Massive Open Online Courses: A Bibliometric Review

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***Abstract*—Massive Open Online Courses (MOOCs) are open courses offered to an indefinite number of participants and accessible through virtual learning environments. These courses have been the subject of research all over the world. The purpose of this paper is to analyze the scientific production on Massive Open Online Courses in journals indexed in Clarivate Analytics' Web of Science and Elsevier's Scopus. The sample is composed by 1908 articles in total. The results obtained by bibliometric analysis showed that the publication continue to increase, in which journals they are published, which are the organizations and countries that publish the most, and which are the most cited articles. We concluded that since Massive Open Online Courses are a reality, there still seems to be a possibility for evolution in good quality publications.**

***Index Terms*—Massive open online courses, MOOCs, bibliometrics, data analysis.**

I. Introduction

Massive Open Online Courses (MOOCs) are courses aimed at unlimited participation worldwide and open access via the web [1], classes delivered in an online environment, free and open to all, which attract substantially larger audiences than traditional online education [2]. The term was first used to describe an open online course 'Connectivism and Connective Knowledge (CCK08)', which was developed at the University of Manitoba by George Siemens and Stephen Downes and had over 2200 participants from all over the world [3]. In 2011, the University of Pennsylvania, Princeton University, Stanford University and the University of Michigan joined forces to offer free courses online. The Massachusetts Institute of Technology and Harvard University came together to do the same in 2012. That partnership has expanded to include a number of other institutions, including the University of California at Berkeley and Wellesley College [4].

MOOCs have bifurcated into two types of course, which are known as cMOOCs and xMOOCs [5]. CMOOCs are constructivist MOOCs, like the early MOOCs that tended to have a decentralized, network-based, non-linear structure focused on exploration and conversation rather than emphasizing instructor-provided content. XMOOCs were hyper-centralized, content-based, and linear, typically focused around a set of short, modularized video-lectures, followed by automated, multiple-choice testing of learners' understanding of the content [3]. A MOOC brings together people interested in learning (or "students") and an expert or experts who seek to facilitate the learning [6], but Jordan [7] calculated that only 6.5% complete the course, with the decrease of enrolment numbers positively correlated with course length.

Ye Zheng and Ruo-Yu Yang [8] selected 445 papers on educational study of MOOCs from the "Chinese Social Science Citation Index (CSSCI)" from 2013 to 2016 for a Bibliometric Analysis. A study [9] provided a systematic and organized review of 32 studies regarding using of Massive Open Online Courses (MOOCs) in Malaysian higher education from 2012 to 2017. Liyanagunawardena, Adams, Williams [6] presented a systematic review of the published MOOC literature (2008-2012): forty-five peer reviewed papers are identified through journals, database searches, Web searching and chaining from known sources to form the base for this review. Lambert [10] presents the results of a systematic review of literature of a set of 46 studies and reports from 2014 to 2018. Moreno-Marcos et al. [11] selected 88 papers to survey the state of the art on prediction in MOOCs through a systematic literature review.

All of these studies are important to give clues on how research in this area has been carried out and eventually to predict the future. This study provides insights not previously identified or evaluated in such detail using bibliometric indicators since the first articles were published until the year 2019. Bibliometric analysis [12] is the quantitative study of bibliographic material: provides a general picture of a research field that can be classified by papers, authors and journals. Bibliometric methods employ a quantitative approach for the description, evaluation, and monitoring of published research. These methods have the potential to introduce a systematic, transparent, and reproducible review process and thus improve the quality of reviews [13]. Bibliometric analysis provides objective criteria that can assess the research development in a field and act as a valuable tool for measuring scholarship quality and productivity [14]. Bibliometric methods offer systematization and replication processes that can improve understanding of the dissemination of knowledge in a field and can highlight gaps and opportunities that contribute to the advancement of the discipline [15].

The aim of this study is to conduct a literature review of the Massive Open Online Courses (MOOCs) research using bibliometric methods. The next section presents the research questions. The methodology is defined in the third section. Then the results are presented and at the end they are discussed and the conclusion is made.

II. The Research Question

The question, along with the purpose of the review, the intended deliverables and the intended audience, determines how the data are identified, collected and presented [16]. There are several questions that we want to answer in this

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paper:

- What has been the evolution of the publication of articles in quality journals related to Massive Open Online Courses (MOOCs)?
- What are the characteristics of journals where there is a greater number of publications related to the subject?
- What is the approach to Massive Open Online Courses (MOOC)?
- Who publishes on the subject? Where do researchers who are interested in Massive Open Online Courses (MOOCs) work? What country do they work? What are the languages in which most of these articles are published?
- What are the most cited articles?
- What is the purpose of the most cited articles? What is the perspective with which the articles approach the theme?
- Who writes the most cited articles? and where do they work?

III. Methodology

The term bibliometrics was first used in 1969 by Alan Pritchard, hopping that the term would be explicitly used in all studies which seeked to quantify the processes of written communication and that it would quickly gain acceptance in the field of information science [17]. Moed mentioned the potential of this type of study that reveals the enormous potential of quantitative, bibliometric analyses of the scholarly literature for a deeper understanding of scholarly activity and performance, and highlighted their policy relevance [18]. In scientific research, it is important to get a wider perspective of research already being conducted concerning a relevant subject matter [19] and a bibliometric analysis profile on the research trajectory and dynamics of the research activities across the globe [20]. This is a bibliometric study that systematically analyses the literature using articles indexed at Elsevier's Scopus (Scopus) and Clarivate Analytics' Web of Science (WoS) databases. This paper conducts a bibliometric analysis of international journal papers that we expect to provides a useful reference for future research.

The search strategy was

Title: "MOOC" OR "MOOCs" OR "Massive Open Online Course"

DocType: Article OR Review

PUBYEAR: < 2020.

IV. Results

A set of 1479 published papers were collected from WoS and 1381 from SCOPUS. The search returned a total of 1908 articles and reviews after discounting the duplicate results. The first article was published in 2009 (Fig. 1. Annual evolution published papers.). The growth of publications has increased every year: 86 until 2013 (5%), 724 in 2014-2016 (38%) and 1098 in 2017-2019 (58%).

141 (7.4%) of the articles have a question mark in the title. The most frequent words in the title of the articles are MOOCs and MOOC. But also Online, Open, Massive, Learning, Courses Education, Course, Study, Analysis, Teaching, based, Design, Development, Higher, Using and Research.

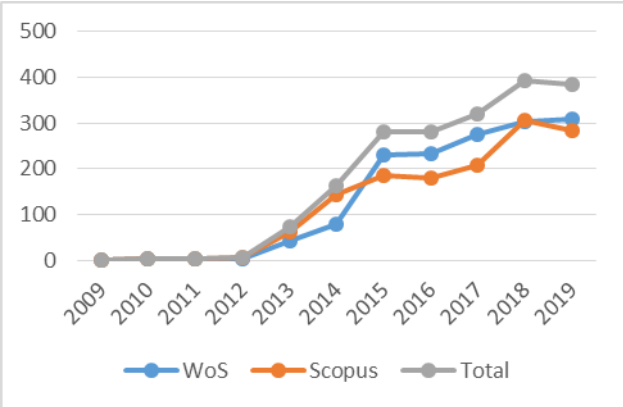

Fig. 1. Annual evolution published papers.

The articles were published in 786 international journals, 15 of which published 15 or more articles (Table I. Journals information's.). International Review of Research in Open and Distance Learning published 90 articles, International Journal of Emerging Technologies in Learning published 40. Seven of those 15 journals were published in the United Kingdom and three in Canada. Computers and Education and Computers in Human Behaviour were the journals with best CiteScore 2018 (CiteScore measures average citations received per document published in the serial [21]), respectively 7.72 and 6.14 and best SJR 2018 (SCImago Journal Rank measures weighted citations received by the serial [22]), respectively 2.323 and 1.711. Computers and Education was the journal with best Source Normalized Impact per Paper (SNIP) 2018. The most common WoS subjects are Social Sciences and Computer Science. The most common WoS categories are Social Sciences (Education) and Social Sciences (E-learning). 33% of those journals are ranked in the first quartile in Journal Citation Reports.

We found 5611 keywords. The 20 most common keyword are MOOC, MOOCs, Massive Open Online Courses, Online learning, Higher education, E-learning, Massive open online course, Learning analytics, Massive open online courses (MOOCs), Education. Online education, Distance education, Massive open online course (MOOC), Instructional design, Distance learning, Motivation, blended learning, Open education, Connectivism and Coursera (Fig. 2. Most common keywords).

Fig. 2. Most common keywords.

The following figure shows the network visualization of the keywords (Fig. 3. Network visualization, keywords.). It is possible to verify that there are 4 keywords clusters:

- C1: assessment, collaborative learning, e-learning, engagement, learning, learning analytics, machine learning, massive open online course (mooc), massive open online courses, moocs, motivation, peer assessment and self-regulated learning.
- C2: connectivism, distance education, education, instructional design, lifelong learning, massive open online course (mooc), massive open online courses, mooc and online learning;
- C3: coursera, higher education, online courses and open education;
- C4: blended learning, distance learning and online education.

TABLE I: JOURNALS INFORMATION'S

Journal	#	Country	Cite Score 2018	SJR 2018	SNIP 2018	Cite Score 2019	Wos Subject (Category)	Q	H I
International Review of Research in Open and Distance Learning	90	Canad	2.87	1.2	1.774	2.78	Social Sciences (Education; E-learning)	Q1	56
International Journal of Emerging Technologies in Learning	40	Germ	0.97	0.219	0.819	1.24	Engineering (Engineering (miscellaneous)); Social Sciences (Education; E-learning)	Q2; Q3; Q3	15
Computers and Education	35	Uk	7.72	2.323	3.797	7.72	Computer Science (Computer Science (miscellaneous)); Social Sciences (Education; E-learning)	Q1	149
Journal of Advanced Oxidation Technologies	31	Canad	0.88	0.274	0.316	0.88	Chemistry (Physical and Theoretical Chemistry)	Q4	21
Ried-Revista Iberoamericana De Educacion a Distancia	25	Spain					Social Sciences (General; Education; Educational Research)		
British Journal of Educational Technology	24	Uk	4.07	1.419	2.354	4.35	Social Sciences (Education; E-learning)	Q1	81
Distance Education	23	Uk	2.19	0.972	1.1.26	2.52	Social Sciences (Education; E-learning)	Q2	40
International Journal of Technologies in Higher Education	20	Canad					Social Sciences (General; Education; Educational Research)		
Journal of Universal Computer Science	18	Austri	1.5	0.332	0.972	1.15	Computer Science (Computer Science (miscellaneous)); Mathematics (Theoretical Computer science)	Q2; Q3	48
Open Praxis	18	Norw.					Social Sciences (General; Education; Educational Research)		
Interactive Learning Environments	17	Uk	2.44	0.901	1.252	2.99	Computer Science (Computer Science Applications); Social Sciences (Education; E-learning)	Q1	34
Turkish Online Journal of Distance Education	17	Turk.	0.73	0.274	0.590	0.93	Social Sciences (Education)	Q3	17
Computers in Human Behavior	16	UK	6.14	1.711	2.245	7.48	Arts and Humanities (Arts and Humanities (miscellaneous)); Computer Science (Human-Computer Interaction); Psychology (Psychology (miscellaneous))	Q1	137
Journal of Interactive Media in Education	16	UK					Social Sciences (General; Education; Educational Research)		
Online Learning Journal	15	UK	1.25	0.547	0.848	1.62	Computer Science (Computer Networks and Communications); Social Sciences (Education)	Q2	42

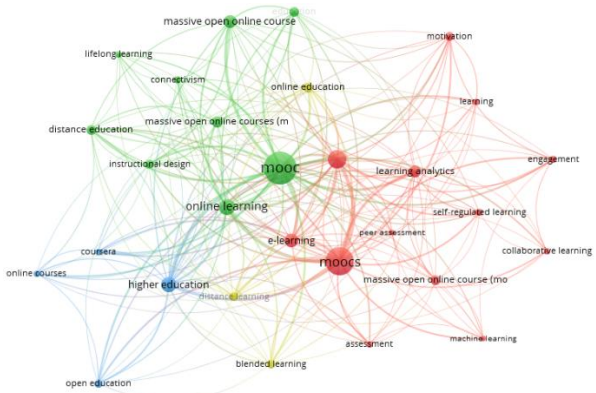

Fig. 3. Network visualization, keywords.

52% of the articles have one author and 22% have two co-authors. (Fig. 4. Number of authors.). There are nine authors with five or more articles: Watson, W. R. (10), Kloos, C. D. (8), Pritchard, D. E. (7), Alario-Hoyos, C, Bote-Lorenzo, M. L., Chen, Y., Dimitriadis, Y., Gašević, D. and Jablokow, K. W. (5) (Table II. Authors with more articles.). Four of these authors are affiliated with Spanish universities, three with universities in the United States, one in Taiwan and the other in Canada. The network visualization (Fig. 5. Network visualization, Authors.) shows that there are groups but that do not seem significant because there are not many networks.

There are authors from 87 countries. The countries with the largest number of articles are: United States (21%), China (13%), Spain (11%), United Kingdom (8%) and Australia (5%). There are 15 countries that are responsible for at least 15 papers (Fig. 6. Countries with at least 15 papers.). This density of countries is clearly visible in Fig. 7. Density visualization, Countries.

There are contributions from 586 organizations: ten of

these organizations have more than ten articles: the first three from United States, Indiana University, Massachusetts Institute of Technology and Harvard University (Table III. Organizations with more references.). We did not find clusters in organizations.

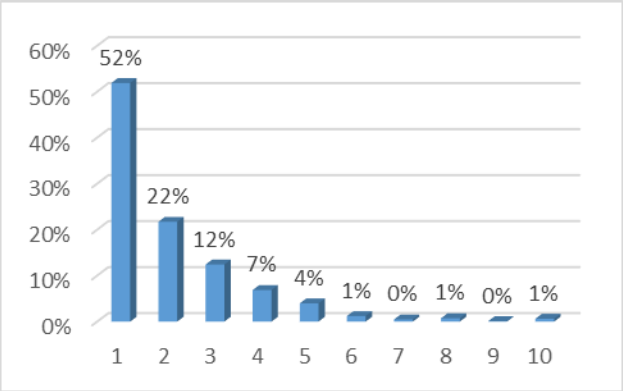

Fig. 4. Number of authors.

TABLE II: AUTHORS WITH MORE ARTICLES

Author	#	Organization
Watson, W. R.	10	Purdue University ·Department of Curriculum and Instruction, United States
Kloos, C. D.	8	University Carlos III de Madrid ·Department of Telematic Engineering, Spain
Pritchard, D. E.	7	Massachusetts Institute of Technology, United States
Alario-Hoyos, C.	5	Universidad Carlos III de Madrid, Spain
Bote-Lorenzo, M. L.	5	Universidad de Valladolid ·Escuela Técnica Superior de Ingenieros de Telecomunicación, Spain
Chen, Y.	5	National Chengchi University, Taipei, Taiwan
Dimitriadis, Y.	5	Universidad de Valladolid ·Escuela Técnica Superior de Ingenieros de Telecomunicación, Spain
Gašević, D.	5	Athabasca University, Canada
Jablokow, K. W.	5	Pennsylvania State University ·School of Engineering Design, Technology, and Professional Programs United States

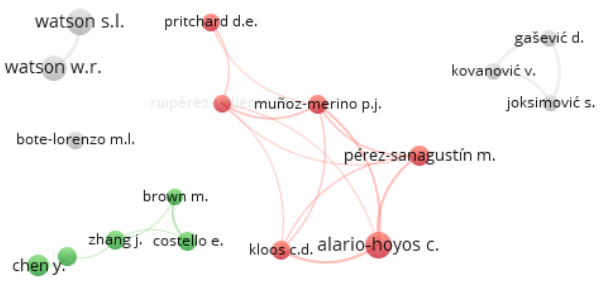

Fig. 5. Network visualization, Authors.

TABLE III: ORGANIZATIONS WITH MORE REFERENCES

Organization
Indiana University, United States
Massachusetts Institute of Technology, United States
Harvard University, United States
Leiden University, Netherlands
Dublin City University, Ireland
Duke University, United States
Karolinska Institutet, Sweden
Anadolu University, Turkey
Athabasca University, Canada
Open University of The Netherlands, Netherlands

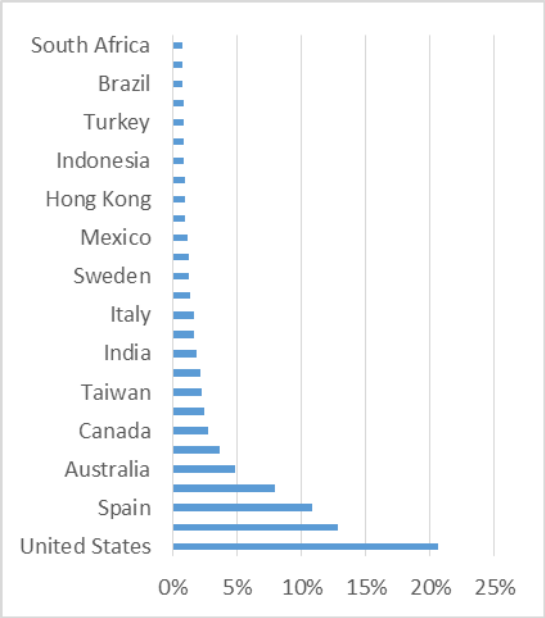

Fig. 6. Countries with at least 15 papers.

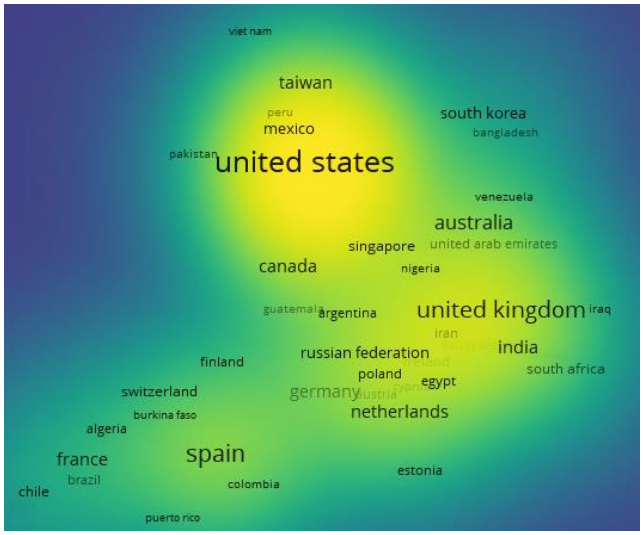

Fig. 7. Density visualization, Countries.

Since we had not used the language exclusion criterion, we can now see that English is used in 92% of the articles (Fig. 5. Language articles.). The other languages are Spanish with 5%, French, Italian and Chinese with 1% each and German, Hungarian, Japanese, Korean, Portuguese and Russian with less than 1% each.

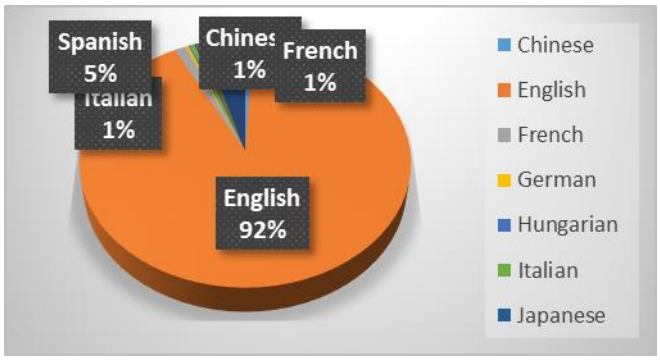

Fig. 8. Language articles.

In the following table (Table IV. Most cited papers.) we list ten most cited papers.

TABLE IV: MOST CITED PAPERS

Author	Year	Title	Journal	Times
Liyanagunawardena, T.R., Adams, A.A., Williams, S.A.	2013	MOOCs: A systematic study of the published literature 2008-2012	International Review of Research in Open and Distance Learning	468
Jordan, K.	2014	Initial trends in enrolment and completion of massive open online courses	International Review of Research in Open and Distance Learning	344
Kop, R.	2011	The challenges to connectivist learning on open online networks: Learning experiences during a massive open online course	International Review of Research in Open and Distance Learning	268
Hew, K.F., Cheung, W.S.	2014	Students' and instructors' use of massive open online courses (MOOCs): Motivations and challenges	Educational Research Review	266
Margaryan, A., Bianco, M., Littlejohn, A.	2015	Instructional quality of Massive Open Online Courses (MOOCs)	Computers and Education	264
Kop, R., Fournier, H., Mak, J.S.F.	2011	A pedagogy of abundance or a pedagogy to support human beings? Participant support on massive open online courses	International Review of Research in Open and Distance Learning	211
Martin, F.G.	2012	Education will massive open online courses change how we teach	Communications of the ACM	184
Fini, A.	2009	The technological dimension of a massive open online course: The case of the CCK08 course tools	International Review of Research in Open and Distance Learning	182
Alraimi, K.M., Zo, H., Ciganek, A.P.	2015	Understanding the MOOCs continuance: The role of openness and reputation	Computers and Education	160
Fox, A.	2013	From MOOCs to SPOCs	Communications of the ACM	148

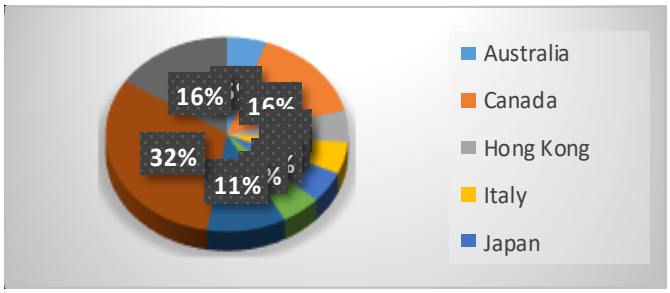

Fig. 9. Affiliation countries, most cited articles.

There is an author who has two articles in the list of the ten most cited articles: Rita Kop from Yorkville University, Fredericton, Canada. One of these articles the author writes alone, in the other article she co-writes with Hélène Fournier (National Research Council Canada, Ottawa ON,, Canada) and with John Sui Fai Mak (Australia).

The authors of the ten most cited articles work in nine different countries, with the United Kingdom, United States and Canada being the most frequent countries (Fig. 9. Affiliation countries, most cited articles.).

TABLE V: AUTHOR AFFILIATION, MORE CITED ARTICLES

	Author	Affiliation
1	Liyanagunawardena, Tharindu Rekha	University of Reading, Reading, United Kingdom
	Adams, Andrew Alexandar	Meiji University, Tokyo, Japan
	Williams, Shirley Ann Nn	University of Reading, Reading, United Kingdom
2	Jordan, Katy L.	Open University, Milton Keynes, United Kingdom
3	Kop, Rita	Yorkville University, Fredericton, Canada
4	Hew, Khe Foon Timothy	The University of Hong Kong, Pokfulam, Hong Kong
	Cheung, Wingsum	National Institute of Education, Singapore City, Singapore
5	Margaryan, Anoush	University of West London, London, United Kingdom
	Bianco, Manuela	Glasgow Caledonian University, Glasgow, United Kingdom
	Littlejohn, Allison	Open University, Milton Keynes, United Kingdom
6	Kop, Rita	Yorkville University, Fredericton, Canada
	Fournier, Hélène	National Research Council Canada, Ottawa ON,, Canada
	Mak, John Sui Fai	Australia
7	Martin, Fred G.	University of Massachusetts Lowell, Lowell, United States
8	Fini, Antonio	Università degli Studi di Firenze, Florence, Italy
9	Alraimi, Khaled M.	Korea Advanced Institute of Science & Technology, Yusong, South Korea
	Zo, Hangjung	Korea Advanced Institute of Science & Technology, Yusong, South Korea
	Ciganek, Andrew Paul	University of Wisconsin-Whitewater, Whitewater, United States
10	Fox, Armando	University of California, Berkeley, Berkeley, United States

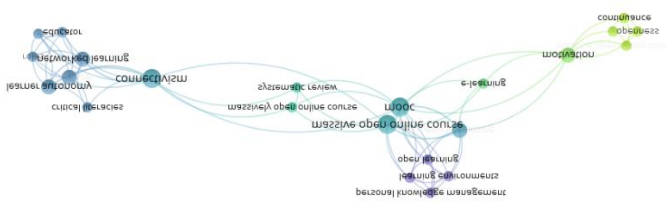

Fig. 10. Keywords, network visualization more cited documents.

Regarding the keywords of the most cited articles, we found five clusters (Fig. 10. Keywords, network visualization more cited documents.).

- C1: Connectivism, critical literacies, educator, learning autonomy, media affordances, networked learning, presence and roles.
- C2: e-learning, learning environments, massive open online course, mooc, online learning, open learning, personal knowledge management and usability.
- C3: continuance, motivation, massive open online course, openness and reputation.
- C4: distance learning, higher education, lifelong learning,

massive open online course and pedagogical issues.

V. Discussion and Conclusions

The purpose of this paper is to analyse the scientific production in Massive Open Online Courses (MOOC) in journals indexed in Clarivate Analytics' Web of Science and Elsevier's Scopus. The sample was composed by 1908 articles and reviews in total. Let us now answer the research questions:

- What has been the evolution of the publication of articles in quality journals related to Massive Open Online Courses (MOOCs)?

The results obtained by bibliometric analysis showed that publication rates continues to increase: The growth of publications has increased every year: 86 until 2013 (5%), 724 in 2014-2016 (38%) and 1098 in 2017-2019 (58%).

- What are the characteristics of journals where there is a greater number of publications related to the subject?

The 1908 articles were published in 786 international journals. International Review of Research in Open and Distance Learning, a first quartile journal, published 90 articles. The most common WoS subject are Social Sciences and Computer Science. The most common WoS categories are Social Sciences (Education) and Social Sciences (E-learning).

- What is the approach to Massive Open Online Courses (MOOC)?

The 20 most common keyword are MOOC, MOOCs, Massive Open Online Courses, Online learning, Higher education are the most common keyword all over the years.

- Who publishes on the subject? Where do researchers who are interested in Massive Open Online Courses (MOOCs) work? What country do they work? What are the languages in which most of these articles are published?

There are nine authors with seven or more articles: Watson, W. R. (10), Kloos, C. D. (8), Pritchard, D. E. (7), respectively from Purdue University · Department of Curriculum and Instruction, United States, University Carlos III de Madrid · Department of Telematic Engineering, Spain and Massachusetts Institute of Technology, United States. There are authors from 87 countries. The country with the largest number of articles is United States (21%). There are contributions from 586 organizations: ten of these organizations have more than ten articles: the first three from United States, Indiana University, Massachusetts Institute of Technology and Harvard University. English is used in 92% of the articles.

- What are the most cited articles? Liyanagunawardena, T.R., Adams, A.A., Williams, S.A.; 2013; MOOCs: A systematic study of the published literature 2008-2012; International Review of Research in Open and Distance Learning was cited 468 times
- What is the purpose of the most cited articles? What is the perspective with which the articles approach the theme? Connectivism, critical literacies, educator, learning autonomy, media affordances, networked learning, presence and roles are keywords from the strongest cluster.
- Who writes the most cited articles? and where do they work? The authors of the ten most cited articles work in nine different countries, with the United Kingdom, United States and Canada being the most frequent countries. The most cited article is written by 3 authors: Liyanagunawardena, Tharindu Rekha from University of Reading, Reading, United Kingdom, Adams, Andrew Alexandar from Meiji University, Tokyo, Japan and Williams, Shirley Ann Nn from University of Reading, Reading, United Kingdom.

Bibliometric results indicate that Massive Open Online Courses is still a topic with a tendency to increase in number and quality of scientific production.

Conflict of Interest

This study was carried out without a conflict of interest.

Author Contributions

The author did a literature review, defined the methodology, research and data treatment, data analysis and conclusions, having written the entire document.

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