the elaboration of the strategies explained in section four.

Results

The researchers applied the search process in three steps. Initially, the researchers obtained 3,417 entries using the first part of the search string, i.e. (“technology-enhanced learning” or “technology-based learning” or “educational technology” or “distance education” or “online learning” or “learning management system” or “LMS” or “open education” or “open educational resource” or

“OER”). In the second step, the researchers filtered the entries for (“large-scale” or “massive”) and obtained 52 entries. From these, the researchers selected 32 publications by applying the exclusion criteria and manually reviewing them for relevance to the research questions. Finally, 13 publications were found by applying the snowballing technique as explained by Jalali & Wohlin (2012), i.e. additional publications that had been cited by the selected studies. The final documentary corpus consists of 45 publications.

RQ1. What are the technological innovations that can be considered historical milestones in large-scale teaching?

The researchers applied a qualitative content analysis technique on the final documentary corpus and found that, in the use of technologies in large-scale teaching, there has been a parallel independent evolution with several milestones distributed along a set of five related roots: distance education and online learning; testing/teaching machines and computer-assisted instruction (CAI); learning management systems (LMS); open education (OE) and open educational resources (OER); and online massive teaching. Figure 1 illustrates the five roots with a selection of years that are explained in the following subsections.

First root: distance education and online learning

Since its inception thousands of years ago, spoken language has enabled oral interchange of information as a form of communication. Later on, the first forms of writing appeared (Ong, 2013). With the emergence of the first alphabets, study texts were also created and, with them, libraries and educational institutions. Large libraries were political and commercial institutions of great strategic value where information was stored and sold; they also provided writing services and physical copies of books. Trade routes transported goods and disseminated information. In the middle of the fifteenth century, the invention of the printing press by Johannes Gutenberg lowered the cost of books and expanded access to information to a larger audience (Assmann, 2006). The first attempt in large-scale teaching was distance education via printed correspondence. In 1728, Caleb Phillips offered a shorthand course by correspondence in US (Holmberg, 1995). In 1840, Isaac Pitman offered a distance course where texts in shorthand were mailed, students returned transcriptions, and feedback to students was provided by the instructor who resided in UK (Bower and Hardy, 2004). By the middle of the nineteenth century, distance-learning degrees via correspondence appeared. By 1906, the International Correspondence School in the US had taught 900,000 students (Bittner & Mallory, 1933). The year 1969 marks a milestone since the Open University was founded in the UK as the first distance university with open admissions (Lockwood, 2013).

Figure 1. Technological innovations in large-scale teaching. This figure illustrates important milestones of five evolutionary roots that lead to the emergence of different MOOC models.

In 1971, the British Broadcasting Corporation was airing on television Open University's learning materials, including lectures and demonstrations (Boyd-Barrett, 2000). In 1989, the University of Phoenix in the US began to offer full online degree programs (Christensen & Eyring, 2011). Currently, there is widespread use of the Internet to deliver online courses. Distance education has evolved into online learning.

Second root: testing/teaching machines and Computer-Assisted Instruction (CAI)

In a similar way that the Industrial Revolution propelled the development of mechanical tools to mechanize factory production, attempts to "mechanize" education began in the early nineteenth century. To be considered a teaching machine, a device must have three characteristics: include a unit of information, means for learners to respond to the information, and feedback about the correctness of the responses (Benjamin, 1988). In 1924, in the US, Sidney Pressey patented a machine for intelligence tests that had two operational modes: test and teach (Austwick, 1964). In test mode, the machine offered a multiple-choice question, recorded the given answer, advanced to the next question and kept track of the number of correct answers. In teach mode, the machine advanced to the next question only if the student gave the right answer. This machine appeared during the Great Depression, when there was no shortage of teachers and no real need to increase the pace of education. It was never commercially produced. Similarly, in 1958, Burrhus Skinner of the US patented a teaching machine that delivered educational material in small steps. Students chose answers and compared them with the correct ones (Skinner, 1958). Three years later, Donald Bitzer designed the Programmed Logic for Automatic Teaching Operations (PLATO) system. PLATO featured broadcast of computer-based lessons to multiple locations, automated testing, messaging, and storage of students' answers and keystrokes (Bitzer, Braunfeld, & Lichtenberger, 1961). PLATO evolved for two decades. By 1985, PLATO IV was a commercial product used in over 100 educational institutions worldwide (Van Meer, 2003). PLATO was shut down in 2006 due to budget issues. In 1978, in the UK, Open University developed the Cyclops machine, which allowed students to communicate with instructors over phone lines and to see each other's drawings using light pens on TV screens (McConnell & Sharples, 1983). Cyclops was ended due to production costs. In the 1980s, CAI using courseware distributed via CD-ROM was very popular in classrooms (Mascha & Seaman, 1994). Personal computers became the new generation of teaching machines that provided one-on-one interaction between computers and students. Nevertheless, CAI did not involve communication with instructors and peers.

Third root: Learning Management Systems (LMS)

Watson and Watson (2007) define an LMS as a systemic infrastructure that manages the learning process of an entire organization. According to Stephen Downes, “The initial development of online learning technology began at scale with the development of the LMS” (Downes, 2014, p.1). In the 1990’s, several universities developed in-house technologies to manage online courses. Nevertheless, the increasing complexity of these custom technologies made it necessary to replace them with commercial products and, later on, with open-source products (Elgort, 2005). In 1996, in Canada, Murray Goldberg developed the first commercially successful LMS called Web-based Course Tools (WebCT) (Goldberg, Salari & Swoboda, 1996). The second LMS, Blackboard, was created in 1999. In 2002, in Australia, Martin Dougiamas created the first open-source LMS called Moodle. In 2004, Sakai, another open-source LMS appeared (Sclater, 2008). In 2005, WebCT and Blackboard merged. In 2010, Instructure launched Canvas also as an open-source platform. In 2011, the Design2Learn Corporation launched BrightSpace (Thakkar & Joshi, 2015). To the best of the researchers’ knowledge, there is no reliable worldwide statistics of LMS usage. Hill (2015) provides statistics of use in the US up to December 2015: Blackboard was the most used LMS with 984 educational institutions, followed by Moodle with 665, Canvas with 393, BrightSpace with 353 and Sakai with 128.

Fourth root: Open Education (OE) and Open Educational Resources (OER)

According to Yuan & Powell (2013), “the development of MOOCs is rooted within the ideals of openness in education, that knowledge should be shared freely, and the desire to learn should be met without demographic, economic, and geographical constraints” (p.6). OE is a movement that promotes the idea that knowledge and education are public goods that should be free and open (Hu, Li, Li, & Huang, 2015). OE seeks to scale educational opportunities by eliminating entry requirements, reducing tuition fees and the cost of educational materials (Yang, 2016). To enable OE, in 2002 the Massachusetts Institute of Technology (MIT) launched the Open CourseWare initiative to provide free online access to learning materials from MIT courses. This initiative gave birth to the Open CourseWare Consortium, now the Open Education Consortium with around 200 members worldwide (Caswell, Henson, Jensen, & Wiley, 2008). In the same year, the United Nations Educational, Scientific and Cultural Organization (UNESCO) hosted a forum on open courseware for Higher Education in developing countries where the term OER was defined to refer to teaching, learning and research materials that have been released under an open license that permits no-cost access, use, adaptation and redistribution (Butcher, 2015). In 2005, in Canada, Downes introduced the concept of e-Learning 2.0, which involves the use of Web 2.0 tools for

collaborative learning (Downes, 2005). A year later, Salman Khan created the Khan Academy in the US which focused on producing micro-lecture videos and made them available for free via YouTube (Murphy, Gallagher, Krumm, Mislevy, & Hafter, 2014). David Wiley, from Utah State University in the US, offered in 2007 a wiki-based open course called “Introduction to Open Education” (Wiley & Gurrell, 2009). The same year, Alec Couros from University of Regina in Canada opened to the general public a for-credit course called “Social Media and Open Education” (Downes, 2016). In 2009, the Cape Town Open Education Declaration established that OE includes not only OER but also any open technology that facilitates collaborative learning, flexible learning, and the open sharing of teaching practices (Wiley & Gurrell, 2009). Under this definition, technologies such as Moodle and Sakai became OE. In the same year, the University of the People was born as the first tuition-free degree-granting global Higher Education institution (Wiley & Hilton, 2009). In 2012, UNESCO issued the Paris OER Declaration urging governments, educational institutions and teachers to release educational resources as OER (UNESCO, 2012).

Fifth root: online massive teaching

The advent of the web brought new possibilities for massive teaching. Nevertheless, the twenty-first century has witnessed several failures: Fathom at Columbia University in US opened in 2000 and closed in 2003, with a total investment of \$15 million; All Learn Alliance of Long Life Learning at Yale University in US opened in 2001 and closed in 2006, with a total investment of \$12 million; and UKeU in UK opened in 2003 and closed in 2004, with a total investment of £50 million (Paulsen, 2009). These attempts failed mainly because underlying technologies were not mature enough and for lack of sustainable business models.

In 2008, the course “Connectivism and Connective Knowledge”, offered by Stephen Downes and George Siemens at the University of Manitoba, Canada, enrolled 2,200 online students (Downes, 2005). Dave Cormier and Brayan Alexander coined the term MOOC to refer to this type of courses. In 2011, MOOCs made their debut in the US in the context of a financial crisis that left universities with budget issues and the need to boost enrollment. The course “Introduction to Artificial Intelligence” offered by Sebastian Thrun and Peter Norving at Stanford University enrolled 160,000 students.

Four years later, in 2012, the US based MOOC providers Udacity, Coursera, and edX appeared (Yuan & Powell, 2013). In 2013, other MOOC platforms appeared: MiriadaX (Spain), FutureLearn (UK), France Université Numérique FUN (France). In 2014, Coursera launched its own credential program called Specialization. At the same time, Udacity partnered with technology companies to create Nanodegrees as a form of alternative credentialing (Class Central, 2017). In 2015, Arizona State University and edX created the Global Freshman Academy: 34,000 students enrolled and 360

students paid the fee for the credit option but only 60 actually paid for credit recognition (Krause, 2016). In the same year, the Mexican government launched MéxicoX. In 2016, edX launched its first certificate program called MicroMasters with an option for credit recognition, followed by other programs called XSeries, Professional Certificate, and Professional Education. Also in 2016, FutureLearn offered its own credential program called FutureLearn Programs (Class Central, 2017). By December 2016, there were 58 million students and 6,850 MOOCs worldwide (ClassCentral, 2016). Table 1 shows statistics from the main MOOC providers (Class Central, 2016; Class Central, 2017).

Table 1

Statistics for main MOOC providers as of June 2017

Provider	Country	Students (millions)	Courses	Partners
Coursera	US	25+	2,000+	150+
edX	US	10+	1,500+	100+
XuetangX	China	7+	400+	N/A
FutureLearn	UK	6+	400+	100+
Udacity	US	4+	170+	N/A
MiriadaX	Spain	3+	600+	100+
FUN	France	1+	270+	90+
MéxicoX	Mexico	1+	60+	40+

RQ2. Historically, what have experts thought about large-scale teaching?

In 1885, William Rainey Harper, president of the University of Chicago, stated that, “The day is coming when the work done by correspondence will be greater in amount than that done in the classrooms of our academies and colleges” (as cited in Edelson and Pittman, 2008, p. 81). Harper predicted that innovative ways of teaching, such as e-learning, would eventually outnumber the traditional face-to-face settings. Thomas Edison, inventor of the phonograph and the movie camera, stated in 1922 that, “I believe that the motion picture is destined to revolutionize our educational system and that in a few years it will supplant largely, if not entirely, the use of textbooks” (as cited in Cuban, 1993, p.2). In reality, several obstacles blocked the use of film in classrooms, e.g., teachers’ lack of skills in using the equipment, the cost of films and equipment, the lack of accessibility to equipment when needed, and the high cost of maintenance (Cuban, 1986). Nevertheless, currently textbooks compete with video lectures in the Khan Academy, TEDTalks,

OERs, MOOCs, and tutorials on YouTube. Thus, channels of education have definitely changed. Sidney Pressey, a professor at Ohio State University in the US, stated in 1933 that, “There must be an ‘industrial revolution’ in education, in which educational science and the ingenuity of educational technology combine to modernize the grossly inefficient and clumsy procedures of conventional education” (as cited in Petrina, 2004, p.305). Pressey predicted the need of technology in education for resources optimization. Similarly, Burrhus Skinner, a professor at Harvard University, reflects:

Will machines replace teachers? On the contrary, they are capital equipment to be used by teachers to save time and labor. In assigning certain mechanizable functions to machines, the teacher emerges in his proper role as an indispensable human being. He may teach more students than heretofore — that is probably inevitable if the worldwide demand for education is to be satisfied — but he will do so in fewer hours and with fewer burdensome chores. (Skinner, 1958, p. 969)

Skinner was correct in his assessment of the need to solve the ever-increasing demand for education and he was also correct in asserting that technology can enable large-scale teaching.

In 1965, Charles Wedemayer, a professor at University of Wisconsin in the US, predicted the current state of online and ubiquitous learning:

The extension student of the future will probably not ‘attend’ classes; rather, the opportunities and processes of learning will come to him. He will learn at home, at the office, on the job, in the factory, store, or salesroom, or on the farm (as cited in Bates, 2015, p.1).

In 1988, Isaac Asimov, a prolific science fiction writer, predicted a broad acceptance of online educational resources and personalized learning:

Once we have computer outlets in every home, each of them hooked up to enormous libraries, where you can ask any question and be given answers, you can look up something you are interested in knowing, however silly it might seem to someone else. Today, what people call learning is forced on you. Everyone is forced to learn the same thing on the same day at the same speed in class. But everyone is different. For some, class goes by fast, for some too slow, for some in the wrong direction. But give everyone a chance, in addition to school, to follow up their own bent from start, to find out whatever they are interested in by looking it up in their own homes, at their own speed, in their own time, and everyone will enjoy learning (as cited in Kent & Williams, 1992, p.118).

In 1998, Peter Neumann, a professor at Harvard University in the US, stated that, “Online education inherits many of the advantages and disadvantages of textbooks and conventional teaching, but also introduces some of its own” (Neumann, 1998, p.136). Among the advantages,

Neumann noticed that teaching materials can be reused and students can schedule their studies at their convenience. Among the disadvantages, Neumann noticed the challenges of creating and updating quality teaching materials; issues concerning the intellectual property of materials; and the limited interaction between students and instructors. Daphne Koller, cofounder of Coursera, stated on a TED Talk in 2012 that, “We cannot afford, as a society, to provide every student with an individual human tutor. But maybe we can afford to provide each student with a computer or a smartphone” (Koller, 2012, p.1). Koller was correct in her assessment of the fact that there is a shortage of teachers that technology can help to palliate. In 2015, Stefan Popenici, a senior lecturer at the Melbourne Centre for the Study of Higher Education, stated that, “The future of universities cannot be changed by a set of gadgets or technological tools, but by a new vision able to create a new context where new technologies can be used to enhance pedagogical solutions” (Popenici, 2015, p.165). Popenici highlighted that the pedagogical dimension supersedes the technologies available.

Discussion

This section discusses three strategies for the successful implementation of MOOCs taken in account that MOOCs differ from traditional online courses in four basic dimensions. First, the scale since a MOOC can have an unlimited number of participants. Second, the access since a MOOC generally does not have entry requirements. Third, the credentialing since MOOC completion does not generally recognize credit towards a degree. Fourth, cost since they are offered free of charge or with low costs.

RQ3. What are the strategies for the implementation of MOOCs in large-scale teaching that can be devised from historical milestones and previous opinions?

First strategy: careful consideration of the c/x MOOC pedagogical spectrum characteristics

There is consensus about two extremes in the MOOC pedagogical spectrum: cMOOC and xMOOC. Both get characteristics from the five roots described in section three. A key difference between cMOOC and xMOOC is their pedagogical approach: cMOOC inherits connectivism from open education, while xMOOC inherits constructivism from LMS and online massive teaching (Ebben & Murphy, 2014; Mackness & Bell, 2015; Toven-Lindsey, Rhoads & Lozano, 2015). The main similarity is that both cMOOC and xMOOC serve geographically distributed students — this characteristic comes from distance education, LMS, OE and online massive teaching (Baturay, 2015). Regarding content, cMOOC gets high-distributed content from OE, while xMOOC gets medium-distributed content from LMS and online massive teaching (Bates, 2015). As far as roles are concerned, cMOOC have a high student role from distance education and OE, while xMOOC have a

medium student role from LMS and online massive teaching (Alario-Hoyos, Pérez-Sanagustín, Delgado-Kloos & Munoz-Organero, 2014; Phan, McNeil & Robin, 2016; Zhang, 2016). cMOOC gets a medium instructor role from LMS, while xMOOC gets a high instructor role from testing/teaching machines and online massive teaching (Daniel, 2012; Haavind & Sistek-Chandler, 2015; Mackness & Bell, 2015). Regarding cost, both cMOOC and xMOOC get a low student cost from testing/teaching machines, OE and online massive teaching; cMOOC have a medium provider cost from OE and online massive teaching, while xMOOC have a high provider cost from distance education, testing/teaching machines and LMS (Bates, 2015; Funieru & Lazaroiu, 2016; Sanchez-Gordon & Luján-Mora, 2014). Table 2 summarises the characteristics of cMOOC and xMOOC that have been discussed above.

Table 2

cMOOC and xMOOC characteristics inherited from the five roots

Characte- ristic	Distance education and online learning	Testing/ teaching machines and CAI	LMS	OE and OER	Online massive teaching	cMOOC	xMOOC
Pedagogical approach	Cognitivism	Behaviourism	Constructivism	Connectivism	Constructivism	Connectivism	Constructivism
Distributed learners	High	Low	High	High	High	High	High
Distributed content	Low	Low	Medium	High	Medium	High	Medium
Student role	High	Low	Medium	High	Medium	High	Medium
Instructor role	Low	High	Medium	Low	High	Medium	High
Student cost	Medium	Low	High	Low	Low	Low	Low
Provider cost	High	High	High	Medium	Medium	Medium	High

Second strategy: selection of an appropriate MOOC model

The definition of MOOCs is continuously evolving. Between the two extremes of cMOOC and xMOOC, several models have appeared, as detailed in Table 3. The current explosion of models makes it difficult to establish a mechanism to choose the appropriate MOOC model for each particular situation. Some models have subtle differentiations. More research is necessary to clearly

characterize each model. It is also important to take in account that the MOOC platform also put restrictions on the selection of a MOOC model (Funieru & Lazaroiu, 2016).

Table 3

MOOC models

Model	Description
aMOOC: adaptive MOOC	This is a MOOC that adapts itself to the individual's learning preferences (Blanco, García-Peñalvo & Sein-Echaluce, 2013; Sonwalkar, 2013).
bMOOC: blended MOOC	This model merges face-to-face interactions with online learning components (Yousef, Chatti, Schroeder & Wosnitza, 2015).
BOOC: big open online course	This is smaller than a massive course, e.g., around 500 students, in order to facilitate interaction (Hickey, Kelley & Shen, 2014; Koxvold, 2014).
cMOOC: connectivist MOOC	This is one of the extreme ends of the c/x MOOC spectrum. This model is based on a "connectivist distributed peer-learning model" where interactions are more important than content (Koxvold, 2014; Mackness & Bell, 2015).
COOC: community open online course	This is a non-profit model open to communities interested in being able to define the content for specific topics and to develop their own learning strategy. It is based on the contributions of informal instructors (Sanchez-Gordon & Luján-Mora, 2014).
COOC: corporate open online course	A COOC is intended for the internal use of employees and potential employees or, more broadly, for the use of business partners, e.g., suppliers, customers and potential customers (Pilli & Admiraal, 2016).
DOCC: distributed online collaborative course	A DOOC is organised around a central topic without a syllabus. The course materials are distributed among students from different institutions, where the use given to the materials might differ (Jaschik, 2013; Koxvold, 2014).
flex-MOOC: flexible MOOC	A MOOC that is more customisable according to the learner's preferences (Koxvold, 2014; Peck, 2013).
iMOOC: innovative MOOC	This model focuses on driving innovation, responsibility, interaction, interpersonal relationships and inclusion (Teixeira & Mota, 2014).
mini-MOOC	A MOOC that has a definable set of competencies and includes a minimum number of instructional objects (Spector, 2014).

mMOOC: mechanical MOOC	The “m” refers to the absence of an instructor to guide the course, which has a focus on peer learning (Ponti, 2014).
MOOL: massive open online laboratories	In a MOOL, students conduct cost-efficient experiments, regardless of place and time, as long as they have an internet connection (Jeffords, Kane, Moghaddam, Rucinski & Temesgen, 2014).
MOOR: massive open online research	A MOOR gives students the opportunity to work on research projects under the direction of scientists (Hosler, 2014).
MOOS: massive open online services	This is an evolution of MOOL, which provides additional services besides laboratories (Jeffords, Kane, Moghaddam, Rucinski & Temesgen, 2014).
pMOOC: project-based MOOC	This is a MOOC that follows a collaborative project-based pedagogy (Haavind & Sisteck-Chandler, 2015; Mor, 2012).
POOC: personalised open online course	This uses technology to analyse the learning profiles and the social web production of students to establish personalised learning paths (Nicholas & Francis, 2016; Sunar, Abdullah, White, & Davis 2016).
sMOOC: social MOOC	This provides a learning experience marked by social interactions (Morgado et al., 2014).
SMOC: synchronous massive online course	In a SMOC, lectures are broadcast live. A SMOC focuses on increasing student participation, building a sense of community and making the class feel personal for all participants (Straumsheim, 2013).
SPOC: self-paced online course	Students can join the course at any moment and complete it at a flexible pace with limited interaction with the teacher and peers (Muñoz-Merino, Ruipérez-Valiente, Alario-Hoyos, Pérez-Sanagustín & Delgado-Kloos, 2015).
SPOC: small private online course	SPOCs restrict the access of students via a selection process. They offer a more customised experience and incur a cost (Cusumano, 2014).
xMOOC: extended MOOC	This is a structured course delivered through a MOOC platform where content is more important than interaction (Baturay, 2015; Ebben & Murphy, 2014; Koxvold, 2014).
VOOC: vocational open online course	This is based on vocational pedagogies, where experts show practical tasks and procedures in real-world examples (Pilli & Admiraal, 2016).

Third strategy: management of implementation challenges

Important challenges for the implementation of MOOCs in large-scale teaching that need to be managed are as follows:

- New pedagogical approaches are needed since current pedagogical approaches do not fully support teaching on a massive scale. The more sound existing approach at present is connectivism for cMOOC. Nevertheless, xMOOC still lacks its own pedagogical approach (Littlejohn, Hood, Milligan & Mustain, 2016).
- There need to be alternative credentialing mechanisms, preferably not mediated by any particular educational institution. Some options are: digital badging; micro-credentialing; non-credit training courses; non-credit certifications; blockchain academic records; and learning digital passports (Alkhatib et al., 2014; Gartner, 2017).
- There needs to be adaptive and personalized learning using learning analytics and profiling (Gartner, 2017; Hickey, Kelley & Shen, 2014). Recommender systems and curation tools can help in defining learning paths and providing educational resources based on student behavior and preferences (Alkhatib et al., 2014).
- There need to be new mechanisms for digital assessment at scale. Current mechanisms, such as automatic grading and peer review, are insufficient (Gartner, 2017).
- There needs to be production of open educational resources and adaptive open e-textbooks that can be freely reused and translated into different languages and cultural contexts (Maringe & Sing, 2014).
- There needs to be efficient use of social media, mobile technology and gamification as learning tools (Literat, 2015).
- The accessibility of MOOC platforms and content needs to be improved, since the probability of students with disabilities participating in a MOOC is higher than traditional online courses (Sanchez-Gordon & Luján-Mora, 2014).
- There need to be sustainable business models for providers to prevent future innovations having the same fate as PLATO, Cyclops, Fathom, All Learn, and UKeU (Alkhatib et al., 2014; Bates 2015; Reich, 2015).

Conclusion

Traditionally, teachers have used courses as means to deliver certain knowledge to students in the context of a hierarchical education system. Nowadays, students use online courses as nodes in a network of learning opportunities and large-scale collaboration. Hence, future online courses should be more like a map than a limited summation of knowledge (Veletsianos, Reich, & Pasquini, 2016).

Social media and mobile devices contribute to this new approach of large-scale teaching and learning in a distributed fashion where students are more connected to each other and more empowered by their own learning.

There are large numbers of people ready to take advantage of any technological means available to meet their learning needs. Technological innovations in large-scale teaching remove the barriers of space and time that could prevent students from engaging in learning.

Future educational system should allow students to take MOOCs from any provider and receive some type of credential that is globally recognized. Nevertheless, it cannot be ignored that, in the future, something completely new might appear and become a substitute for MOOCs. In that case, all that has been said here would be a hypothesis proved wrong, just like some of the past opinions of experts in the field.

Last but not least, as Tony Bates stated, “Good teaching may overcome a poor choice of technology but technology will never save bad teaching” (Bates, 2010, p.1). As future work, the researchers intend to deepen into the MOOCs models, refine the strategies proposed in this study, and apply them to implement the use of MOOCs in an educational institution.

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