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## **Analysis and implications of the Impact of MOOC Movement in the Scientific Community: JCR and Scopus (2010-13)**

**Análisis e implicaciones del impacto del movimiento MOOC en la comunidad científica: JCR y Scopus (2010-13)**

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### **Abstract**

The emergence of massive open online course (MOOC) has been a turning point for the academic world and, especially, in the design and provision of training courses in Higher Education. Now that the first moments of the information explosion have passed, a rigorous analysis of the effect of the movement in high-impact scientific world is needed in order to assess the state of the art and future lines of research. This study analyzes the impact of the MOOC movement in the form of scientific article during the birth and explosion period (2010-2013) in two of the most relevant databases: Journal Citation Reports (WoS) and Scopus (Scimago). We present, through a descriptive and quantitative methodology, the most significant bibliometric data according to citation index and database impact. Furthermore, with the use of a methodology based on social network analysis (SNA), an analysis of the article's keyword co-occurrence is presented through graphs to determine the fields of study and research. The results show that both the number of articles published and the citations received in both databases present a medium-low significant impact, and the conceptual network of relationships in the abstracts and keywords does not reflect the current analysis developed in general educational media.

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## Resumen

La irrupción de los cursos MOOC (Massive Online Open Courses) ha supuesto un punto de inflexión en el mundo académico y, especialmente, en el diseño y oferta de cursos formativos en la Educación Superior. Una vez superado el primer momento de explosión informativa, se precisan análisis rigurosos sobre la repercusión del movimiento en el mundo científico con más alto impacto para valorar el estado de la cuestión y las líneas de investigación futuras. El presente estudio analiza el impacto del movimiento MOOC en forma de artículo científico durante el período de nacimiento y explosión (2010-2013) en dos de las bases de datos de revistas científicas más relevantes, Journal Citation Reports (WoS) y Scopus (Scimago). A través de una metodología descriptiva y cuantitativa se presentan los datos bibliométricos más significativos por su índice de cita y repercusión. Asimismo, mediante la metodología de Análisis de Redes Sociales (ARS) se realiza un análisis de co-ocurrencia con representación en grafo de las palabras clave de los artículos para la determinación de los campos de estudio e investigación. Los resultados muestran que tanto el número de artículos publicados en ambas bases de datos como las citas que reciben presentan un índice medio-bajo de impacto y la red temática de interrelaciones en los resúmenes y palabras clave de los artículos publicados no reflejan la crítica actual de los medios divulgativos generales.

## Keywords / Palabras clave

MOOC, science popularisation, indexations, bibliometrics, scientific journals, network analysis, Higher Education.

MOOC, divulgación científica, indexaciones, bibliometría, revistas científicas, análisis de redes, Educación Superior.

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## 1. Introduction

Massive open online courses (MOOC ) have been considered as a revolution in the divulgative and scientific literature, with a great incidence on educational and formative context (Martin, 2012; Cooper & Sahami, 2013; Aguaded, Vázquez-Cano & Sevillano, 2013; Vázquez-Cano, López-Meneses & Sarasola, 2013; Yuan & Powell, 2013; Downes, 2013). The latest Horizon Report (Johnson et al., 2013) provides a prospective study of the use of educational technologies and future trends in various countries and especially highlights the impact of MOOC in today's educational context. Moreover, the Ibero-American Edition oriented to higher education believes that the «massive open courses» will be implemented in institutions of Higher Education within the next four to five years (Durrall & al., 2012).

MOOC have attracted a worldwide interest because of their potential to offer free training accessible to anyone regardless of their country of origin, a previous training without the need to pay for tuition (Vázquez-Cano & al., 2013). Since early 2010, the emergence of these courses has begun to be viewed from a more academic perspective when different prestigious universities began their mass activities; among others: Stanford, Harvard, MIT, and the University of Toronto. There is consensus in the scientific community about the importance and popularity of the movement, mainly by its international scope and the opportunity to offer a diversified Higher Education through prestigious institutions, which even recently was only possible for a small group of people. At the same time, there are discrepancies and doubts about the pedagogical value and future of the MOOC movement in Higher education. The scientific community focus on its impact on the educational and social context from different positions; some of them consider

it a destructive development (Touve, 2012), while others see it as a deeply renewing and creative movement (Downes, 2013).

The last two years have seen a peak of over sizing with a high impact and widespread dissemination on media and networks. A Google search on the term MOOC produces more than three million results, whereas a search for more established terms from the scientific literature such as «e-learning» or «mobile learning», generates less than half the results. This gives us an idea of what might be called a «disruptive» event.

In this paper, we analyze the MOOC' scientific impact in two of the most prestigious scientific databases WOS (Journal Citation Reports) and Scimago (Scopus) to focus on the main implications for future research and the most significant global bibliometric data, with special emphasis on articles, authors, institutions, and the more representative semantic fields according to citations and database impact. Thus, we can also determine the impact on the scientific world and if the results in this area may also be considered «disruptive».

## **2. The scientific impact of MOOC movement**

Arguably, David Wiley (professor at the State University of Utah, United States), with his open education course offered in 2007, created the first MOOC in history. Subsequently, in 2008, George Siemens and Stephen Downes designed the course that is considered the genesis of the MOOC movement «Connectivism and Connective Knowledge (CCK08)». This event, along with the landmark in the autumn of 2011, when 160,000 people were enrolled in a course on artificial intelligence offered by Sebastian Thrun and Peter Norvig at Stanford University through a startup company called «Know Labs» (now Udacity), converted to an MOOC movement, meant a turning point for the academic and scientific community.

From these events, many teachers, institutions, and universities have started to develop plenty of open courses, multiplying exponentially their impact on the learning processes of Higher Education. The academic and scientific world have analyzed the benefits of this training model in numerous publications, mainly in divulgative journals, scattered in blogs, wikis, journals, social networks, and so on. A sign of this is the prolific activity of researchers such as Stephen Downes with a continuous process of open publication ([www.downes.ca](http://www.downes.ca)), Sir John Daniel with his thoughts and research on quality assessment (Daniel, 2012) and George Siemens with his approaches to the movement from the connectivism principles (Siemens, 2013), among many others. The publishing phenomenon in this movement has followed a similar pattern to other «disruptive innovations». For example, the Twitter microblogging phenomenon that first appeared in 2006, only produced three articles until 2007, but in 2011, there were hundreds (Williams, Terras & Warwick, 2013). The MOOC phenomenon presents an opportunity for emerging research in the coming years in three priority research areas: technology architecture (models and tools in the service of masses), pedagogical model's reviews and the principles on which it is based (monetization, assessment, accreditation, etc.), implications for rethinking course offerings, and the educational model of Higher Education.

Today, publishers are beginning to seriously invest in MOOC and offer publications for the development of courses. The Elsevier publishing group has entered

the edX group, and Coursera is negotiating with several publishing groups. This commercial interest may have a negative impact on teaching and monetization aspects that could be seen in the near future (Howard, 2012). On the other hand, research on the development of courses and their principles is limited, due to restrictions for researchers to access to interview students from different platforms or develop surveys on teaching functionality or technological development of the different courses. This is generating many studies by teachers who have designed their own MOOC course or by platforms that assess the impact of their own courses with the corresponding bias in investigations in both cases.

Now that the peak of «excitement» has passed, it is time to analyze the current state regarding the impact of the movement in the scientific community taken as reference two of the most representative data bases in academia and the scientific world: Journal Citation Report and Scopus to verify impact among researchers and the lines of research undertaken. Thus, this analysis could serve as a reference for future researchers to highlight both the benefits and challenges that MOOC movement has to face for its improvement and consolidation in the educational context (Aguaded, Vázquez-Cano & Sevillano, 2013; Touve, 2012).

To date, there are no studies presenting a rigorous analysis on the MOOC movement from the conceptual and bibliometric perspectives. Regarding the analysis of the impact of publications from a bibliometric perspective, there have been some studies examining the impact from a comparative approach with other concepts (Martínez-Abad, Rodríguez-Conde & García-Peñalvo, 2014) or the impact of movement in different databases (Liyanagunawardena, Adams & Williams, 2013). No research has been developed to analyze and assess the implications of the MOOC movement in two of the most prestigious databases with greater global impact in accordance with criteria and variables that allow us to analyze the state of the art, the areas with higher impact, and the main implications for the MOOC movement. For this reason, it seems appropriate to conduct a study that analyzes the different variables, both bibliometric and semantic, that allow researchers and others interested in MOOC to have an updated overview of the scientific impact of the movement from different variables and perspectives of study to detect the difficulties and weaknesses, including new challenges.

### **3. Method**

#### **3.1. Objectives**

The research aims were twofold:

- To quantify from a bibliometric approach the MOOC scientific production in the form of articles in JCR and Scopus databases during the period 2010-2013, according to the following variables: total number of published papers; number of received citations; major citable journals; average citations per year; name, country, and institutional affiliation of the most cited authors; and articles' methodological approach.
- Analyze the key words used in articles to establish the thematic and conceptual implications to better understand the MOOC movement.



### **3.2. Research design and analysis**

This investigation stems from the principles embodied in bibliometric studies in the field of education (Fernández & Bueno, 1998), with the use of descriptive, quantitative, and correlational techniques with the application to the study of semantic keywords with the technique of social network analysis (Knoke & Yang, 2008) via networks generated in UCINET and visual representation with VOSviewer. The use of databases from a comparative perspective is a research method used in measuring the impact of a term or trend and is usually referenced to three international databases: JCR, Scopus, and Google Scholar (Jacso, 2005; Levine-Clark & Gil, 2009). Recently, the results of Google Scholar have been seriously questioned (Delgado, Robinson & Torres, 2014), and the recovered entries frequently found to incorporate unreliable references. For this reason, this research has been limited to the two databases with greater impact and international recognition, JCR and Scopus (Delgado & Repiso, 2013).

### **4. Data analysis**

For the analysis, we used a technique based on the bibliographic data quantification of articles; with this approach, we obtained several indicators that have been used in other studies in relation to the following: authors, countries, institutions, and subject areas (Davis & Gonzalez, 2003; Chiu & Ho, 2005). Subsequently, we turned to the analysis of keywords frequency (Bhattacharya & al., 2003; Ding, Chowdhury & Foo, 2001) with special attention to the analysis of co-occurrence within the specific research domain of MOOC. With the same conceptual goal, different areas of study have demonstrated successful implementations (Cahlik, 2000; Neff & Corley, 2009; Viedma & al., 2011).

Initially, the search equation «mooc» or «MOOC » or «massive open online course» was used in both JCR and Scopus databases. With the initial information from both databases, a total of 63 publications in JCR and 180 in Scopus were retrieved, and they were finally reduced to 48 and 111, respectively, by removing books, books chapters, repeated records, irrelevant publications, conference proceedings, and documents that did not fit the purpose of the study or were out of the 2010-2013 interval. We used the automated mechanisms for analysis included in both databases, with representation in figures and tables. Data extraction was performed by direct consultation of the databases according to the following variables: total number of articles and quartile position, MOOC article citations in journals, year/month of publication and average citations per year, authors, authors' institutional affiliation, productivity by country, article's methodological approach (theoretical, quantitative, qualitative, and mixed), and keywords in Scopus and JCR (networks using UCINET and word clouds by generating .txt file (WoS) and csv (Scopus) and key words visual representation in VOSviewer program).

### **5. Results**

We opted to present the quantitative data of both databases to respond to the first objective of this research. In a second phase, we present graphs of keywords in both databases and their analysis to define the major implications in the study of MOOC movement according to key topics developed until today. Table 1 shows

the number of articles published in the 2010-2013 interval in both databases. The articles in Scopus are double in quantity those published in JCR; but the number of articles in relation to other concepts such as «e-learning» in the same period (1243 items) is significantly lower (Martínez-Abad, Rodríguez-Conde & García-Peñalvo, 2014).

**Table 1. Number of articles in JCR and Scopus**

| Publication year      | Number of articles |        |
|-----------------------|--------------------|--------|
|                       | JCR                | Scopus |
| 2010                  | 1                  | 0      |
| 2011                  | 4                  | 4      |
| 2012                  | 3                  | 13     |
| 2013                  | 40                 | 94     |
| <b>Total</b>          | 48                 | 111    |
| <b>Total articles</b> | 159                |        |

The 159 articles were distributed heterogeneously among the different quartiles of databases. Most published articles in both databases are concentrated in 2013 (134%-84.27%) as shown in table 2 (<http://goo.gl/yjS2XK>). The increase in the number of citation of articles in both databases since 2010 is significant, but it continues to have a low incidence, as is shown in table 3 (<http://goo.gl/uny7Eo>); no article reached 5 citations in JCR and Scopus. Table 4 (<http://goo.gl/6cFFJt>) shows the evolution of citations distributed by month. It shows a significant increase in the number of articles published since the second half of 2013 as the MOOC movement generated more interest and data. The year 2013 concentrates almost all citations in the interval studied (84.27%). Table 5 (<http://goo.gl/-YSgkzD>) shows that the average number of citations in the past three years increased substantially. In 2013, the average citation was 3.33 in JCR and 7.83 in Scopus, which multiplies 3- and 6-fold, respectively, the citation rates from 2010 to 2012. Despite this increase, it still represents a low rate with respect to the dissemination of informative articles on the MOOC network literature (Google Scholar shows 2125 MOOC citations in the same period).

Table 6 presents the impact of the most cited authors in the two databases, and as can be seen, it is low. For example, Professor Rita Kop (Yorkville University, Canada) with her article «The Challenges to Connectivist Learning on Open Online Networks: Learning Experiences During a Massive Open Online Course» only receives two citations in each of the two databases, whereas in Google Scholar, this article receives 98 citations. This implies a low effect on high-impact databases.

**Table 6. Most cited authors**

| Most cited authors  | JCR | Scopus |
|---------------------|-----|--------|
| Skiba D.J.          | 0   | 3      |
| DeSilets, Lynore D. | 2   | 2      |
| Kop, Rita           | 2   | 2      |
| Abajian, Sean       | 1   | 2      |

|                         |   |   |
|-------------------------|---|---|
| Barbera, Elena          | 1 | 2 |
| Clara, Marc             | 1 | 2 |
| deWaard, Inge           | 1 | 2 |
| Forsey, Martin          | 1 | 2 |
| Gallagher, Michael Sean | 1 | 2 |
| Glance, David           | 1 | 2 |
| Hogue, Rebecca          | 1 | 2 |
| Keskin, Nilgun          | 1 | 2 |
| Koutropoulos, Apostolos | 1 | 2 |
| Mackness, Jenny         | 1 | 2 |
| Rodriguez, Osvaldo C.   | 1 | 2 |

Table 7 (<http://goo.gl/4Tm3vs>) shows the most active countries during this early period of the movement. It is remarkable that the United States accounts for half of all citations received in both databases. The second country is the United Kingdom but quite a distance behind; Australia, Canada, and Spain occupy the following positions. Other countries are far ahead of those mentioned with an almost symbolic authors' representation in JCR, which does not exceed 2%. In table 8 (<http://goo.gl/y1GHhS>), we can see that American universities are the most representative in the MOOC movement, followed by European, Canadian, and Oceania universities. The role of Spanish universities representing 50% of the European scientific production in JCR and 81.83% of production in Scopus is remarkable.

The methodological approach of the articles is a relevant aspect providing an overview of how the research and reflection on MOOC movement is being addressed at this early stage and expansion. The results show that, even today, the main body of research has focused on the theoretical reflection and essays, with a percentage of 80% in both databases. Table 9 (<http://goo.gl/CTRWFh>) shows the classification of articles according to their methodological approach. Thus, we can see that the ten articles with more citations in both databases have an eminently theoretical approach.

The theoretical approach of the articles with the highest citation index in both databases shows that MOOC research is still at an early stage, and the efforts made to date focus more on the informatics field than on the scientific and academic context (table 10). Some of the biggest names in MOOC research, such as George Siemens, Stephen Downes, and Sir John Daniel who have more than 200,000 search results on Google about MOOC, have not yet published high-impact articles in these two databases.

| <b>Table 10. Most cited articles in MOOC movement</b>   |               |  |             |                      |                         |
|---|---------------|--|-------------|----------------------|-------------------------|
| <b>Article's title</b>  | <b>Author</b> | <b>Journal</b>   | <b>Year</b> | <b>Citations JCR</b> | <b>Citations Scopus</b> |
| The Challenges to Connectivist Learning on Open Online Networks: Learning Experiences during a Massive Open Online Course | Kop, R.       | International Review of Research in Open and Distance Learning | 2011        | 7                    | 20                      |
| Connectivism: Its Place in Theory-Informed Research and Innovation in Technol-  | Bell, F.      | International Review of Research in Open and Distance Learn-   | 2011        | 6                    | 12                      |

|   |   |  |      |             |             |
|---|---|--|------|-------------|-------------|
| ogy-Enabled Learning  |   | ing  |      |             |             |
| A Pedagogy of Abundance or a Pedagogy to Support Human Beings? Participant Support on Massive Open Online Courses | Kop, R.; Fournier, H.; Mak, J.F.  | International Review of Research in Open and Distance Learning | 2011 | 6           | 15          |
| A Revolutionary Journey Into Learning/Education   | DeSilets, L.D.  | Journal of Continuing Education in Nursing                     | 2013 | 3           | 4           |
| Connectivism and Dimensions of Individual Experience  | Tschofen, C.; Mackness, J.  | International Review of Research in Open and Distance Learning | 2012 | 2           |             |
| Using mLearning and MOOC to Understand Chaos, Emergence, and Complexity in Education                              | deWaard, I.; Abajian, S.; Gallagher, Sean, M.; Hogue, R.; Keskin, N.; Koutropoulos, A.; Rodriguez, O.C. | International Review of Research in Open and Distance Learning | 2011 | 2           | 4           |
| Navigating the changing learning landscape: perspective from bioinformatics.ca                                    | Brazas, M.D.; Ouellette, B.F. Francis   | Briefings in Bioinformatics                                    | 2013 | 1           | No Indexado |
| Are MOOC the future of medical education?   | Harder, Ben   | British Medical Journal  | 2013 | 1           | No Indexado |
| MOOC: An Opportunity for Innovation and Research  | Pritchard, S.M.   | Portal-Libraries and the Academy                               | 2013 | 1           | No Indexado |
| Reflections on Stanford's MOOC  | Cooper, S.; Sahami, M.  | Communications of the ACM                                      | 2013 | 1           | No Indexado |
| Education: will massive open online courses change how we teach?  | Martin F.G.   | International Review of Research in Open and Distance Learning | 2012 | No Indexado | 16          |
| Will MOOC destroy academia?   | Vardi M.Y.  | Communications of the ACM                                      | 2012 | No Indexado | 4           |
| Disruption in Higher Education: Massively open online courses (MOOC)  | Skiba, D.J.   | Nursing Education Perspectives                                 | 2012 | No Indexado | 4           |

The ten journals with the highest citation are published mostly in North American institutions (80%); Canada is represented by the journal «International Review of Research in Open and Distance Learning», one of the most productive in the MOOC movement, Australia by «Distance Education» and the only European journal is the Spanish one, «Comunicar», as you can see in figure 1 (<http://goo.gl/KvMqGE>).

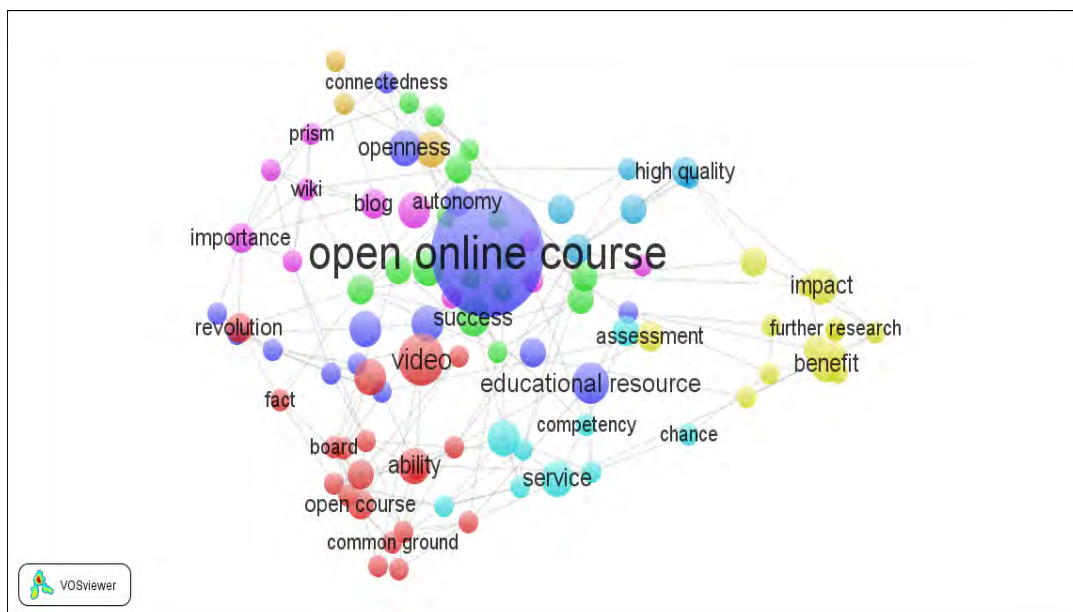
Once the descriptive and quantitative analysis of the impact of MOOC movement in both databases was implemented, we conducted an analysis of the relations established between keywords through a graph representation. We then chose the words «Abstract» and «Keywords» as the basis for obtaining the word network



once the article has been uploaded to the archive, and for the development of binary count, we considered a minimum of two items:

- Of a total of 530 terms extracted from Web of Science, the program determined that only 67 terms meet this criterion.
- Of a total of 1,715 terms extracted from Scopus, the program determined that only 323 terms meet this criterion.

After fixing these criteria, the map of keywords was generated. The matrix was previously built in the UCINET program to calculate the nodal degrees of intermediation and closeness of the five most representative concepts and descriptive keywords in both databases; results are displayed in table 11 (<http://goo.gl/4oKw54>). If we take into account all the criteria together, that is, nodal degree, rank, closeness, and betweenness, we find that the most relevant values are concepts related to materials or instruments used: video and educational resources as well as educational learning experience, environment, design, and evaluation. The networks presented in Figures 2 and 3 are the graphical representation of the matrix of relations among keywords in JCR and Scopus, respectively.



**Figure 2. Graphical representation of keywords in JCR.**

In JCR, Figure 2 shows the central position of concepts in the network (Spencer, 2003) and shows a high score of 67% with a total number of 23 nodes. The maximum degree (maximum number of relations of a node in the network) is 3,199 (video), indicating that each keyword is intertwined with an average of 3. The graph density is 0.07, a low value, well away from the value of 1 (high density). The results show that the aspects with a high standardized range (Nrmdegree: percentage of connections of a node on the total network) and a higher node degree focus on the following items: «educational resource», «openness», «assessment» and «impact».



cult to conduct a deep analysis from a scientific approach. Until now, universities and countries that are having greater scientific impact are the United States, Australia, Canada, the UK, and Spain. Also, the journals with the highest citation index are concentrated in the United States (80%) and, to a lesser extent, in Canada, Australia, and Spain.

Analysis by networks of abstract and keywords shows that MOOC's relations are being linked thematically with the educational experience of learning, environment, design, and evaluation. These relations are not in direct line with the current main criticism that focuses on the pedagogical principles of connectivism, monetization, accreditation, and technological architecture of platforms and resources embedded in them (Hill, 2012; Daniel 2012, Vázquez-Cano, López-Meneses & Sarasola, 2013).

Finally, some of the biggest names in MOOC research, such as George Siemens, Stephen Downes, and Sir John Daniel, have not published in both databases and develop their reflections in lower impact journals and in their own Web pages, blogs, specific newspapers, social networks, and so on. These non-academic publications serve as a vehicle for reflection and analysis to the academic and scientific community, which should make scientific journals think about their role in the identification of emerging research fields and more call for papers on this topic to foster a deeper and scientific reflection.

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