Knowledge Management & E-Learning
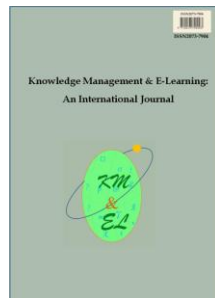
A supply sided analysis of leading MOOC platforms and universities

Georg Peters
Munich University of Applied Sciences, Germany
Australian Catholic University, Australian
Jan Seruga
Australian Catholic University, Australian

A supply sided analysis of leading MOOC platforms and universities

Georg Peters*

Department of Computer Science and Mathematics
Munich University of Applied Sciences, Germany
Australian Catholic University, Australian
E-mail: georg.peters@hm.edu

Jan Seruga

Faculty of Education and Arts
Australian Catholic University, Australian
E-mail: jan.seruga@acu.edu.au

*Corresponding author

Abstract: Investing in education is generally considered as a promising strategy to fight poverty and increase prosperity. This applies to all levels of an economy reaching from individuals to local communities and countries and has a global perspective as well. However, high-quality education is often costly and not available anytime anywhere. Therefore, any promising concept that might help to democratize education is worth pursuing, in a sense that it makes education accessible for everybody without any restrictions. The characteristics attributed to MOOC – Massive Open Online Courses are promising to contribute to this objective. Hence, our objective is to analyse MOOC as it currently operates. Obviously, there is a huge demand for free high-quality education anytime anywhere but a shortage on the supply side. So, we will concentrate on supply-sided effects and study MOOC platforms as well as content providers, particularly universities. We focus our research on some of the leading platforms and universities worldwide. Relative to their size Australia and the Netherlands are very active players in the MOOC sector. Germany is lagging behind and leading universities in the UK seem to virtually refrain from offering MOOC. Our research also shows the leading role of US universities and platform providers.

Keywords: Massive open online courses; MOOC platforms; MOOC content providers; Supply sided analysis

Biographical notes: Georg Peters is a professor of information systems in the Department of Computer Science and Mathematics at Munich University of Applied Sciences and honorary professor at Australian Catholic University.

Jan Seruga is a professor in computing at the Faculty of Education and Arts, Australian Catholic University (ACU).

1. Introduction

Education is considered one of the most important investments in the future of an economy (Hanushek & Wossmann, 2010). Firstly, in particular, the transformation from manufacturing to services in mature economies requires a highly educated and trained workforce. Beyond services, the so-called knowledge sector has emerged where the need for excellently educated staff is even more evident. Secondly, education is regarded as a crucial instrument that helps to prevent or overcome poverty in mature economies and even more importantly in developing countries. However, high-quality education is expensive, time consuming and in general not accessible anytime and anywhere. And with tightening public budgets, funding of education becomes increasingly challenging (Feigenbaum & Iqani, 2015).

Any progress towards high-quality education provided at reasonable costs or even for free, independently of any time constraints and geographical restrictions would contribute to the well-being and life prospects of a significant number of people. A possible step forward is the concept of MOOC – Massive Open Online Courses (Parry, 2010; Jacoby, 2014). MOOC could revolutionize the education sector by offering high-quality courses for free without any restrictions. MOOC very much leverage on technologies that have enabled companies like Facebook or Google to advance in the list of the most valuable enterprises worldwide, i.e. information technology with its rapidly increasing capacities and enhanced functionalities at decreasing costs.

The implications of information technology have been widely discussed. For example, the term Industry 4.0 (Kagermann, Lukas, & Wahlster, 2011) stands for the transformation of mass production manufacturing to highly flexible production processes that are capable of addressing individual requirements in unprecedented ways. The finance sector is challenged by new tech-players that are aiming to take over the money transfer business and more from traditional banks (Roux, 2015) etc. Fifteen years after the New Economy bubble burst the information technology revolution finally seems to have really started. Therefore it is important to investigate if MOOC have similar disruptive powers as information technology is assumed to have in manufacturing, finance and sectors beyond.

There are two sides of the coin when it comes to MOOC, the demand side and the supply side. On the demand side as briefly discussed, MOOC could potentially have tremendous benefits for students and their stakeholders, particularly, potential employers seeking qualified staff and countries appreciating prosperous tax payers. On the supply side, disruptive technologies often change market structures significantly. Long established supplies vanish while entrepreneurs with new business models take over. The MOOC market is characterized by network effects and economies of scale. Such markets frequently tend to end in oligopolies or even monopolies (Katz & Shapiro, 1985). An early adopter often can leverage on its networks and therefore obtains a crucial advantage over adopters that decide to enter the market at a later stage.

Hence the objective of our explorative study is to give a snapshot of the current positions of leading countries and universities in the MOOC market. We provide a supply-sided analysis of the market, i.e. we exclude a detailed analysis of demand-sided aspects including e.g. pass rates and students ratings of the courses. We investigate which countries, universities and platforms are most active in the MOOC sector currently and may further leverage on their already established network in future.

The remainder of the paper is structured as follows. In the next section, we briefly describe the important foundations of MOOC and outline our research. In Section 3, key

figures of major MOOC providers are depicted. In Section 4 we analyse the MOOC portfolios of the top five universities in countries that are highly ranked in the university sector. The paper concludes with a discussion and summary in Section 5.

2.   Foundations of MOOC and research outline

2.1. Foundations of MOOC

2.1.1. A brief history of MOOC

MOOC – Massive Open Online Courses emerged around the year 2008 when Siemens and Downes offered one of the first MOOC (Parry, 2010). The term MOOC itself is often accredited to David Cormier of the University of Prince Edward Island (Jacoby, 2014). The basic idea of MOOC is to provide educational courses via the internet for free to anyone who wants to take a course. So, MOOC are taking online education to a next stage (Hoy, 2014).

It was initially assumed that MOOC could have the potential to significantly change the way education is provided. However, like many new technologies, MOOC seem to be following the five phases of the hype cycle as proposed by Gartner Inc. (2015b): rising first, peaking with exaggerated expectations, and then turning down sharply in a valley of disappointment, recovering and finally reaching a realistic level of expectations. Presently, there seems to be a downturn in the expectations combined with MOOC. For example, MOOC are listed as "Sliding Into the Trough" in Gartner's "Hype Cycle for Education 2014" (Lowendahl, 2014). In the most recent study on education, Gartner does not list MOOC anymore at all; however MOOC enabling technologies are considered to be "On the Rise" (Lowendahl, 2015). Kolowich (2015) also discusses the current downturn of MOOC. This decline in the expectations of MOOC is accompanied by a reasonable number of critical comments and studies on the MOOC (e.g. see Laurillard (2014) or Zemsky (2014)). However, some of the core drivers of MOOC so far, further enhance their portfolios. For example, Massachusetts Institute of Technology recently confirmed its commitment to MOOC by announcing a series of "MicroMaster's Credential in Supply Chain Management" (Schaffhauser, 2015).

2.1.2. Characteristics of MOOC

The characteristics of Massive Open Online Courses can be directly derived from the term itself (Hoy, 2014; Rodriguez, 2013; Stewart, 2013):

- *Massive* can be interpreted in two different ways (Stewart, 2013): On the one hand, it stands for the virtually unlimited number of students that can join a course. Hence, massive stands for the ambitious objective of MOOC, i.e. to be open to practically anybody who is aspiring to high-quality education. On the other hand, massive also refers to the huge amount of knowledge that is generated and exchanged by the participants while studying. Therefore, the term massive summarizes the core objectives of MOOC: massive numbers of people obtain, generate and exchange massive amounts of knowledge. The remaining three terms, *open*, *online*, and *course*, can be interpreted as enablers that are essential to make the core objective *massive* possible.

- *Open* means that there are no formal entry barriers for students to join a course, i.e. the courses are offered free of cost to students (Stewart, 2013). On the downturn, the institutions offering MOOC normally do not award certificates for the successful completion of courses. They are possibly trying to avoid extra costs for formal exams and a self-cannibalization of their core business models. When certificates are offered students normally have to pay a fee for this extra service (Rodriguez, 2013). Moreover, subscribing to a MOOC does not require any previous knowledge; however, it is often strongly recommended (Hoy, 2014). This openness is possibly not only motivated by the philosophy of open access to education but also to avoid costs for the course provider for checking and/or testing any kind of entrance requirements. Open may also refer to the characteristics of MOOC in that they are accessible independently of time and location, i.e. anytime and anywhere. Note, that anytime in a narrow sense only applies to self-paced MOOC; most MOOC have a course structure (see Section 4) with defined start and end dates.

- *Online* refers to the crucial technological basis that enables MOOC. Offering free education to a massive number of people, who obtain, generate and exchange massive amounts of knowledge, would be impossible without the support of latest internet technologies. Aspects include keywords such as rapidly deteriorating costs, social media technologies, virtually ubiquitous accessibility to internet services.

- *Course* relates to the structure most MOOC are offered in. They have defined start and end dates. All students studying at the same stage of a course foster the forming of learning and discussion groups and support the exchange of knowledge (Hoy, 2014). In the meantime, a reasonable number of self-paced courses are offered where students can choose when to begin and decide on their own pace of study. At least for popular MOOC with high numbers of students, we think that the advantages of a self-paced course outweigh MOOC with defined start and end dates. In such popular MOOC, there should always be a sufficient number of class mates studying the same unit of a course for forming learning groups etc. Furthermore, we would consider it as advantageous for students at different stage of a course to exchange their knowledge.

2.1.3. Types of MOOC

Basically, two types of MOOC can be distinguished (Siemens, 2012): cMOOC and xMOOC where the *c* stands for *connectivist* and the *x* is derived from the common interpretation of the letter x for *extended* used, e.g. by the platform edX and by respective universities to brand their online courses (HarvardX, MITx etc.).

cMOOC are based on the idea of connectivism that is defined as a network-based pedagogy (Siemens, 2005; Downes, 2011). Though predefined course content is essential to cMOOC, its main purpose is to function as a catalyst for discussions and interactions among the participants of a particular cMOOC (Downes, 2011). So, cMOOC are very much more user/student centred than classic pedagogical approaches. It is obvious, that the emergence of social media technologies have been crucial for cMOOC.

xMOOC, contrasting cMOOC, follow more classic pedagogical concepts, in particular behaviourist learning theories (Conole, 2013). An important purpose of xMOOC is to complement traditional teaching by information technology; for example

by providing learning material online, supporting learning groups by social media among others. Hence, xMOOC are an evolution of online education rather than a revolution.

Fig. 1 illustrates the different approaches of cMOOC and xMOOC. In the figure, the squares symbolize the central source of knowledge and the circles the students. In the left subfigure, the structure of cMOOC is shown: the students are well connected (indicated by solid lines) while the stimulating source of knowledge, although crucial, is of secondary importance (indicated by solid lines). In the right subfigure, the structure of xMOOC is depicted. The central source of knowledge is of primary importance for the students (solid lines) while the interaction of the students is secondary (dashed lines).
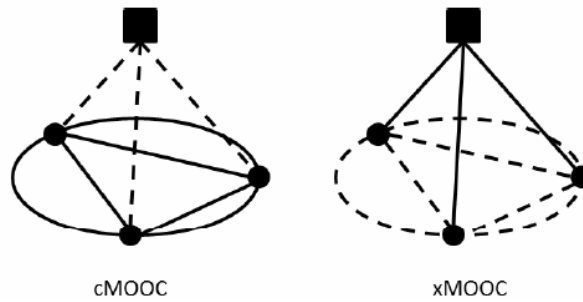

Fig. 1. Characteristics of cMOOC and xMOOC

The classifications of cMOOC and xMOOC have overlapping characteristics. However, most of the MOOC presently offered by universities on the major platforms can be considered as xMOOC rather than cMOOC. In particular, MOOC offering certificates need stable and well-defined curricula to ensure equal conditions for the students taking the exams.

2.1.4. Stakeholders of MOOC

To analyse the parties interested in MOOC, we distinguish between supply- and demand-sided stakeholders (see Fig. 2). The supply side of the MOOC market is formed by the MOOC platforms that provide the technical infrastructure to run MOOC. The MOOC platforms host the courses of the content providers. Presently, most of the content is provided by universities and companies.
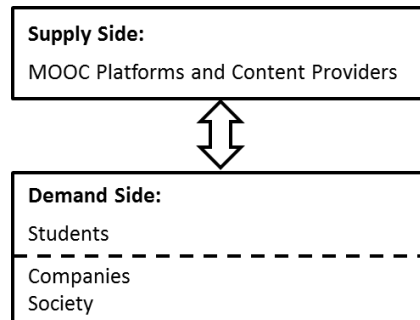

Fig. 2. Stakeholders of MOOC

On the demand side we have students subscribing to MOOC. Indirectly, via the students, companies and society (countries etc.) are also demand-sided stakeholders. Companies are looking for a well-qualified workforce and societies are looking for people making contributions, including paying taxes. Note, one might also argue the opposite way: the main stakeholders are companies and societies and students "just" the instruments for reaching their goals.

2.2. Research outline

To date MOOC have a history of almost ten years. After a stellar start, positioning them as a revolution in education, it can be observed currently that disillusion has emerged here and there, leading towards a more realistic evaluation of their properties. The objective of our research is to contribute to the assessment of MOOC by giving a snapshot of the present MOOC market.

We focus on the supply side of the MOOC market and analyse the respective platforms and universities providing courses. Our objective is to compare their current relative strengths and to identify the platforms and universities that have obtained leading positions in the MOOC market. Due to network externalities (Katz & Shapiro, 1985) and economies of scale, these platforms and universities can possibly further leverage on these effects and dominate the MOOC market in the long run (Stewart, 2013).

In our analysis, we adapted well-accepted, state of the art methods from other domains that are indicators of the strengths of entities. In particular, we apply in Section 4.3:

- the relation of MOOC to the GDP to obtain country-specific indicators for the commitments to MOOC,
- the h-index (Hirsch, 2005), which is used to evaluate the impact of the publications of academics,
- the Gini-coefficient (Lamb, 2012) is frequently used in economics to measure inequality of wealth and income,
- a modified MOOC Leadership Matrix (Peters, Sacker, & Seruga, 2015) to compare the universities with respect to their world rank and MOOC portfolios.

To obtain manageable number of entities in our research, we concentrate on the top five universities of the top five countries, which we regard as leading in the tertiary education sector (see Section 4 for our definitions of the top five universities and countries).

Although our study gives comprehensive insights into the supply side of the MOOC market, there are some limits in our research. These include the following issues: we collected the data from the websites of the MOOC platforms and universities and, therefore, depend on their accuracy; the numbers given (e.g. the number of students) and their definitions are also often imprecise (e.g. number of participants in courses does not necessarily equal the number of students enrolled in MOOC since a student may be taking more than course) or information is missing (e.g. how many subscriber of each course can be considered as active). The same applies to the courses, e.g. archived courses may never be offered again, etc. There is no easy categorization of "normal" online courses and MOOC. We also do not assess the quality and user-sided acceptance of MOOC. Another limit is that the small number of data does not allow any rigorous statistical analysis. Hence, we cannot provide statistically significant results; we only can

give approximations and indications. Finally, there are several different university rankings, e.g. the Times Higher Education World University Rankings (https://www.timeshighereducation.com/world-university-rankings) and the Academic Ranking of World Universities (http://www.shanghairanking.com/). Although they are all similar in certain aspects they vary significantly in detail. Our analysis depends on the particular university ranking we take.

3.   MOOC platforms

MOOC platforms provide the services to run MOOC. In the last decade, several MOOC platforms have been developed. They range from small experimental platforms at universities to professional start-ups that aim to establish sound business models.

In the context of our paper, we concentrate our presentation on some of the leading MOOC platforms. In particular, we focus on the platforms that host MOOC of the top five universities in the top five countries as defined further down in Section 4.

The data and information in this section have been collected from the websites of the MOOC platforms and the universities if not otherwise mentioned.

3.1. Preferred MOOC platforms of top universities

The top five universities of the top five countries offer their MOOC on the following four platforms: Coursera, edX, FutureLearn and NovoED (Table 1 summarizes key indicators of the MOOC platforms):

Table 1
Key indicators of the MOOC platforms

→ Number of ↓ Platforms	Courses	Students	Partners
Coursera	1462	15,600,00+	133
edX	690	400,000+	83
FutureLearn	193	2,400,000	72
NovoED	83	N/A	42

- Coursera (https://www.coursera.org) was founded as a for-profit company by Daphne Koller and Andrew Ng from Stanford University. Ng was responsible for the development of Stanford's platforms OpenClassroom and the ml-class/db-class. He also gave one of the first MOOC at Stanford, a course on machine learning with more than 100,000 students. Koller is a highly regarded expert in the field of artificial intelligence.

- edX (https://www.edx.org) is a joint non-profit project of Harvard University and Massachusetts Institute of Technology (MIT) (edX, 2013). Harvard and MIT not only operate edX but they are also the most active MOOC providers. EdX is powered by the free and open source platform Open edX (https://open.edx.org) that was also initiated by Harvard and MIT. Therefore, any institution around the world can download the software and run its own

Open edX platform. For example, Stanford University hosts its MOOC on the Stanford OpenEdX platform (http://online.stanford.edu/courses/platform/OpenEdX).

- FutureLearn (https://www.futurelearn.com) is an initiative by the Open University UK (http://www.open.ac.uk) that founded it as a subsidiary. The company launched its first course in 2013. Up to now more than 2 million students have subscribed to courses that have been offered on FutureLearn. Although FutureLearn attracts partners from all over the world it has a particularly strong position in its home market in the UK.

- Like Coursera NovoED (https://novoed.com) is a for-profit company that was founded in 2013. It is a spin-off of the Venture Lab project at Stanford University that offered a technology entrepreneurship course on the web (Empson, 2013).

According to the numbers, the for-profit platform Coursera can be regarded as the leading MOOC platform worldwide. It has the largest number of partners and the biggest portfolio of MOOC. The student numbers seem also to be the highest of all MOOC platforms with almost 16 million subscribers. The number of courses offered by edX and FutureLearn are considerably lower at 83 and 72 respectively. NovoED follows with 42 courses.

Table 2
Penetration of the MOOC platforms within the top universities

→ Number of ↓ Platforms	Courses	Universities	Countries
Coursera	107	9	4
Open edX	209	8	4
FutureLearn	5	1	1
NovoED	29	2	1

Table 2 summarizes some of the key figures of these platforms with regard to the top universities. Note, we pool the platforms that use Open edX technology, i.e. edX run by Harvard and MIT and Stanford OpenEdX run by Stanford University. The table shows that Open edX technology is used to host by far the most MOOC for the top universities. A reason for this is that edX is run by two of the most active universities in the MOOC market (Harvard and MIT). Furthermore, Stanford agreed to collaborate and contributed to the Open edX project (edX, 2013). Open edX is followed by Coursera, also hosting a reasonable number of MOOC on its platform. Both platforms have similar numbers of top universities as their customers in four countries each. FutureLearn and NovoED seem to serve niche markets only - with respect to the number of MOOC they host, the number of top universities they have as customers and also with regard to their international positions.

When we summarize the observations made above, we assert that Coursera and Open edX are by far the leading MOOC platforms in the academic sector. Coursera has the largest number of students, hosts the highest number of MOOC and partners with the biggest number of universities. However, with respect to the top five universities Open

edX seems to take pole positon, mainly because of the high commitment of three of the leading universities, namely Harvard, MIT and Stanford. These are not only some of the most active content providers but they are also committed as key drivers behind the Open edX technology.

3.2. Further MOOC platforms

Further platforms we are considering in the paper are the German based iversity (https://iversity.org) offering 72 MOOC and OpenLearning (https://www.openlearning.com) that was founded in Australia. OpenLearning states on its website that 272,407 students are subscribed to 835 courses. However, the list of courses they are currently offering on their websites is smaller with 100+ courses. The Australian counterpart to the British platform FutureLearn as a subsidiary of the Open University UK (http://www.open.ac.uk/), is Open2Study (https://www.open2study.com). Open2Study is operated by the Open University Australia (https://www.open.edu.au) and hosts 49 courses currently.

The company Udacity (https://www.udacity.com) focuses on courses for professionals and partners with the leading tech-companies. Hence, its business model differs from the business models of the platforms discussed above. The former platforms are positioning themselves as service providers for universities, while Udacity has a clear focus on industry courses. Last but not least, there are even more specialized MOOC platforms run by tech-companies aiming to give professionals support in their own company's technological ecosystems, e.g. openSAP (https://open.sap.com).

4. MOCC content providers

4.1. Data summary

To determine the leading countries and their top universities, we refer to the recently published university ranking for the year 2016 by the Times Higher Education (https://www.timeshighereducation.com). The Times Higher Education World University Rankings is regarded as one of the leading international benchmarks for the quality and reputation of universities.

To obtain a manageable number for our analysis, we have developed the Top 5 Squared Matrix (T5S-Matrix) comprising the five leading universities from the five leading countries in the tertiary education sector. We define the five leading countries of the tertiary education sector as follows: we take the top five universities of each country and order them by their average world ranking. As depicted in Table 3, we identified the US, the UK, Germany (DE), Australia (AU) and the Netherlands (NL) as leading countries.

Note, that our approach does not take into account the size of a country, e.g. by population, gross domestic product (GDP) or other indicators. For example, taking the population as "normalization factor", would disclose even more impressively the performance of the smaller countries: Australia and the Netherlands. The limit to five universities per country is also rather arbitrary and the possible criteria such as the variance of the rankings are also neglected. However, any of these criteria would also be arbitrary to a certain degree.

Table 3
World ranking of the top 5 university in the top 5 countries

→ Country ↓ Local rank	US	UK	DE	AU	NL
			↓ Global rank		
1	1	2	29	33	47
2	3	4	37	52	58
3	5	8	49	56	62
4	6	14	53	60	65
5	7	23	72	73	67
Sum	22	51	240	274	289
Average	4.4	10.2	48.0	54.8	57.8

Our shortlist consists of the US, the UK, Germany followed by Australia and the Netherlands. The top five universities in each of these countries are summarized in Table 4. In the further course of this section, we analyse their commitments in the MOOC sector in more detail.

Table 4
TOP 5 squared matrix (T5S-Matrix): Top 5 universities in the top 5 countries

Rank	US	UK	DE	AU	NL
1	Caltech	Oxford	LMU	Melbourne	Wageningen
2	Stanford	Cambridge	Heidelberg	ANU	Amsterdam
3	MIT	Imperial	Humboldt	Sydney	Utrecht
4	Harvard	UCL	TU Munich	Queensland	Delft
5	Princeton	LSE	Free Univ.	Monash	Leiden

4.2. Country specific results

Most universities in the world have investigated the nature and potential of MOOC at least to a certain degree. However, the involvements of the universities have varied significantly. For example, MOOC are an area of research for academics in the fields of information systems and education. Hence, many research papers have been published on MOOC. Conferences of MOOC have been organized and hosted (e.g. by the University of Sydney (http://sydney.edu.au/elearning/pd/MOOC.shtml) in 2013) and university managements have evaluated the potential of MOOC.

But there is a crucial difference between talking about MOOC and establishing a comprehensive portfolio of MOOC. The latter requires significant resources for similar risks many early adopters of a technology face: in the best case, they are rewarded taking the risks and become important players in the new market; in the worst case, the expected market potential turns out to be too optimistic or competitors entering the market later learn from the pioneers and push them out of the market.

In our analysis we concentrate on aspects of the MOOC market that require serious commitments and significant resources. Therefore, we focus on MOOC offered

by universities and disregard any other involvement in MOOC such as publications on MOOC.

The data and information in this section have been collected from the websites of the MOOC platforms and the universities if not otherwise mentioned.

4.2.1. MOOC offered by the leading US universities

The US universities dominate the top ten of the Times Higher Education World University Rankings. Only two British universities managed to get into the phalanx of the leading US universities: Oxford at rank 2 and Cambridge at rank 4. The best universities of the remaining top five countries are far behind: Germany's LMU Munich at 29, Australia's University of Melbourne at 33 and at rank 47 Wageningen University and Research Center from the Netherlands. Table 5 summarizes key figures of the universities.

Table 5
MOOC offered by leading US universities

University	Announced, running, archived	On-demand, self-paced	Platform
Caltech	5	2	Coursera
Stanford	89	7	Coursera (33)
			Open edX (37)
			NovoEd (26)
MIT	60	11	edX
Harvard	28	28	edX
Princeton	16	4	Coursera (17)
			NovoED (3)

- California Institute of Technology (http://www.caltech.edu). Caltech offers two MOOC on-demand and a further five courses are listed. Currently, the latter MOOC have the status "Date to be announced". All courses are in the field of science except a MOOC on economics for scientists.

- Stanford University (https://www.stanford.edu). Stanford University has a large program of online courses. It is active on all major platforms, including Coursera, Open edX run by Stanford, and NovoED. In our analysis, we excluded double entries for courses on one platform. Courses with identical titles on different platforms are counted separately for each platform. In total Stanford offers almost 100 courses.

- Massachusetts Institute of Technology (http://web.mit.edu). MIT together with Harvard University is the founder of edX which shows their serious commitments to MOOC. Therefore, it is not surprising that MIT also offers a large number of MOOC on edX. Of the total of 71 courses, 11 are self-paced while the remaining 60 have a classroom structure with definite start and end dates.

- Harvard University (http://www.harvard.edu). Harvard is a cofounder of edX and offers a total of 56 MOOC on the platform. In contrast to MIT, the proportion of self-paced courses is significantly higher. Twenty-eight courses are offered in this mode, i.e. fifty per cent of the courses are self-paced.

- Princeton University (http://www.princeton.edu). Princeton University offers 17 courses on Coursera and a further three MOOC on NovoED platform. Four of the Coursera courses are "on-demand".

The American universities have established considerable portfolios of MOOC. In particular, Harvard, MIT and Stanford are contributing not only content but are also engaged in the development of MOOC platforms. Obviously, they have considered online learning in a comprehensive way, as platform and content provider and as a field of research.

Since we limited our research to the top five universities from each country, some of the leading universities are excluded from our study. For example, the University of California at Berkeley (http://mooclab.berkeley.edu/berkeleyx/) has a reasonable number of 35 MOOC at edX.

4.2.2. MOOC offered by the leading UK universities

The leading universities in the UK are: University of Oxford, University of Cambridge, Imperial College London, University College London and the London School of Economics and Political Sciences. University College London and the London School of Economics and Political Sciences belong to the University of London. However, these colleges are regarded as universities in virtually any ranking; so we follow suit.

The University of London International Programmes (http://www.londoninternational.ac.uk/coursera) organizes the external programs of its colleges and offers a number of MOOC. Since the University of London is not considered in rankings we exclude the MOOC it is offering.

University of Oxford (http://www.ox.ac.uk). The university refrains from offering MOOC. "University of Oxford Pro-Vice Chancellor of Education Sally Mapstone describes the MOOC approach as the 'antithesis' of Oxford's vision of pedagogical excellence, and says the university has no intention of adopting the model anytime soon." (University of Oxford, 2014). However, Oxford's Department for Continuing Education (https://www.conted.ox.ac.uk/courses/online/) offers more than 90 online courses. Most of these courses are short courses running between 5 and 10 weeks.

University of Cambridge (https://www.cam.ac.uk). Like University of Oxford, Cambridge virtually abstains from offering MOOC. A partnership of University of Cambridge Press, the Raspberry Pi Foundation and OCR offer "The Cambridge GCSE Computing Online MOOC" for children between 14 and 16 (http://www.cambridgegcsecomputing.org). The Judge Business School of University of Cambridge offers three executive short courses on Digital Business Academy (http://www.digitalbusinessacademyuk.com) that require about 15 hours each. Like Oxford, Cambridge's Institute of Continuing Education (http://www.ice.cam.ac.uk/courses/online-courses) offers a reasonable number of online courses. We would regard the offers of the Judge Business School and the Institute of Continuing Education as classic online courses rather than MOOC.

Imperial College London (https://www.imperial.ac.uk). The Imperial College has online offers, including its Global Online MBA (http://wwwf.imperial.ac.uk/business-school/programmes/global-mba). However, particular MOOC are not offered.

University College London (http://www.ucl.ac.uk). Like the University of Cambridge the UCl offers courses on Digital Business Academy. Furthermore, they have a range of online courses (https://extendstore.ucl.ac.uk). In April 2015, UCL started an initiative to support the development of two MOOC (UCL, 2015).

London School of Economics and Political Sciences (http://www.lse.ac.uk). Like many universities the LSE offers online courses. It also contributed to a MOOC led by the World Bank Group entitled "Engaging Citizens: A Game Changer for Development?" (LSE, 2015). However, this MOOC seems to be rather intended to contribute to international society in general rather than being a classic academic course. Currently, the London School of Economics and Political Sciences seems to have no further MOOC hosted by one of the major international platforms.

Taking their excellent global reputation into account, the UK's leading universities are surprisingly reluctant to offer MOOC. They do not have any language barriers since English is the world's lingua franca and the leading universities have always been very internationally minded attracting the brightest people in the world. Therefore, we think that Oxford's opinion (see above the statement of its Pro-Vice Chancellor of Education Sally Mapstone) also applies to many of the other universities: the nature of MOOC contradicts the understanding UK universities have of academic tuition. A further reason could be that developing MOOC is time-consuming and costly and the UK universities may have limited resources experimenting with MOOC in comparison to their US counterparts. We would like to mention again that UK universities have a reasonable number of online courses, but they are not labeled as MOOC. In contrast to this, not all courses promoted as MOOC by universities worldwide might be MOOC in a narrow sense.

4.2.3. MOOC offered by the leading German universities

Two of the leading German universities are located in Munich, Ludwig-Maximilians-Universität München (LMU Munich) and Technical University of Munich (TU Munich) and another two in Berlin, Humboldt University and Free University. The top five German universities are completed by the University of Heidelberg. Table 6 summarizes key figures of the universities.

- Ludwig-Maximilians-Universität München (http://www.uni-muenchen.de/index.html). LMU Munich offers its MOOC on Coursera (http://www.en.uni-muenchen.de/students/moocs/index.html). Presently, five courses are listed as "date to be announced" and two courses are open ("on-demand"). The latter two courses are offered in English and Chinese.

- University of Heidelberg (http://www.uni-heidelberg.de/). The University of Heidelberg announced a project to develop a MOOC, "Creating a MOOC about Academic Essay Writing in English", for 2015 (University of Heidelberg, 2015). However, presently, the course is still to be published on the designated platform Open edX. Therefore, we list it in brackets in Table 6 but do not incorporate in in our further research.

- Humboldt University (https://www.hu-berlin.de). Berlin's Humboldt University seems to offer no MOOC presently.

- Technical University of Munich (https://www.tum.de/). The university offers MOOC on Cousera and edX (http://www.mz.itsz.tum.de/elearning/moocs/). Presently, on each of the platforms two courses are listed, but neither is presently open for subscription.
- Free University of Berlin (http://www.fu-berlin.de). Like its Berlin counterpart, the Free University, has not established a MOOC program so far.

Table 6
MOOC offered by leading German universities

University	Announced, running, archived	On-demand, self-paced	Platform
LMU	5	2	Coursera
Heidelberg	(1)		(Open edX)
Humboldt			
TU Munich	4		Coursera (2)
			edX (2)
Free Univ.			

The MOOC portfolio offered by Germany's top universities is very limited. Only the two universities from Munich offer MOOC, while Heidelberg announced one for 2015. Besides the language barriers, a possible reason might be that the German universities are public institutions with challenges to get sufficient resources to set up a significant number of MOOC.

4.2.4. MOOC offered by the leading Australian universities

The top five Australian universities belong to the Group of Eight (https://go8.edu.au), eight universities that consider themselves as the leading research universities on the continent. The remaining three of Group of Eight universities are the universities of Western Australia, Adelaide and New South Wales. Table 7 summarizes key figures of the universities.

Table 7
MOOC offered by leading Australian universities

University	Announced, running, archived	On-demand, self-paced	Platform
Melbourne	16		Coursera
ANU	6	3	edX
Sydney	(1)		
Queensland	5	5	edX
Monash	5		FutureLean

- University of Melbourne (http://www.unimelb.edu.au). Presently, the University of Melbourne offers 16 MOOC on Coursera (University of Melbourne, 2015). According to the University of Melbourne, it was the first Australian university offering MOOC; up to date it has had more than 850,000 students in 120 countries enrolled in MOOC.

- Australian National University (http://www.anu.edu.au). In contrast to the University of Melbourne, the Australian National University has chosen edX as its platform (https://www.edx.org/school/anux). On edX the ANU offers nine MOOC; three of them are self-paced.

- University of Sydney (http://sydney.edu.au). Presently, the University of Sydney does not offer any MOOC on any of the leading MOOC platforms. However, its Charles Perkins Centre, researching in the fields of obesity, diabetes and cardiovascular disease, announced that it was selected to develop one of the first MOOC at the University of Sydney (Simpson, 2015).

- University of Queensland (http://www.uq.edu.au/). The University of Queensland partners with edX. Presently, the university offers 10 courses on the platform; half of them are self-paced.

- Monash University (http://www.monash.edu/). The university is one of the few top institutions that offer courses on a platform other than Coursera and edX. Monash's five MOOC are hosted by FutureLean.

Australia's top five universities are quite active in offering MOOC. Four out of five universities already have an established MOOC program and the University of Sydney is about to commence one.

4.2.5. *MOOC offered by the leading Dutch universities*

The Netherlands is ranked fifth in the global university ranking. According to the Times Higher Education World University Rankings, its top five universities rank between 47 and 67. Table 8 summarizes key figures of the universities.

Table 8
MOOC offered by leading Dutch universities

University	Announced, running, archived	On-demand, self-paced	Platform
Wageningen	3	1	edX
Amsterdam		11	Coursera
Utrecht		1	Coursera
Delft	24		edX
Leiden	13		Coursera

- Wageningen University and Research Center (http://www.wageningenur.nl). The university and research centre is focused on agriculture and environmental studies. Its position as the leading university in the Netherlands and one of the top 50 world-wide shows the success of the strategy of Wageningen. In its fields of specialization it offers four MOOC; one of them is self-paced.

- University of Amsterdam (http://www.uva.nl/en/home). The University of Amsterdam offers eleven on-demand MOOC on Coursera. Five of these courses are combined in a paid program on "Methods and Statistics in Social Sciences Specialization". Each of its modules costs US$ 49; hence the total amount for the program is US$ 245. A MOOC on the Ebola virus is jointly offered with the University of Utrecht.

- University of Utrecht (http://www.uu.nl/en/). As already mentioned above, University of Utrecht and the University of Amsterdam jointly offer MOOC on Ebola. The course is hosted at Coursera. For simplicity reasons we count the course as full for both universities.

- University of Delft (http://www.tudelft.nl/). University of Delft is the most active Dutch university. It offers at total of twenty-four MOOC on edX. Six are archived, but the remaining eighteen are presently running or announced.

- University of Leiden (http://www.leidenuniv.nl/). The university offers thirteen MOOC on Coursera. Hence, it is the second most active Dutch university after Delft.

Three of the top five Dutch universities show impressive commitments to MOOC. Each of them offers more than ten courses. University of Delft offers the largest number of MOOC with a portfolio of 24 courses at edX. The highly specialized Wageningen University and Research Center also offers MOOC. University of Utrecht is the only leading Dutch university that has not entered the MOOC market yet (except a MOOC in cooperation with the University of Amsterdam).

4.3. Comparative analysis

In our comparative analysis of universities we focus on four criteria: we put the number of MOOC offered by the top five universities in relation to a country's economic power indicated by its gross domestic product (GDP). Then we adapt the idea of the h-index to MOOC followed by comparing the Gini-coefficients. Finally, a modified MOOC Leadership Matrix is applied to summarize our research.

4.3.1. MOOC and gross domestic product

The gross domestic product is considered as one of the most important indicators to evaluate a country's economic power. For example, public and private debts of a country are normally measured against the GPD as an indicator for their sustainability.

Table 9
Strength of the countries in the MOOC sector (GDP: World Bank (2015))

Country	Number of MOOC	GDP in US$ in 2014	MOOC/GDP [e-11]	Rank
US	250	17,419,000,000,000	1.44	3
UK	0	2,941,885,537,461	0.00	5
Germany	11	3,852,556,169,656	0.29	4
Australia	40	1,453,770,210,672	2.75	2
Netherlands	53	869,508,125,480	6.10	1

Hence, we also use the GDP as a reference to analyse the strengths of the countries in the MOOC sector in relation to their economic power. The results are depicted in Table 9.

The US offers by far the most MOOC, i.e. 250 courses, a number almost 2.5 higher than the number of MOOC offered by the remaining four countries combined which offer 104 in total. However, in relation to the economic power of each country, the Netherlands is ranked first, followed by Australia. The US is only ranked third. In relation to its economic power, Germany offers very few MOOC and it ranked fourth. As the UK offers no MOOC, it ranks last in this comparison.

Table 10
Ordered list of the numbers of MOOC in each country

Country	Rank	University	Number of MOOC
US	1	Stanford	96
	2	MIT	71
	3	Harvard	56
	4	Princeton	20
	5	Caltech	7
UK	1	Oxford	0
	2	Cambridge	0
	3	Imperial	0
	4	UCL	0
	5	LSE	0
Germany	1	LMU	7
	2	TU Munich	4
	3	Humboldt	0
	4	Heidelberg	0
	5	Free Univ.	0
Australia	1	Melbourne	16
	2	Queensland	10
	3	ANU	9
	4	Monash	5
	5	Sydney	0
Netherlands	1	Delft	24
	2	Leiden	13
	3	Amsterdam	11
	4	Wageningen	4
	5	Utrecht	1

4.3.2. H-index analysis

The h-index was proposed by Hirsch (2005) to evaluate the impact of academics' publications. The publications are ordered by the number of citations they received; then the h-index is defined as the value where a paper's rank equals the number of citations. Applying the principle of the h-index to MOOC we obtain an ordered list of universities for each country as shown in Table 10.

The derived h-indices for each country are depicted in Table 11. Note, the h-index for the US is denoted as 5+ indicating that it might be higher when the list of the best universities is expanded.

The US is leading followed by Australia and the Netherlands both with an h-index of 4. Germany is on the fourth rank again. The UK has an h-index of zero.

Table 11
Countries' h-indices

Country	h-index	Rank
US	5+	1
UK	0	5
Germany	2	4
Australia	4	2
Netherlands	4	2

4.3.3. Gini analysis

The Gini-coefficient (Lamb, 2012) is an indicator of how equally data are distributed. In economics it is commonly applied to wealth and income. The coefficient ranges from 0 to 1 where 0 indicates complete inequality and 1 a fully equal distribution.
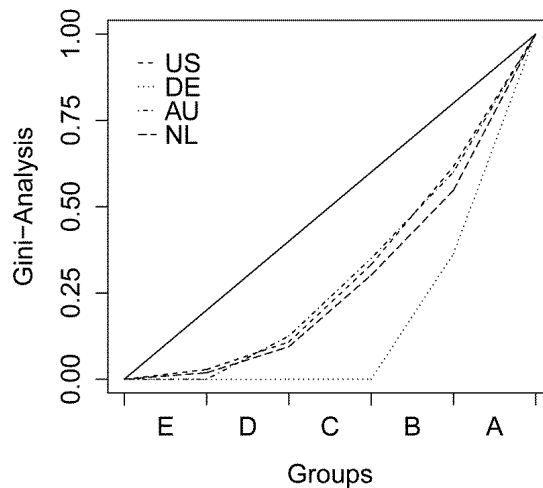

Fig. 3. Gini analysis (excluding the UK)

In the context of our paper, the Gini-coefficient discloses how the MOOC offered by the top 5 universities are distributed among them. A low Gini-coefficient shows that only a few universities offer most of the MOOC, while a high Gini-coefficient shows that the universities offer more or less equal numbers of MOOC. The main advantage of a Gini analysis is that it is independent of the absolute numbers of MOOC offered by a country assuming that the number is not zero. Hence, we need to exclude the UK, since no university offers MOOC. The results are depicted in Fig. 3 and Table 12.

As similarly observed in our analysis of the h-index, the US is leading closely followed by Australia. Due to the very active role of University of Delft, the Gini-coefficient of the Netherlands is a little bit lower than the coefficients of the US and Australia. Only Germany falls behind with a Gini-coefficient that is reasonably low compared to the other countries.

The high Gini-coefficients of the US, Australia and the Netherlands show that the MOOC offerings have penetrated its top universities. In contrast to this, in Germany, MOOC are hosted at some "lighthouse" universities only, while the remaining universities seem to refrain from entering this market. However, due to the small absolute numbers, the Gini-coefficient is sensitive to any change. For example, when the University of Heidelberg eventually launches the announced MOOC the Gini-coefficient will increase by more than 15 per cent from 0.3454545 to 0.4.

Table 12
Countries' Gini-coefficients

Country	Gini-Coefficient	Rank
US	0.6336000	1
UK		
Germany	0.3454545	4
Australia	0.6300000	2
Netherlands	0.5849057	3

4.3.4. MOOC leadership matrix

In the year 1970, Boston Consulting Group's Henderson (1970) proposed a 2x2 matrix to classify a company's product portfolio into four quadrants. The compelling reason for such a matrix is that it represents complex issues in an illustrative and simplified way. It very much helps in making complex issues transparent and easily and quickly accessible. The BCG matrix has become very famous and inspired many researchers to apply such a matrix to a diverse range of fields. For example, Gartner developed its well-known Gartner Magic Quadrant methodology to access technologies (Gartner Inc., 2015a). For our analysis, we modify the MOOC Leadership Matrix (Peters, Sacker, & Seruga, 2015) and define its four quadrants as depicted in Fig. 4.

The Aspiring The rankings of the aspiring universities are lower than the ranking of the Leaders but they offer a comparable number of MOOC. Hence, they are ambitious.		**The Leaders** These universities are leading in both aspects. First, they are regarded as the best universities in world. Second, they offer a high number of MOOC.
The Laggards The laggards are the opposite of the leaders. Relatively to the leaders they are positioned lower in university rankings and they offer less numbers of MOOC than the Leaders.		**The Traditionalists** The traditionalists are world class universities that have refrained so far to offer a reasonable number of MOOC.

Fig. 4. Modified MOOC leadership matrix

Applying the modified MOOC Leadership Matrix to our data we obtain results as depicted in Fig. 5 and Table 13 (DE: Germany, AU: Australia, NL: Netherlands). Since all universities are ranked within the 100 top universities worldwide and no university offers more than 100 MOOC we set the borders between the quadrants in each dimension at 50. An alternative way would be, e.g. by taking the medians as borders.

Note, that we limit our analysis to the top five universities in the top five countries, i.e. we restrict our analysis to an exclusive group of some of the leading universities in the world. This has to be taken into account when world class universities like LSE, the Australian National University etc. are categorized as Laggards in the MOOC Leadership Matrix.
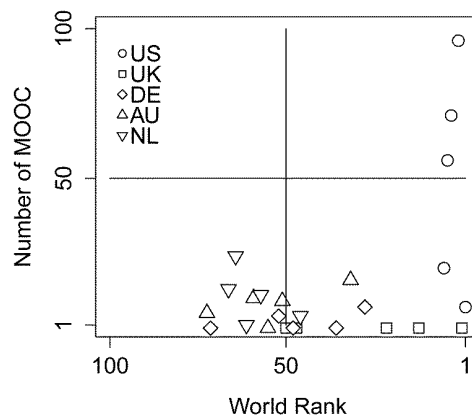

Fig. 5. MOOC leadership matrix for the T5S universities

The MOOC Leadership Matrix shows the dominating role of the US with respect to word ranking and the number of MOOC offerings. Three of its top five universities (Harvard, MIT and Stanford) offer more than 50 MOOC each. Hence, these universities are regarded as Leaders. It is noteworthy that all three are not only content providers;

they are also involved in the development of MOOC platforms. MIT and Harvard founded edX/Open edX and Stanford has contributed to Open edX.

Table 13
Detailed MOOC leadership matrix

Quadrant	US	UK	DE	AU	NL
Leaders	Stanford				
	MIT				
	Harvard				
Tradition-alists	Caltech	Oxford	LMU	Melbourne	Wageningen
	Princeton	Cambridge	Heidelberg		
		Imperial	Humboldt		
		UCL			
Aspiring					
Laggards		LSE	TU Munich	ANU	Amsterdam
			Free Univ.	Sydney	Utrecht
				Queensland	Delft
				Monash	Leiden

In contrast to the US, British universities seem to be reluctant offering MOOC. Presently, the top universities from the UK virtually do not offer MOOC at all. They seem to find MOOC incompatible to their understanding of tertiary education.

The universities of the remaining three countries offer some MOOC. Although considered as Traditionalists and Laggards both Delft and Melbourne have a reasonable number of MOOC. Germany is not very active in the MOOC market. Only two out of five universities offer MOOC at all; and these two Munich universities run rather limited programs.

4.4. Discussion

We have refrained from a detailed analysis of the current state and future perspective of the MOOC sector as a whole. This would be beyond the scope of our paper. However we consider MOOC an evolution in online education rather than a revolution. Much of the MOOC hype seems to equal frequently observed hypes in information technology, where buzzwords are used to promote new and not so new ideas. We think that the long term success of MOOC depends on several factors, including the following: (1) The ability of platforms and content providers to establish sustainable business models. (2) We consider it as a bottleneck that most MOOC do not offer certificates yet. Certificates, signalling qualifications, are required to avoid challenges of asymmetric information in the professional job market. (3) The ability of MOOC to provide learning experiences that are superior to traditional face-to-face education (Zemsky, 2014). In particular, the University of Oxford seems to make a bold statement regarding this issue (University of Oxford, 2014). (4) How much of the current MOOC hype is a result of its novelty, though it is perhaps illusionary to study at a world class university like Harvard or MIT. To put it this way: HarvardX is Harvard but it is not Harvard and MITx is MIT but it is not MIT.

Nevertheless, we assume that MOOC in a wider sense will become an important part of online education in the long run. Many of the features of social media have not been new to education but now they have been professionally integrated in platforms associated with MOOC. However, these are platforms that are much more than just MOOC platforms; they can be used to support any kind of online learning independently of factors such as the size of the class or if they are offered for free or not.

As the sector is characterized by network effects and economies of scale, the actors that manage to establish networks are most likely to become dominant players (Stewart, 2013). Our comparative analysis discloses that the US is by far the leading country currently. The US leads in three of our four categories, i.e. with respect to the h-index, the Gini-coefficient and the MOOC Leadership Matrix. It is only in the category that compares MOOC sector output with GDP that the smaller countries Australia and the Netherlands are leading. A reason for their involvement could be that the Australian and the Dutch tertiary sectors have traditionally been internationally minded. However, this criterion is irrelevant with respect to network effects. Germany is virtually invisible in the MOOC sector and is significantly lagging behind. Budget constraints and insufficient funding resources might be reasons as well as language barriers, i.e. that English is required as a tuition language if the goal is to attract large numbers of international users. Note, the Netherlands also faces similar language challenges, but as a smaller country its universities have possibly already needed to develop stronger international links. The UK universities, excluding the University of London International Programmes, seem to take a firm position that MOOC are not compatible with the kind of education they think is best. So with respect to network effects and economies of scale the US already has a significant head start and this is further supported by the excellent reputation of its most active universities in the MOOC sector. Hence there is a reasonable chance that these universities will continue to dominate the MOOC market.

The same applies to the MOOC platforms. The US platforms Coursera and edX/Open edX dominate the market already. They have fundamentally different business models. Coursera is a for-profit company while edX is a platform provider and runs on open-source software. They will also leverage on network effects and economies of scale to further strengthen their leading positions in the international online education market.

5. Conclusion

In our paper we have analysed the current position of leading platforms and universities in the MOOC market. We focused on the relative position of these supply-sided stakeholders and excluded any detailed analysis of the MOOC sector as its whole. However, we assume that the MOOC hype has already very much revitalized and enriched online learning. Platforms like Coursera and edX are not only limited to MOOC but provide excellent infrastructures for virtually any kind of online education, independent of factors such as the number of students or the business models of the content providers. Therefore, we regard these platforms as a big step forward in online learning.

It will be interesting to watch if and how the platforms and content providers establish sustainable business models. The long term acceptance of MOOC by students needs also to be analysed. Therefore, Harvard and MIT regard their edX not only as a platform but also as a research project holistically addressing online education.

As discussed above, network effects and economies of scale impact online education, in particular MOOC. The US already has a significant head start with respect to the platforms and institutions that provide content. If the MOOC sector continues to flourish, we assume the US will continue to dominate it as in other IT-driven sectors, such as search engines or social media.

References

Conole, G. (2013). MOOCs as disruptive technologies: Strategies for enhancing the learner experience and quality of MOOCs. *Revista de Educación a Distancia, 39*: 4.

Downes, S. (2011). 'Connectivism' and connective knowledge. Huffington Post (Blog), Retrieved from http://www.huffingtonpost.com/stephen-downes/connectivism-and-connecti_b_804653.html

edX. (2013, April 3). *Edx learning platform to be open source and available on June 1*. edX. Retrieved from https://www.edx.org/press/stanford-university-collaborate-edx

Empson, R. (2013). *Stanford's NovoEd brings collaboration and group learning to MOOCs to help fight attrition*. TechCrunch, Retrieved from http://techcrunch.com/2013/04/15/stanfords-novoed-brings-collaboration-and-group-learning-to-moocs-to-help-fight-attrition/

Feigenbaum, A., & Iqani, M. (2015). Quality after the cuts? Higher education practitioners' accounts of systemic challenges to teaching quality in times of 'austerity'. *Journal of Further and Higher Education, 39*(1), 46–66.

Gartner Inc. (2015a). *Gartner research methodologies: Technology-related insights for your critical business decisions*. Gartner Inc. Retrieved from http://www.gartner.com/imagesrv/research/methodologies/methodologies_brochure_14.pdf

Gartner Inc. (2015b). *Gartner's hype cycles for 2015: Five megatrends shift the computing landscape*. Gartner Inc. Retrieved from https://www.gartner.com/doc/3111522/gartners-hype-cycles-megatrends-shift

Hanushek, E. A., & Wößmann, L. (2010). Education and economic growth. In P. Peterson, E. Baker, & B. McGaw (Eds.), *International Encyclopedia of Education* (Vol 2, pp. 245–252).

Henderson, B. (1970). *The product portfolio*. Boston, MA: Boston Consulting Group.

Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences of the United States of America, 102*(46), 16569–16572.

Hoy, M. B. (2014). MOOC 101: An introduction to massive open online courses. *Medical Reference Services Quarterly, 33*(1), 85–91.

Jacoby, J. (2014). The disruptive potential of the massive open online course: A literature review. *Journal of Open, Flexible, and Distance Learning, 18*(1), 73–85.

Kagermann, H., Lukas, W. D., & Wahlster, W. (2011). *Industrie 4.0: Mit dem Internet der Dinge auf dem Weg zur 4*. Industriellen Revolution. VDI Nachrichten, Berlin.

Katz, M. L., & Shapiro, C. (1985). Network externalities, competition, and compatibility. *The American Economic Review, 75*(3), 424–440.

Kolowich, S. (2015, February 5). The MOOC hype fades, in 3 charts. *The Chronicle of Higher Education*. Retrieved from http://chronicle.com/blogs/wiredcampus/the-mooc-fades-in-3-charts/55701

Lamb, E. (2012, November 12). Ask Gini: How to measure inequality. *Scientific American*. Retrieved from http://www.scientificamerican.com/article/ask-gini/

Laurillard, D. (2015, January 16). Five myths about Moocs. *Times Higher Education*. Retrieved from https://www.timeshighereducation.com/comment/opinion/five-myths-

about-moocs/2010480.article

Lowendahl, J. M. (2014). *Hype cycle for education, 2014*. Gartner Inc., Stamford, CT, U.S.A. Retrieved from https://www.gartner.com/doc/2806424/hype-cycle-education-

Lowendahl, J. M. (2015). *Hype cycle for education, 2015*. Gartner Inc., Stamford, CT, U.S.A. Retrieved from https://www.gartner.com/doc/3090218/hype-cycle-education-

LSE. (2015). *Engaging citizens: A game changer for development?* London School of Economics and Political Science. Retrieved from http://www.lse.ac.uk/publicEvents/events/2015/03/20150319t1900vNT.aspx

Parry, M. (2010, August 29). Online, bigger classes may be better classes. *The Chronicle of Higher Education*. Retrieved from http://chronicle.com/article/Open-Teaching-When-the/124170

Peters, G., Sacker, D., & Seruga, J. (2015). A comparative analysis of MOOC - Australia's position in the international education market. In *Proceedings of the 25th Australasian Conference on Information Systems*.Adelaide, Australia.

Rodriguez, O. (2013). The concept of openness behind c and x-MOOC (Massive Open Online Courses). *Open Praxis, 5*(1), 67–73.

Roux, M. (2015). Finance otherwise: The end of banks? In W. A. Barnett& F. Jawadi (Eds.), *Monetary policy in the context of the financial crisis: New challenges and lessons (International Symposia in Economic Theory and Econometrics, vol. 24)* (pp. 517–536). Bingley, UK: Emerald Group Publishing Limited.

Schaffhauser, D. (2015). *MIT intros MOOC 'Micro-Master's'*. Campus Technology. Retrieved from https://campustechnology.com/articles/2015/10/13/mit-intros-mooc-micromasters.aspx

Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning, 2*(1), 3–10.

Siemens, G. (2012). *MOOCs are really a platform*. Elearnspace. Retrieved from http://www.elearnspace.org/blog/2012/07/25/moocs-are-really-a-platform/

Simpson, S. (2015). *Update from academic director*. Charles Perkins Centre, University of Sydney. Retrieved from http://sydney.edu.au/perkins/about/update-from-academic-director.shtml

Stewart, B. (2013). Massiveness + openness = new literacies of participation? *MERLOT Journal of Online Learning and Teaching, 9*(2), 228–238.

UCL. (2015). *UCL MOOC development: Call for expressions of interest to develop UCL's first two MOOCs*. University College London. Retrieved from https://www.ucl.ac.uk/teaching-learning/tl-news/moocs-expression-interest

University of Heidelberg. (2015). *Massive open online course (MOOC) on academic writing*. University of Heidelberg. Retrieved from http://www.asia-europe.uni-heidelberg.de/en/research/publishing/mooc.html

University of Melbourne. (2015). *eLearning design and development*. University of Melbourne. Retrieved from https://le.unimelb.edu.au/elearning-design-and-development

University of Oxford. (2014). *Online courses: A comparison of free vs fee (Department News)*. Department of Continuing Education, University of Oxford. Retrieved from https://www.conted.ox.ac.uk/news/index.php?post=2014-07-21:172733:506

World Bank. (2015). *GDP at market prices (current US$)*. World Bank. Retrieved from http://data.worldbank.org/indicator/NY.GDP.MKTP.CD

Zemsky, R. (2014). With a MOOC MOOC here and a MOOC MOOC there, here a MOOC, there a MOOC, everywhere a MOOC MOOC. *Journal of General Education, 63*(4), 237–243.