

Analysis of the scientific literature on Massive Open Online Courses (MOOCs)

Análisis de la literatura científica sobre los cursos en línea abiertos y masivos (MOOC)

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Abstract

Massive Open Online Courses (MOOCs) have been gaining attention from Academy by the disruptive innovation with which technology is brought into the educational system. Due to the emergence of the theme, the area needs recent bibliometric studies that point at previous studies about it and indicate directions for further research. Therefore, this study aims to map MOOC researches on published until December 2014 in two scientific databases: Scopus and Web of Science. Relevant aspects of scientific literature on MOOCs were explored from the collected data such as: (i) the number of publications per year; (ii) mapping of the institutions; (iii) authors with the most publications; (iv) classification in macro-theme of the identified jobs and (v) references most used by the authors. For the analysis, it was used 294 papers written by 694 authors, affiliated with 266 institutions. In the articles analysed, the authors used 5,060 different references, as well as 634 different keywords. This work, in addition to a mapping of research, aims to contribute to the spreading of the idea that the MOOC theme is emerging, promising and it needs to go further in the development of new researches.

Keywords: Massive Open Online Courses; bibliometric studies; databases.

Resumen

Los Massive Open Online Courses (MOOC) están ganando atención en el campo académico por la innovación disruptiva que llevan para el sistema educativo. Debido a la emergencia del tema, el área necesita estudios bibliométricos recientes que apunten los estudios realizados previamente y sugieran pautas para futuras investigaciones. Por tanto, el presente trabajo tiene como objetivo mapear las investigaciones acerca de MOOCs publicadas hasta diciembre de 2014 en dos bases de datos científicas: Scopus y Web of Science. A partir de los datos recogidos, algunos aspectos relevantes fueron explorados, a saber: (i) el número de publicaciones por año; (ii) el mapeo de las instituciones; (iii) los autores con la mayor cantidad de publicaciones; (iv) la clasificación en macrotemas de los trabajos identificados y (v) las referencias más utilizadas por los autores. Para el análisis, fueron utilizados 294 artículos escritos por 694 autores, afiliados a 266 instituciones. En esos trabajos los autores utilizaron 5.060 referencias diferentes, así como 634 palabras clave. En los artículos analizados, los autores utilizaron 5.060 referencias diferentes, así como 634 palabras claves diferentes. Este trabajo, además de un mapeo de investigación, tiene como objetivo contribuir para la

propagación de la idea de que el tema MOOC es aún emergente y prometedor, y necesita avanzar para el desarrollo de nuevas investigaciones.

Palabras clave: cursos en línea, abiertos y masivos; estudios bibliométricos; bases de datos.

The *Massive Open Online Course* (MOOC) has gained academic attention, for the disruptive and innovative way that technology is brought into the educational system. Since it is considered a disruptive innovation (Bass, 2014) in higher education, the MOOCs are courses offered online through Web 2.0 platforms, freely or openly available, without requiring pre-requisites for participation, and offered to a large number of students (Almenara, 2015).

Many educational institutions, when offering MOOCs, have the following strategies: attracting new students to formal education; altruism and believing that education is a public good and should be encouraged for the equitable development of humankind; experimentation with new models of learning and fundraising with the possibility to sell certification. As for students, the benefits are such as cost reduction, free access to courses in renowned institutions and lifelong learning.

The term MOOC was coined by Dave Cormier and Bryan Alexander, describing the “*Connectivism and Connective Knowledge*” course (CCK08), which was offered by George Siemens and Stephen Downes at the University of Manitoba in 2008 (Aguaded & Medina-Salguero, 2015; Yousef, Chatti, Schroeder, Wosnitza, & Jakobs, 2014). Initially, the purpose of the MOOCs was to try and to learn how to use the different educational technologies offered by the Internet at the time. However, in 2011, Sebastian Thrun, from Stanford University, created a course on Artificial Intelligence, in which there had been 160,000 subscribers from 190 countries, which attracted the press’ and investors’ attention (Iqbal, Zang, Zhu, Chen, & Zhao, 2014).

Several MOOC providers like edX, Coursera and Udacity emerged in the United States, and this movement was also disseminated to the UK with FutureLearn, to Germany with iVersity and to Australia with Open2Study (Weller, 2014). However, the challenge for the institutions providing MOOCs is the introduction of new methodologies and teaching to the virtual context (Pérez & Martínez, 2015), and the balance between revenue and expenditure in order to ensure the sustainability of this type of business (Aparicio, Bacao, & Oliveira, 2014; Porter, 2015; Stuchlíková & Kósa, 2013; Wu, Shen, & Kuo, 2015).

Initially, MOOCs were seen as an individualized experience, a specific teacher in an educational institution having a course proposal strongly focused on networked learning. With the rise of proprietary platforms, several MOOCs became institutionalized and sustainable, having their pedagogy focused on videos and automatic evaluation (Burd, Smith, & Reisman, 2014). For this reason, two categories have been established for MOOCs: cMOOCs, which are based on connectivism theory (Siemens, 2005; Yeager, Hurley-Dasgupta, & Bliss, 2013), and xMOOCs,

which are based on the traditional lecture format, video classes, interactive exercises and forums (Grünewald, Meinel, Totschnig, & Willems, 2013).

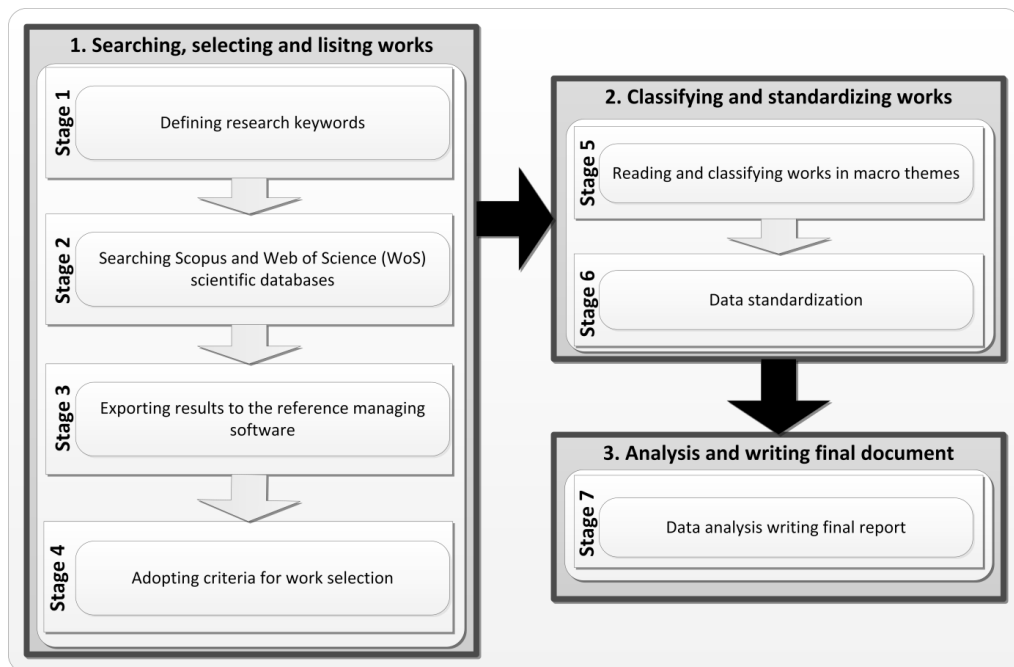
Since 2013, the theme MOOC has been widely discussed in the academy (Aires, 2016) through publications with different theoretical and practical perspectives. Due to the rising of the theme, the area lacks recent bibliometric studies (Ng'Ambi & Bozalek, 2015; Sangrà & Wheeler, 2013) that point at which surveys have been conducted and which direction should be taken by the new ones.

Some work has been done for classifying/in order to classify publications related to MOOCs such as: Liyanagunawardena, Adams, and Williams (2013), Kennedy (2014) and Yousef et al. (2014). As for Abad, Conde, and Peñalvo (2014), the authors conducted a survey listing the terms e-learning and MOOCs. However, these studies did not include the works conducted in 2014. For this reason, this study aims to map the scientific literature on MOOCs until December 2014 in order to identify: a) the main authors and the institutions to which they are affiliated; b) the theoretical basis of such studies; c) the classification of research in macro-themes and; d) references most used by the authors. For this purpose, it is presented, in section 2, the details of the methodological procedures used for the development of this research. Section 3 describes the results and Section 4 shows the final considerations, followed by the used references.

METHODOLOGICAL PROCEDURES

The main characteristic of a bibliometric research is to review scientific literature in order to identify indicators that can portray the development of a particular area (Bufrem & Prates, 2005; Horst, 2013). This work has been carried out in three phases: 1) searching, selecting and listing the works; 2) standardizing and classifying them and 3) data analysis and writing the final document. These stages, when expanded, comprise seven steps, which are shown in Figure 1 and are described below.

Figure 1. Phases and stages of the research methodological procedures



Source: Research results.

Stage 1: Defining research keywords

At this stage, the purpose was to identify scientific papers published on *Massive Open Online Course* topic and indexed in international scientific databases. To carry out the search on the databases, the use of the exact term “Massive Open Online Course” has been chosen and from it, through reading, the main macro-themes addressed in the studies have been identified.

Stage 2: Searching scientific databases

The searches were conducted in two international databases: Scopus and Web of Science (WoS), without limiting the year or language of publication. Those databases were chosen because they are multidisciplinary, internationally recognized by the scientific community, widely used for bibliometric studies (Brambilla & Stumpf, 2012; Regolini & Jannès-Ober, 2013) and for being “an international benchmark for measuring scientific production of countries” (Packer, 2011, p. 29). In addition,

they were chosen because they have records on the researched topic and allow data exporting to EndNote bibliography management software in a standardized format.

Stage 3: Exporting results to the reference managing software

The information from consulting the selected databases, such as title, author, place of publication and keywords, has been exported to reference managing software, thus forming a single set of articles.

Stage 4: Adopting criteria for work selection

In the reference managing software, the following criteria for the selection of the works were applied, removing those which: a) had no authorship; b) were duplicates (indexed articles in more than one database); c) were not written in English, Spanish or Portuguese; d) have costs to access the full text; e) could not provide access to the full text; f) were published after December 2014 and; g) were out of the study context.

It has been decided to select publications in English due to its importance as an international knowledge communication tool. However, Spanish and Portuguese were also considered, due to the authors' geographical nature and nationality. In relation to the temporal delimitation of publications, it has been chosen to select all works published until December 31st, 2014, allowing complete annual reviews.

Stage 5: Classifying works in macro-themes

In order to classify the works in macro-themes, the title, abstract and keywords of the selected works were read and, in case of any doubt, the full text was read. To help the listing process, the work by Liyanagunawardena et al. (2013) and Youset et al. (2014) was used as a basis.

Stage 6: Data standardization

The records identified in Scopus and WoS have different criteria for spelling information such as authors' names, which change the results, as the ranking of researchers' and institutions' productivity. For that reason, it was necessary to standardize data, to ensure homogeneity. In addition, information regarding the authors' affiliation and references are not available in the metadata, creating the need to pick them up directly in the article text. Information on keywords has also been complemented. To help this process, a new database was created by the use of Microsoft Access. Each item has been standardized and data have been complemented manually. As for the references, those, that did not have the date of

publication or access, were discarded. The standardization process takes time and it is essential for the bibliometric study.

Stage 7: Data analysis and writing the final report

In the final set of selected and standardized work, it was possible to generate queries and images that best display the data, and the results were described in a final report.

RESULTS

Initially, the research in the scientific databases Scopus and WoS was held on 13th July 2015. After the adoption of some filters, described in step 4 of the methodological procedures, it has come up with a set of 294 selected works. The selecting process of publications for the final analysis is presented in Table 1.

Table 1. Work selection process

Tasks	Scientific Database				Total	
	Scopus		WoS			
Initial result of searches in databases	551		87		638	
Selection process	Removed	Kept	Removed	Kept	Removed	Kept
1. Withdrawal of paper without identification of authors	6	545	0	87	6	632
2. Withdrawal of duplicates articles	58	487	6	81	64	568
3. Withdrawal of works not written in English, Spanish or Portuguese	4	483	0	81	4	564
4. Withdrawal of works that require payment to access the full text	91	392	9	72	100	464
5. Withdrawal of articles whose full text was not possible to find	40	352	15	57	55	409
6. Withdrawal of works published after December 2014	77	275	12	45	89	320
7. Withdrawal of works out of the study context	19	256	7	38	26	294

Source: Research results.

Among the 294 selected papers, 140 are indexed articles in scientific journals and 154 are publications in conference proceedings. As for the language, 283 were published in English and 11 in Spanish. Table 2 presents the general bibliometric research data.

Table 2. General bibliometric research data

Bibliometric data	Absolute frequency
Total number of selected works	294
Total source* of publications	178
Total authors	694
Total institutions to which the authors are affiliated	266
Total countries of the institutions	45
Total of different keywords used in the work	634
Total distinct references used to compose the work	5060

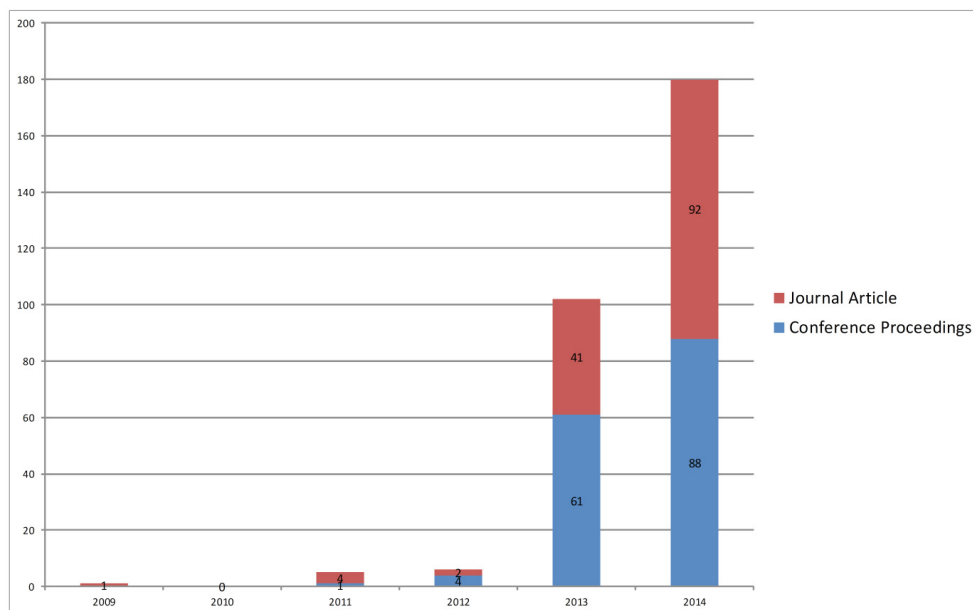
Source: Research results

* Source, in this study, refers to where (*Journals or conference proceedings*) the work has been published.

Time Trends

By analyzing the 294 selected works, it was observed, through the graph in Figure 2, that the first publication on MOOC was in 2009, in the Journal International Review of Research in Open and Distance Learning (IRRODL), called “The Technological Dimension of a Massive Open Online Course: The Case of the CCKo8 Course Tools”, by Antonio Fini. This paper presents the results of the course “Connectivism and Connective Knowledge (CCKo8)”, developed by George Siemens and Stephen Downes in 2008.

Figure 2. Graph with the number of publications per year



Source: Research results.

In 2011, the year in which there was an awakening on the subject, there were five publications: one at the “1st International Conference on Learning Analytics and Knowledge LAK’11”, held in Canada from 27 February to 1 March 2011, and four in the journal IRRODL.

Unlike 2011, when the greatest number of publications was in a scientific journal, in 2012, out of the six identified works, four originated in conferences –4th International Congress on Engineering Education– Improving Engineering Education: Towards Sustainable Development (ICES), International Conference on Web Intelligence and Intelligent Agent Technology Workshops (WI-IAT); 10th IEEE International Conference on Emerging eLearning Technologies and Applications (ICETA) and 13th Annual Conference on ACM Special Interest Group for Information Technology Education (SIGITE) –and only two appeared in journals– Communications of the ACM and IRRODL.

In 2013, there was a jump in the academic interest towards MOOCs. Of the 102 papers identified that year, 61 originated in 42 conferences and 41 were published in 36 different journals. The International Conference in MOOC Innovation and Technology in Education (MITE) are highlighted, with five identified articles, and the journal IRRODL, with three published articles.

In 2014, of the 180 identified studies, 88 originated in 44 conferences and 92 were published in 58 journals. Emphasis is given to the conferences 1st ACM Conference on Learning at Scale, with 16 articles, and MITE, with 10 published articles; also, to the IRRODL journals, with 17 published works, and Profesorado, with 5 published articles.

It can be seen that in 2012 and 2013 there was a greater interest by researchers, in publications at conferences, while in 2014 there were more publications in journals, which may suggest a maturing in research on MOOCs.

Main sources of publications

Of the 294 selected works, 26 were published in the IRRODL and of the 26 publications carried out in the journal, 17 were held in the year 2014. Table 3 presents the main *journals* used by the authors to publish their work.

Table 3. Journals with the highest number of publications

Journal	ISSN	Periodicity	Total of publications
Journal International Review of Research in Open and Distance Learning (IRRODL)	1492-3831	Bimonthly	26
Communications of the ACM	0001-0782	Monthly	6
Profesorado	1138-414X	Every four months	5
Distance Education	0158-7919	Every four months	4
Journal of General Education	0021-3667	Every four months	4
Insights	2048-7754	Every four months	3
Turkish Online Journal of Distance Education	1302-6488	Quarterly	3

Source: Research results.

In relation to the conferences, the two ones with the most work on the MOOC thematic occurred in 2014: the 1st ACM Conference on Learning at Scale (L@S), held in Atlanta in the United States in March, with 16 published works, and the International Conference on MOOCs Innovation and Technology in Education (MITE), held on 19 and 20 December, 2014, in Patiala, India, with 10 published articles.

Main authors and institutions

By analyzing the authorship of the selected works, in Table 4, it is illustrated the main authors and institutions to which they are affiliated. It is worth noting that information about the authors' affiliation was collected in the articles and may not reflect their current position.

Table 4. Authors with the most publications and their institutions

Authors	Total of published works	Author's affiliation
Christoph Meinel	7	University of Potsdam
Christian Willems	7	
Daniel T. Seaton	4	MIT
Armando Fox	4	University of California
Marti A. Hearst	4	
Jo-Anne Kelder	4	
Carolyn King	4	University of Tasmania
Andrew Robinson	4	
James Vickers	4	

Source: Research results.

Table 5 highlights the institutions that have the greatest number of affiliated authors.

Table 5. The most productive institutions

Institution	Total affiliated authors	City	Country
University of California	18	Davis	USA
MIT	14	Cambridge	
Peking University	14	Beijing	China
Microsoft Research India	13	Bengaluru	India
UNED: Universidad Nacional de Educación a Distancia	13	Madrid	Spain
University of Potsdam	13	Potsdam	Germany
Carnegie Mellon University	12	Pittsburgh	USA
Universidad Carlos III de Madrid	12	Madrid	Spain
Harvard University	11	Cambridge	USA

Institution	Total affiliated authors	City	Country
Stanford University	11	Stanford	
University of Maryland	11	College Park	
Georgia Institute of Technology	10	Atlanta	

Source: Research results.

From the location data of the institutions to which the authors are affiliated, it was possible to build a map (Figure 3) showing where there has been research on MOOCs. Each point on the map represents an institution and the larger the circle, the larger the number of research in that place.

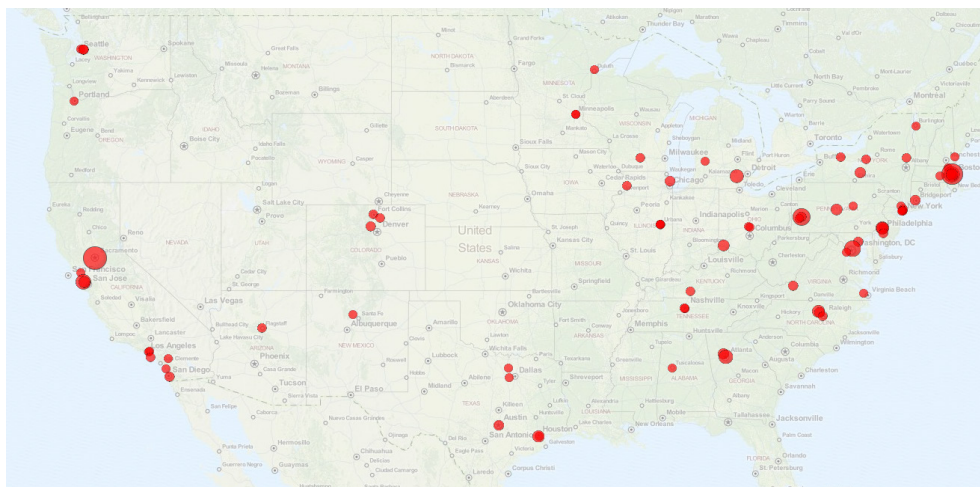
Figure 3. Map showing the location of the authors' institutions



Source: Research results.

The main countries working in research on MOOCs are: the United States, with 82 institutions and 257 researchers; India, with 22 institutions and 45 researchers, Spain, with 21 institutions and 78 researchers; the UK, with 16 institutions and 36 researchers and Australia, with 12 institutions and 38 researchers. Due to the high interest of American institutions on MOOCs, Figure 4 shows in more detail the places where this type of research occurs in that country.

Figure 4. Map with US institutions (largest number of institutions)



Source: Research results.

Note that research on MOOCs in the United States is distributed across the country, demonstrating the spread and interest in the subject in the various institutions.

Main keywords and Macro-themes of publications

Of the 294 works selected in this study, the authors used 634 different keywords. The most frequently used term was MOOC with 130 repetitions and “Massive Open Online Course” appearing in 70 articles. Even though both terms have the same meaning in 26 papers, the authors chose to use the two terms as a form of identification.

The other most mentioned terms are: e-learning used in 29 works; higher education, used in 21; online learning in 20; Open Educational Resources, in 16; online education, in 15 and connectivism, used in 12 papers. The tag cloud shown in Figure 5 illustrates the terms used as keywords in the analyzed studies.

Figure 5. Tag Cloud



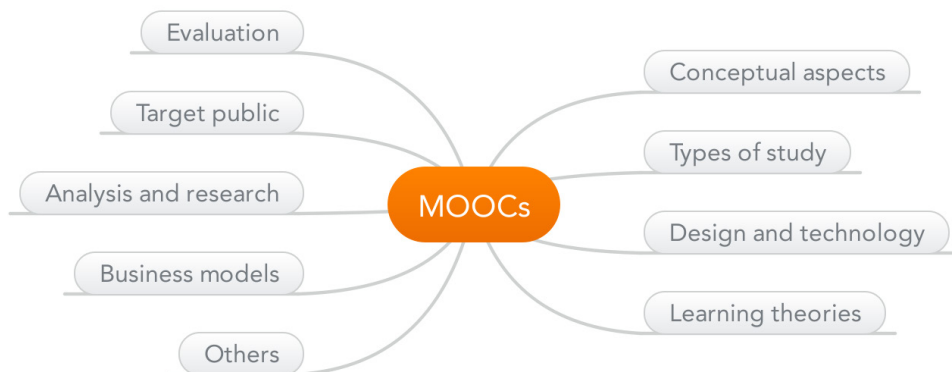
Source: Research results.

Obs.: To make viewing easy, the terms MOOC and *Massive Open Online Course* were removed from the cloud.

It can be observed that out of the 634 different keywords used to identify the works, 515 (81.2%) are terms that are not repeated, suggesting the existence of different themes being addressed in research on MOOCs.

Based on the classification adopted by Liyanagunawardena et al. (2013) and Youset et al. (2014), it was possible to distribute the articles selected in macro-themes, from the reading of the title, abstract, keywords and, when in doubt, of the complete work (Figure 6). It is worth mentioning that the same analyzed work may be in more than one macro-theme and due to the high number of articles, only some works will be exemplified in each of the macro-themes shown in Table 6.

Figure 6. Macro-themes



Source: Adapted from Liyanagunawardena et al. (2013) and Youset et al. (2014).

Table 6. Topics discussed in the macro-themes

Macro theme	Description	Total works
Conceptual aspects	It includes works that deal with the conceptualization and history of MOOCs as in Nechifor and Purcaru (2014), of open education as in Pisutova (2012), of open educational resources, such as in Deimann and Farrow (2013) and of Open Couserware as in Rhoads, Berdan, and Toven-Lindsey (2013); they make a counterpoint between education X technology as in the article by Comeau and Cheng (2013); and address issues such as communities of practice as in Overmyer (2013), pedagogical innovation as in Sangrà and Wheeler (2013), and the advantages, disadvantages and timeliness of MOOCs such as in Stuchlíková and Kósa (2013).	140
Design and technology	Works that address accessibility have been identified as in Sanchez-Gordon and Lujan-Mora (2013); the machine learning, such as Singh and Lal (2013); of the evaluation platforms as in Kay, Reimann, Diebold, and Kummerfeld (2013); instructional design, course format and material production in Grünewald et al. (2013); engagement, incentives and tools for production as discussed by Anderson, Huttenlocher, Kleinberg, and Leskovec (2014); flipped classroom, forums, interaction, gamifications, metadata and issues related to course quality as in Speck et al. (2014) and Sadykova (2014).	154
Learning theories	The works searched were those that directly address the learning theories, connectivism being among them, as approached by Clarà and Barberà (2013).	12
Types of study	The following types of work were identified: dealing with course evaluations; bibliometric research; framework; quantitative research; report of experiences and use; theoretical and empirical work.	278
Business Models	Works dealing with institutional challenges of sustainability projects, as in Burd et al. (2014), and with discussions related to the business model as discussed by Kalman (2014), were identified.	21
Target public	They include aspects related to learners' learning characteristics and courses for seniors as in Sanchez-Gordon and Lujan-Mora (2013); retention of students, as in Adamopoulos (2013); and use of social media, as approached by Kravvaris, Ntanis, and Kermanidis (2013).	5
Evaluation	It was sought studies that deal with self-assessment, electronic evaluation, peer review and evaluation process in general, as in the work by Admiraal, Huisman, and van de Ven (2014).	8
Analysis and research	It was classified works that directly address research related to access, view and add-on fees of the courses, as the work by Zhuhadar and Butterfield (2014); sentiment analysis and social interactions, as in Harris, Zheng, Kumar, and Kinshuk (2014) and students' engagement, as in Hew (2014).	23
Others	It was classified the works that address issues such as Big Data, the future of MOOCs, institutional policies and publications in the form of videos, such as in the work by Daries et al. (2014).	4

Source: Research results

Main references cited

The authors of the 294 studies analyzed used 5,060 different references. Table 7 shows the main references used by the authors. Of the 10 most frequently studies cited in the articles, only two are in the set of analyzed studies: “*Deconstructing Disengagement: Analyzing Learner Subpopulations in Massive Open Online Courses*” and “*The Challenges to Connectivist Learning on Open Online Networks: Learning Experiences during a Massive Open Online Course*”.

Table 7. Main references used by the authors

Author	Year	Title	Number of citations
John Daniel	2012	Making sense of MOOCs: Musings in a maze of myth, paradox and possibility	47
George Siemens	2005	Connectivism: A learning theory for a digital age	36
Alexander McAuley; Bonnie Stewart; George Siemens; Dave Cormier	2010	The MOOC Model for Digital Practice	33
Laura Pappano	2012	The Year of the MOOC	32
René F. Kizilcec; Chris Piech; Emily Schneider	2013	Deconstructing Disengagement: Analyzing Learner Subpopulations in Massive Open Online Courses	29
Lori Breslow; David E. Pritchard; Jennifer DeBoer; Glenda S. Stump; Andrew D. Ho; Daniel T. Seaton	2013	Studying learning in the worldwide classroom: Research into edXs first MOOC	25
Jenny Mackness; Sui Fai John Mak; Roy Williams	2010	The Ideals and Reality of Participating in a MOOC	24
Rita Kop	2011	The Challenges to Connectivist Learning on Open Online Networks: Learning Experiences during a Massive Open Online Course	23
Li Yuan; Stephen Powell	2013	MOOCs and Open Education: Implications for Higher Education	22
C. Osvaldo Rodriguez	2012	MOOCs and the AI-Stanford like Courses: Two Successful and Distinct Course Formats for Massive Open Online Courses	20

Source: Research results

In the article “Making Sense of MOOCs: Musings in a maze of myth, Paradox and Possibility”, Daniel makes an overview about MOOCs addressing from the definition to issues related to the platforms, pedagogical aspects and quality involving MOOCs, in addition to certification. Still, the evolution of the North American platforms Coursera, Udacity and edX as well as reflections on the present and the future of MOOCs, are issues addressed in the article “The year of the MOOC”, published in The New York Times on November 2, 2012, by Pappano.

With respect to learning theories, Siemens, in his article “Connectivism: The learning theory for the digital age”, discusses the limitations that exist among behavioral, cognitive and constructivist theories in order to introduce an alternative theory, the connectivism.

In the case of the analysis of courses in the article “Deconstructing Disengagement: Analyzing Learner subpopulations in Massive Open Online Courses”, the authors investigated three MOOCs of the computer science area with the focus on apprentices’ engagement, in order to increase the completeness of the MOOC courses.

Also, in the article “Studying learning in the classroom worldwide: Research into edXs first MOOC”, the authors present the data collected relating to students’ behaviour in the first course offered by the edX, called “Circuits and Electronics”.

In the work “The Ideals and Reality of Participating in a MOOC”, they analyze the CCKo8 course (Connectivism and Connective Knowledge) conducted in 2008 and they highlighted that autonomy, diversity, openness and connectivity / interaction are characteristic factors of MOOCs, but they are difficult to resolve in online courses due to lack of infrastructure and monitoring of courses by tutors.

Still, in the work “The Challenges to Connectivism Learning on Open Online Networks: Learning Experiences During a Massive Open Online Course”, Kop analyzed the self-learning, the presence (student’s participation in online activities) and critical literacy (skills to use ICTs in MOOCs). Rodriguez, in the article “MOOCs and the AI-like Stanford Courses: Two Distinct and Successful Course Formats for Massive Open Online Courses”, makes a comparison between two different course formats successfully applied: the cMOOCs and the AI-Stanford.

It can be observed, therefore, that the authors of these studies agree that, in addition to an evaluation, it is necessary to advance in MOOCs research in order to improve the methodology of online courses.

In the report “MOOCs and Open Education: Implications for Higher Education”, Yuan and Powell discuss open education and the changes taking place in higher education in order to assist managers in understanding the disruptive innovation occurring through MOOCs in this universe and its political implications.

Discussions

It can be seen an increasing consolidation of academic research on MOOC after 2012, and confirmed in the studies by Yousef et al. (2014) and Liyanagunawardena

et al. (2013). The opening given by technology and education conferences for the theme, coupled with the intensification of investments in MOOC projects by Udacity, Coursera and edX platforms, and the interest of the media contributed to the dissemination and further research in recent years.

Data also indicate that 257 affiliated researchers at 82 US institutions have published 106 studies, in which only 13 were in collaboration with foreign institutions. This behaviour is also observed in other countries that concentrate more researchers in the MOOC theme: considering the 22 Indian institutions with 45 affiliated researchers, out of the 18 published works, only four were in partnership; as for the 21 Spanish institutions with 78 affiliated researchers, out of the 31 published works, eight were in partnership; and concerning the 16 institutions from the UK, with 36 affiliated researchers, out of the 25 studies, seven were in partnership. However, Asian and European institutions, even having a small number of researchers, are more open to international research collaboration.

Among the set of selected works, 20.4% are mentioned in the references of other articles, representing 1.8% of references used by the authors. In a pooled analysis, it is assumed that there is still no central group of articles because of the rising of the theme. However, it is believed that the work identified in Table 7 can be considered by the academic community as seminal and used to support further research on MOOCs.

In relation to the limitations of the work, of the 294 analyzed articles, in 73 (24.8%), the authors did not report the keywords in the text, which impaired a more accurate analysis. Lack of keywords in the metadata hinders the location of the works by the search engines. In addition, in 13 studies there is no clear identification of the authors' affiliation in the documents, making it impossible to analyze the overall data in these requisites.

CONCLUSION

This study aimed to identify and analyze the scientific production on MOOCs published until December 31, 2014 in English, Spanish and Portuguese, in international databases Scopus and WoS.

From the mapping and analysis of scientific literature on MOOCs, it was possible to see the current state of research in this area. To this end, this work enabled to (a) identify the increase of scientific studies published in the limited time period; (b) show the main sources in which the selected works were published; (c) present the main authors and their institutions; (d) point out the most used keywords; (e) classify the articles in macro-themes and (f) reveal the main theoretical frameworks used in the identified articles. It has become, thus, a theoretical framework that has the intention to help those interested in expanding the studies and the development of MOOCs, besides enriching the discussion on the direction of research and trends on MOOCs.

Even though this work is limited to two scientific databases and to articles published until December 2014, it is noted that MOOCs have aroused great interest in the academic community for bringing innovation into the education system, enabling new business models. However, there is the need to develop research regarding the sustainability of long-term projects and the technological infrastructure needed to store, manage and deliver courses in MOOCs format. For future work, we suggest the expansion of research bases and research period, as well as using other analytical techniques that allow the comparison between different types of “free and paid” scientific basis.

The paradigm of online learning is relatively new to certain global realities, however it influences the way in which knowledge is disseminated. The MOOCs can contribute to make knowledge a public good and available to a larger number of people.

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