

A Study on Massive Open Online Courses in Higher Education

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Abstract

In this paper the current usage of active Massive Open Line Courses (MOCC) is analysed. First a systematic literature revision is performed, in order to identify and classify the published works and the existing developments in this area, being the most used MOOCs platforms also found out. Afterwards, a content analysis of the two most popular MOOCs' platforms – Coursera and EdX – and a comparison between them is performed. This analysis takes into account, among others, the number and areas of knowledge of the accessible courses, the Higher Education Institutions (HEI) that offer courses using the platforms, the length of the courses and the expected workload for a student to successfully complete the MOOCs. The main findings were that the use of MOOCs has been growing in the last years and that Coursera and EdX are the two main platforms used by HEIs in order to make MOCCs available.

Keywords: MOOCs, Higher Education, Coursera, EdX

1. INTRODUCTION

Higher Education Institutions (HEIs) are becoming more receptive to integrate in their teaching and learning processes, new technologies, being the Massive Open Online Courses (MOOCs) platforms, one of the most recent.

MOOC is a concept associated to e-learning [Fini 2009] that offers world-class education to an unlimited number of participants (massive) around the globe with Internet access (online) for low or no fees [Aboshady et al. 2015] and [Glance et al. 2013]. MOOCs make use of some traditional courses' materials such as videos, short videos combined with formative quizzes, texts and problem sets, using tools for interaction, in order to build a community for students and lecturers [Ahlberg 2014]. In these courses, it is also possible to implement formative quizzes, automated assessment, peer and self-assessment and online forums for support and discussion [Glance et al. 2013]. Therefore, they can offer educational benefits to HEIs, professors, and students [Aboshady

et al. 2015], providing opportunities for thousands of learners to participate in free online courses [Ahlberg 2014] and [Yousef et al. 2015].

Hew and Cheung [2014, p.51] refer three main differences between MOOCs and traditional classroom' courses: "the large and diverse student enrolment in MOOCs, the high dropout rate of MOOCs compared to that of traditional courses, and the relatively lack of instructor presence or support in MOOCs compared to traditional courses". Concerning the comparison between MOOCs and the traditional e-learning courses, it is recognized that MOOCs involve more self-directed learning than the other e-learning courses, and that the central role of the mediator is more recognised in the traditional e-learning courses than in MOOCs [Nyoni 2013].

The MOOCs' underlying technology is recent, the first MOOC having been launched in 2008 [Ahlberg 2014] and [Fini 2009]. In 2011 there was a 'wave of offers' of MOOCs platforms [Tschofen and Mackness 2012], and, at the present, HEIs are offering a growing variety of MOOCs [Yousef et al. 2015], using different platforms, being Coursera and EdX the most widely used ones [Kim 2015].

This paper aims to analyse the current usage of MOOCs platforms and courses by HEIs as well as its future trends. This analysis was performed in two phases: the first one consisted in literature review, identifying and classifying the published works and the existing developments in this area, and the second one was based on the content analysis about MOOCs offered by some of the most recognized HEIs around the world.

The paper is organized in four sections. The MOOC concept was outlined in this introductory section. The methodology used in this study is described in the second section and in the third section the results and their discussion are addressed. Finally, in the fourth section, some conclusions and future trends are presented.

2. METHODOLOGY

The methodology followed in this study was a systematic literature review complemented with content analysis about MOOCs' platforms available from some selected HEI.

Since a systematic study of the published literature between 2008 and 2012 has already been published by Liyanagunawardena et al. [2013], this paper aims to complement this analysis, extend it to the years of 2013 to 2015 and, when possible, compare the results of the two studies in order to identify the trends on MOOCs' usage.

In order to gather data about the systematic review of published MOOC literature, firstly, there were selected the more common scientific databases in the areas of Information and Communication

Technologies (ICT) and Education, which were (i) ISI Web of Knowledge; (ii) Scopus and (iii) IEEE Xplorer.

The selected search terms were: (i) MOOC; (ii) massive open online course; (iii) higher education; (iv) university and (v) universities.

The time period considered was from 2008 until 2015, since the first MOOC appeared in 2008 [Ahlberg 2014] and [Fini 2009].

From the study just mentioned, resulted 156 relevant articles (article or review document types), that were analysed in order to identify the more referred MOOCs platforms. Finally, the two most referred MOOCs platforms were subjected to content analysis based on the information of the sites of some of the most recognized HEIs around the world, which also allowed the comparison of those platforms.

In the next section, the results of this study are presented.

3. RESULTS AND DISCUSSION

In this section the results of the systematic literature revision are presented (section 3.1), followed by brief characterization of the articles considered relevant (section 3.2). The main objective of section 3.3 is to identify the more referred MOOCs' platforms in the identified articles. Finally, and taking into account the results of the study made in 3.3, in section 3.4 a detailed content analysis of the two most popular MOOCs' platforms and a comparison between them are performed.

3.1. Results from the systematic search

An overview of the documents identified based on the criteria referred in the Methodology section, is presented in Table 1. The first column identifies the database used in each search; the 2nd column presents the resulting number of documents (article, book, conference paper, editorial, news, patent, review) and, in the 3rd column, the resulting number of articles (article or review document types).

Database	Number of documents	Number of articles	Date
ISI Web of Knowledge	136	74	24/03/2015
Scopus	281	137	24/03/2015
IEEE Xplorer	102	4	19/05/2015

Table 1 – Search documents in academic databases

Note that the articles are part of the documents and so their number is included in the number of documents. The last column of the table refers to the date of the search performed.

Comparing the results presented in Table 1 with those from the work of Liyanagunawardena *et al.* [2013], where they referred that by the end of 2012 there were 5 documents in ISI Web of Knowledge, 39 in Scopus, and one in IEEE Xplorer, it can be noticed that in the last 2 years and 3 months the number of documents published in this area in the most relevant scientific databases increased considerably.

Taking into account only the type of documents “articles” (which includes articles and reviews), it should be taken into account that some of them are present in more than one database, as can be seen in Figure 1.

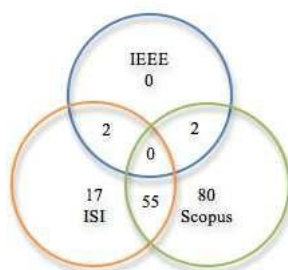


Figure 1 – Number of articles in academic databases

The data collection resulted thus in 156 articles, 17 only from ISI Web of Knowledge, 80 only from Scopus, 55 from ISI Web of Knowledge and Scopus, 2 from ISI Web of Knowledge and IEEE Xplorer, and 2 from Scopus and IEEE Xplorer.

3.2. Characterisation of the selected articles

The articles identified in the previous section were afterwards analysed according to the year of publication, the journals where they were published and the respective authors.

Figure 2 presents the number of articles published on MOOCs in the databases analysed, per year from January 2012 until March 2015, and it can be seen that this number have been increasing consistently through this period of time.

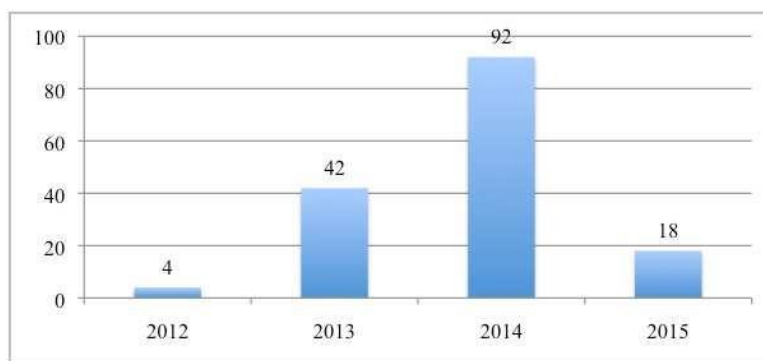


Figure 2 – Number of articles by publication year

The numbers reported in the study by Liyanagunawardena et al. [2013] on MOOCs' articles in journals, indicated one in 2008, one in 2009, two in 2010, four in 2011, and nine in 2012. These numbers reflect a fact already expected. As the first MOOC appeared in 2008, it was not possible to report on MOOCs before that. The apparent contradiction between the results from the two studies in the year 2012 (9 vs 4), is due to the fact that Liyanagunawardena et al. [2013] reported the results for more databases than the three used in the present work (including, for example, Google Scholar).

Concerning the number of journals publishing in this area, by March 2015 there were 92 scientific journals of the 3 selected databases that published articles about MOOCs. From those, 72 had published only one article. Among the other 20, it should be emphasized the *International Review of Research in Open and Distance Learning*, that published 16 articles on this theme.

Comparing these numbers with those of the work by Liyanagunawardena et al. [2013] (6 journals with more than one article on MOOCs in 2012 vs 20 in 2015 and 6 articles published by *International Review of Research in Open and Distance Learning* in 2012 vs 16 in 2015), it can be confirmed the growing interest in this area also by the scientific magazines.

An analysis of the number of articles by authors has also been made. Meneses and Vazquez- Cano has the highest number of publications (three), while the other authors have two or one articles. According to Lopez-Meneses et al. [2015], Forsey and Glance are the most cited authors. In this analysis, these two authors have two articles each.

3.3. Identification of MOOCs platforms

The selected 156 articles were analysed in order to identify which MOOCs' platforms were most mentioned in the scientific literature. In Table 2 the list of the platforms that are referred in more than four articles is presented, as well as the references of the articles themselves.

Refer	Cousera	EdX	Udacity	FutureLearn	OpenupEd	Udemy	Open2Study	MiriadaX	Canvas	Khan Academy	Iversity
[Aboshady et al. 2015], [Ahlberg 2014], [Atenas 2015], [Burch and	•	•	•	•							
[Amemado 2014], [Ayala et al. 2014], [Baggaley 2013, 2014], [Bonvillian and Singer 2013], [Bulfin et al. 2014], [Carr 2012], [Comeau and Cheng 2013], [Cusumano 2014], [DeBoer et al. 2014], [Egerstedt 2013], [Glance et al. 2013], [Guzdial and Adams 2014], [Jordan 2014], [Kellogg 2013], [King et al. 2014], [Knox 2014], [Liyanagunawardena et al. 2013], [Longstaff 2014], [Lopez-Meneses et al. 2015], [Martin 2012], [Perna et al.	•	•	•								
[Audsley et al. 2013]	•	•	•								
[Barnes 2013]	•	•	•	•	•		•				
[Canessa et al. 2013], [Fox, 2013], [Monedero-Moya et al. 2015], [Moodie 2014], [Najafi et al. 2014] and [Reilly et al. 2014]		•									
[Comer et al. 2014], [Fisher 2014], [Fowler and Smith 2013], [Jiang et al. 2014], [Murray 2014], [Kustritz 2014], [Sadhasivam 2014], [Sidorenko 2014], [Spada 2014], [Tucker et al. 2014] and [Costa-Jussà et al. 2014]	•										
[Cervone 2015], [Daniel et al. 2015], [Dillahunst et al. 2014], [Friedman and Friedman 2013], [Gillani and Eynon 2014], [Hollands 2014], [Laplante, 2013] [Mackness et al. 2013], [Marshall 2014], [Searls 2014] and [Subhi et al. 2014]	•	•							•		
[Daza et al. 2013]	•		•		•			•			
[Langen and Bosch 2013] and [Manouselis et al. 2013]	•		•								
[Estevez-Ayres et al. 2013]	•	•	•					•			
[Firmin et al. 2014]			•								
[Galán 2014]	•	•	•			•					
[Hew and Cheung 2014]	•	•	•			•			•		
[Hollands and Tirthali 2014]	•	•									
[Jobe and Hansson 2014]	•	•	•							•	
[Kern 2014]	•	•	•							•	
[Kim 2015]	•	•	•	•			•				•
[Leito et al. 2015]	•	•				•					
[Liyanagunawardena and Williams 2014]	•	•	•	•	•	•	•	•	•		•
[Macleod et al. 2014]	•	•		•							
[Martín-Monje et al. 2014]	•	•	•		•			•	•		
[Medina-Salguero and Aguaded 2014]	•	•	•					•			
[Mehta et al. 2013]	•	•	•							•	
[Nkuyubwatsi 2014]	•	•	•	•	•		•				•
[Nyoni 2013] and [Selwyn et al. 2015]	•	•	•	•							

[O'Connor 2014]	•	•	•	•	•		•				•
[Oyo and Kalema 2014]	•	•	•			•					
[Pantò and Comas-Quinn 2013]	•	•	•							•	
[Parkinson 2014]	•	•	•	•							
[Paton 2014]	•	•		•							
[Pujar and Bansode 2014]	•	•	•	•	•						
[Rhoads et al. 2013]		•	•								
[Ros et al. 2014]					•						
[Sanchez-Vera et al. 2015]	•			•	•						
[Vargas 2014]	•	•		•		•	•				
[Vázquez-Cano and Meneses 2014]	•	•	•					•			
[Vila et al. 2014]	•	•	•					•	•		
[Wu 2013]	•	•	•			•				•	
[☆ ♪ □ and Jun 2014]	•	•	•	•		•	•				•
Number of	89	82	63	14	9	8	7	7	5	5	5

Table 2 – Number of articles by MOOCs platforms

According to Table 2, the most referenced platforms are Coursera and EdX. A detailed content analysis of those MOOCs' platforms and a comparison between them are performed in the next section.

3.4. Characterisation and Comparison of Coursera and EdX platforms

The Coursera and EdX platforms were analysed considering the following criteria: (i) number and areas of knowledge of the courses accessible through each platform; (ii) number of HEIs that offer courses using the referred platforms; (iii) number of MOOCs made available by the HEIs that offer more than three courses; (iv) percentage of courses that present an introductory video, summarizing the objectives and main contents of the course, as well as the number of instructors involved; (v) descriptive statistics of the duration of the courses and (vi) descriptive statistics of the expected workload for a student to successfully complete the MOOCs.

Regarding the universities using Coursera, it was found that on 19/05/2015 there were 102 universities that offered 1036 courses [Coursera 2015]; while on 02/11/2012 there were 36 universities presenting 198 courses [Audsley et al. 2013]. Concerning EdX, on 19/05/2015, there were 39 universities that offered 516 courses [EdX 2015]; while on 02/11/2012 there were only three universities presented 9 courses [Audsley et al. 2013]. Taking into account the current figures, it can be seen that the relationship between the number of courses and number of universities offering the courses ($N_{\text{Courses}}/N_{\text{Universities}}$) is higher in the case of EdX (about 13) than in the case of Coursera (about 10).

On the date of this study (19/05/2015), it was found that more than 13 million students have signed up courses using Coursera [Coursera 2015]. The same information from EdX was not available, but it was possible to notice that 0.4 million students obtained certificates from EdX courses [EdX 2015]. Actually, the number of students that use MOOCs in these platforms has increased substantially, since on March 2013, 2.8 million people learned through Coursera, and about 1.3 million people used EdX [Kim 2015], and by November 2014, more than 10 million students have signed up for Coursera's courses [Coursera in Kim 2015], and more than 1.7 million students have signed up for EdX's courses [Kim 2015].

Concerning the knowledge areas of the MOOCs, in Coursera platform they are classified in 25 different categories while in EdX the correspondent number is 28.

Table 3 presents the knowledge areas considered in each of the platforms being studied, and the number and percentage of courses classified in each one. Note that some courses are classified in more than one area.

Areas of Knowledge - Coursera	N	%	Areas of Knowledge - EdX	N	%
			Architecture	7	0.6
Arts	53	2.3	Art & Culture	37	3.1
Biology & Life Sciences	137	6.0	Biology & Life Sciences	58	4.9
Business & Management	170	7.4	Business & Management	60	5.1
Chemistry	33	1.4	Chemistry	24	2.0
			Communication	24	2.0
Computer Science: Artificial Intelligence	45	2.0			
Computer Science: Software Engineering	77	3.3			
Computer Science: Systems & Security	41	1.8	Computer Science	96	8.1
Computer Science: Theory	66	2.9			
Economics & Finance	138	6.0	Economics & Finance	38	3.2
Education	127	5.5	Education	21	1.8
			Electronics	25	2.1
Energy & Earth Sciences	49	2.1	Energy & Earth Sciences	12	1.0
Engineering	91	4.0	Engineering	94	8.0
			Environmental Studies	32	2.7
Food and Nutrition	29	1.3	Food & Nutrition	11	0.9
Health & Society	155	6.7	Health & Safety	35	3.0
			History	57	4.8
Humanities	188	8.2	Humanities	99	8.4
Information, Tech & Design	143	6.2	Design	3	0.3
Law	44	1.9	Law	19	1.6
			Literature	41	3.5
Mathematics	83	3.6	Math	47	4.0
Medicine	121	5.3	Medicine	29	2.5
Music, Film, and Audio	51	2.2	Music	7	0.6
			Ethics	10	0.8
			Philosophy & Ethics	27	2.3
Physical & Earth Sciences	54	2.3			
Physics	51	2.2	Physics	55	4.7
			Science	86	7.3
Social Sciences	177	7.7	Social Sciences	81	6.9
Statistics and Data Analysis	85	3.7	Statistics & Data Analysis	46	3.9
Teacher Professional Development	92	4.0			
Total	2300	100	Total	1181	100

Table 3 – Areas of knowledge of courses and number of courses in Coursera [2015] and EdX [2015]

Many of the areas are common to both platforms. In Coursera, the areas where there are more courses are: Computer Science (229; 10.0%), Humanities (188; 8.2%), Social Sciences (177;

7.7%), Business & Management (170; 7.4%) and Health & Society (155; 6.7%). In EdX the corresponding areas are: Humanities (99; 8.4%), Computer Science (96; 8.1%), Engineering (94; 8.0%), Science (86; 7.3%) and Social Sciences (81; 6.9%).

On 22/05/2015, Coursera had 107 available courses from 54 HEIs, while EdX had, on 26/05/2015, 115 available courses from 39 HEIs. In Figure 3 it can be seen that 4 of those HEIs (Berklee College of Music, École Polytechnique Fédérale de Lausanne, Peking University, and Rice University) offered courses in both platforms simultaneously.

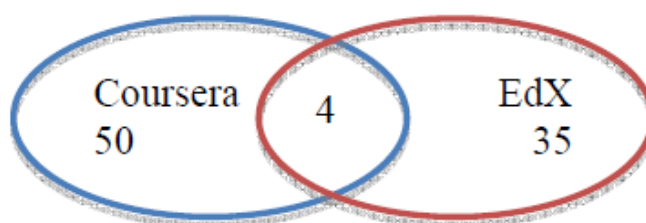


Figure 3 – Number of universities offering courses in MOOCs platforms

Although by May 2015 there were 102 HEIs that used Coursera, only 54 of them had available courses on that date, while concerning EDX, all the 39 HEIs had available courses. Table 4 presents the universities offering 4 or more available courses.

University	Number of courses		
	Coursera	EdX	Total
Berklee College of Music	4	2	6
Cornell	0	4	4
Harvard University	0	26	26
Johns Hopkins University	4	0	4
MIT	0	12	12
Peking University	9	6	15
Rice University	3	1	4
Stanford University	4	0	4
Tsinghua University	0	10	10
Universitat Autònoma de Barcelona	4	0	4
University of Copenhagen	5	0	5
University of Pennsylvania	7	0	7
Universitat Politècnica de València	0	9	9
The University of Queensland, Australia	0	4	4

Table 4 – Number of MOOCs offered by universities with 4 or more available courses

Harvard University, Peking University and MIT are the universities with more available MOOCs in both studied platforms. Note that Harvard University and MIT only have courses in EdX platform, which confirms a higher variety of courses per HEI in EdX than in Coursera.

With respect to the introductory video which presents in an easy and fast way to provide a first contact with the course content and the professor [Audsley et al. 2013], it can be observed that it is included in 93.5% of the courses found in Coursera [Coursera 2015] and in 88.7% of the courses found in EdX [EdX 2015]. Most of the courses have only one (Coursera – 59%; EdX –36.5%) or two instructors (Coursera – 21.5%; EdX – 29.6%) [Coursera 2015] and [EdX 2015].

Finally, some information regarding the duration of the courses and the expected workload for a student to successfully complete the MOOCs (with the exception of the time of attending the “lessons”), are presented. Tables 5 and 6 show the descriptive statistics (number of courses (N), mean, median, mode and standard deviation) of the duration of the courses (in number of weeks) and the courses’ workload (in hours) for both platforms, respectively. Note that there were some courses in EdX that did not have the referred information accessible.

	Duration (weeks)	
	Coursera	EdX
N	107	111
Mean	9.4	8.4
Median	6.0	8.0
Mode	6	6
Std. Deviation	13.49	3.89

Table 5 – Descriptive statistics of the duration of courses (number of weeks) in both platforms

On average, the duration of the courses in Coursera is 9.4 ($s=13.49$) weeks, and 8.4 ($s=3.89$) in EdX. According Haggard (2013 in Atenas, 2015), the MOOCs courses are normally between 4 and 10 weeks long.

	Minimum (hours)		Maximum (hours)	
	Coursera	EdX	Coursera	EdX
N	107	107	107	107
Mean	3.93	4.14	6.10	5.07
Median	4.00	4.00	6.00	5.00
Mode	4.0	4.0	5.0	6.0
Std. Deviation	1.912	2.059	2.595	2.267

Table 6 – Descriptive statistics of courses' workload (in hours) in both platforms

On average, the minimum of hours per week of workload, is 3.93 ($s=1.912$) hours, and the maximum is 6.10 ($s=2.595$) hours in Coursera platform. In EdX, on average, the minimum of hours per week of workload is 4.14 ($s=2.059$) hours, and the maximum is 5.07 ($s=2.267$) hours.

Comparing the values presented in Table 6 for courses available on both platforms, it can be observed that there are no considerable differences in the workload required to successfully complete the courses, since the intervals defined by the minimum and maximum values of workload are overlapped.

4. CONCLUSIONS

A systematic literature review about MOOCs in higher education was carried out to identify and classify the published works in order to understand MOOCs based research. The ISI Web of Knowledge, Scopus and IEEE Xplorer databases were used in order to search work published since 2008. The analysis resulted in 156 articles.

With this work it was verified that the number of studies published in this area in the most relevant scientific databases increased considerably in the last two years.

As Coursera and EdX platforms were the most mentioned in the referred articles, a characterization and comparison of these platforms has been made, using a content analysis of the information available in the platforms' sites.

On May 2015 there were 102 universities that offered 1036 courses in the Coursera platform, while regarding EdX, there were 39 universities that offered 516 courses. Thus, it can be concluded that the relationship between the number of courses and number of universities offering the courses is higher in the case of EdX than in the case of Coursera.

The average duration of the courses in Coursera is 9.4 weeks, and in EdX is 8.4 weeks. The average course in Coursera requires 3.93 to 6.10 hours of work per week, and in EdX requires

4.14 to 5.07 hours per week. The values from the workload required do not differ considerably between both platforms.

It could be noted that EdX is more interdisciplinary than Coursera because it covers a higher number of knowledge areas. Architecture, Communication, Ethics, History, Literature, Philosophy & Ethics, and Science are examples of areas present in EdX and not included in Coursera.

For future work, it is intended to complement the characterization of the two studied platforms based on the categories of courses and on their demand. It is also intended to proceed with the comparison between them. Additionally, it is planned to continue to study the evolution of MOOCs concept and its supporting platforms, and analyse other platforms that can arise in this context.

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