What public media reveals about MOOCs: A systematic analysis of news reports

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Abstract

One of the striking differences between MOOCs and previous innovations in the education technology field is the unprecedented interest and involvement of the general public. As MOOCs address pressing problems in higher education and the broader educational practice, awareness of the general public debate around MOOCs is essential. Understanding the public discourse around MOOCs can provide insights into important social and public problems, thus enabling the MOOC research community to better focus their research endeavors. While there have been some reports looking at the state of the MOOC-related research, the analysis of the public debate surrounding MOOCs is still largely missing.

In this paper we present the results of a study that looked at the content of the public discourse related to MOOCs. We identified the most important themes and topics in MOOC-related mainstream news reports. Our results indicate that coverage of MOOCs in public media is rapidly decreasing: by the middle of 2014 it decreased by almost 50% from the highest activity during 2013. In addition, the focus of those discussions is also changing. While the majority of discussions during 2012 and 2013 were focused on MOOC providers, the announcements of their partnerships, and million dollar investments, the current focus of MOOC discourse seems to be moving toward more productive topics focused on the overall position of MOOCs in the global educational landscape. Among different topics that this study discovered, government-related issues and the use of data and analytics are some of the topics that seem to be growing in popularity during the first half of 2014.

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Practitioners Notes

What is already known about this topic

- MOOCs received a significant amount of coverage by the public media, whose importance is widely recognized.
- MOOCs are portrayed as a revolution in education and as "a disruptive" change, despite the long tradition in online and distance education which enabled their development.
- The MOOC research community is becoming more fragmented between researchers with educational and computer science backgrounds.
- Current research focuses on small, isolated studies looking at the effects of the structure of higher education and pedagogical approaches on MOOCs, and case studies about early MOOC experiences.

What this paper adds

- The paper identifies the main themes and topics in the MOOC public discourse.
- Through the analysis of the key themes and how they have changed over time, the paper provides an in-depth analysis of MOOC public debate and points to the important implications for current research and practice.

Implications for practice and/or policy

- MOOC-related coverage in public media is rapidly decreasing. By the second quartile of 2014, coverage decreased by almost 50% from its highest intensity in the third quartile of 2013.
- The tone of the public debate has changed. Public discourse is moving away from discussions related to MOOC providers to the more productive discussions about the position of MOOCs in the global educational landscape.
- Current criticism of MOOCs is primarily focused on the failure of MOOCs to bring the long-awaited revolution in current educational practices.
- Government-related issues and the use of analytics and big data are gaining importance in the public discourse. This suggests the increased focus on government-related regulations, as well as the need for the use of analytics and data for enhancing learning experience in MOOCs.
- There is a significant discussion related to adoption of MOOCs in different parts of the world, including China, India and Australia, pointing to the need for MOOCs to better cater to the needs of different markets.

Introduction

While there have been many innovations in the field of educational technology over the decades, by far the most prominent public discussion in mainstream media has been given to the phenomenon of Massive Open Online Courses (MOOCs). The now well-cited New York Times article by Pappano (2012) labeled 2012 as *"the year of the MOOCs"* and the subsequent reporting in the mainstream media made MOOCs one of the most popular

educational technology buzzwords (Siemens, 2012b). This spontaneous creation of the "MOOC hype" can be seen as a major change that is reflective of an increased democratization and diversification of education and growing calls for a systemic change. According to Bates (2014), a combination of different social, political, and economical reasons are responsible for the surprising high public interest in MOOCs and online education. Those reasons include the potential disruptiveness of MOOCs, involvement of highly respected institutions like Stanford, connections to Silicon Valley entrepreneurs, and the economic climate in the aftermath of the 2008 financial crisis (Bates, 2014). Given that education is listed as one of the humanity's top ten challenges for the next 50 years (Smalley, 2003), MOOCs and the growing interest in online education can be seen as the beginning of the long-awaited changes in education. The educational research community has welcomed MOOCs with a rapidly growing number of conferences, journals, and research papers related to MOOCs (Liyanagunawardena, Adams, & Williams, 2013).

The tone of public discussion about MOOCs has changed significantly since 2012. Initially, supporters of MOOCs were outspoken about the possible impact of MOOCs on the existing educational system. In 2013 and early 2104, critics of MOOCs have also become more noticeable, with some suggesting that MOOCs failed to achieve their promises (Adams, 2013; Lewin, 2013). This change in public opinion is important, especially given the rising challenges of modern education and the broader adoption of online and distance learning. Therefore, it is important to understand the discourse surrounding MOOCs in the public in order to inform future research, and ensure that critical concerns of the broader public interest are thoroughly interrogated and addressed.

In this paper, we present the results of a study that looked at the changes of the public image of MOOCs in the mainstream media. We investigated the key themes and trends in MOOC-related public discussions, as well as how they have developed and changed. As the dataset for our study, we collected 3,958 articles from 591 news sources from around the world using the Dow Jones & Company's Factiva business information and research tool (Dow Jones & Company, 2014). By using the techniques from information retrieval (IR) and data mining (DM), we identified key aspects of MOOC-related public debate. We provide an overview of the areas of particular societal and public importance to the MOOC research community, as some of these trends might dramatically affect broader acceptance of MOOCs and online learning in general.

Origins of MOOCs and the development of MOOC public interest

The vision of MOOCs dates back at least to 2005 and the idea of connectivism and networked learning (Siemens, 2005). Originally envisioned as a platform for supporting connectivist and open learning, the first publicly available MOOC was "Connectivism and Connective Knowledge (CCK08)" in 2008, facilitated by S. Downes and G. Siemens. While it attracted more than 2,300 students (Kolowich, 2014), the mainstream media interest in MOOCs at that time was limited. Only with the offering of the first three open online courses by Stanford University professors — who described them as the revolution in higher education (Friedman, 2012) — did mainstream media start to extensively report on MOOCs and MOOC-related topics. Some disagree with this qualification of MOOCs as a revolution, and refer instead to the implications of MOOCs as an evolution in online

education (Daniel, 2014). This evolution is seen by these proponents as part of a much longer timeline of progress in the field of online education and the increased use of open educational resources (Bali, 2014).

It is interesting to note that Stanford MOOCs had little resemblance with the original MOOCs by S. Downes and G. Siemens, particularly in terms of the adopted pedagogical approach and the overall goals of the courses. The focus of the Stanford MOOCs was primarily on knowledge transmission by means of recorded video lectures, rather than fostering of networked and discussion-based learning — which was the original goal of the MOOCs by S. Downes and G. Siemens. This difference is now well accepted and captured by the commonly used classification of MOOCs into connectivist MOOCs (cMOOCs) and behaviorist MOOCs (xMOOCs) (Daniel, 2014; Siemens, 2012b; Yeager, Hurley-Dasgupta, & Bliss, 2013).

Analysis of MOOC publications

In research, a synthesis of the existing information and knowledge is an essential activity (Mulrow, 1994). While there are many approaches to conducting literature reviews (e.g., full systematic reviews, scoping studies, meta-analyses), they all more or less share a common set of goals (Arksey & O'Malley, 2005; Mulrow, 1994) such as: i) to aggregate and synthesize existing empirical evidence, ii) to investigate the generalizability of research findings, iii) to assess the consistency of relationships and identify inconsistencies in existing research, iv) to classify existing knowledge, and v) to map main concepts in a research domain to their existing sources of evidence. Attainment of these goals represent an important research activity in many different social sciences, including education (Andrews, 2005). Likewise, in the field of online education research, there have been numerous literature review studies focused on many important constructs such as interactions (Bernard et al., 2009), motivation (Kawachi, 2003), social learning theories (Hill, Song, & West, 2009), and the effects of technology use in higher education (Schmid et al., 2014).

Given that MOOCs are still new, there were only few studies that looked at the state of MOOC research. The systematic review by Liyanagunawardena, Adams, and Williams (2013) revealed a strong focus on learners' experience, and to a lesser extent institutional opportunities and threads, with an important gap in the literature related to facilitators' experiences and practices of conducting MOOCs. Furthermore, as learning and interactions in MOOCs often happen on several technological platforms, researchers are typically focused only on a fraction of the available data, which limits the understanding of the complex MOOC phenomena. Liyanagunawardena et al. (2013) identified a large number of studies looking at the effects of the structure of higher education and pedagogical approaches on MOOCs, and case studies reporting on the experiences from the early MOOC offerings.

Another relevant study is a systematic review of the research proposals submitted to the MOOC Research Initiative (MRI) (MOOC Research Initiative, 2013) by Gasevic, Kovanovic, Joksimovic, and Siemens (2014). This study evaluated 266 first stage (2 pages plus citations) research proposals, 78 second stage (5–8 pages plus citations), and 28 funded proposals. In their study, Gasevic et al. (2014) identified five main trends in the current

research on MOOCs: i) student engagement and learning success, ii) MOOC design and curriculum, iii) self-regulated learning and social learning, iv) social network analysis and networked learning, and v) motivation, attitude and success criteria. Furthermore, Gasevic et al. (2014) identified the frequent use of mixed and qualitative research methods, and a possible threat of the fragmentation of the research community — one formed around the MRI initiative dominated by education researchers and another one around the ACM Learning@Scale conference (ACM, Inc., 2014) dominated by computer scientists.

This study: analysis of public discourse surrounding MOOCs

Besides the analysis of research literature, important sources of insight about MOOCs are the discussions occurring in the mainstream media. These public sources can be used to identify important technical, social, institutional, pedagogical, and related challenges surrounding MOOCs. The early stage of MOOC research (Liyanagunawardena et al., 2013) requires an analysis of the discourse about MOOCs in public media, informing future research about the topics of highest societal and public importance and thus making researchers aware of important areas of research. In this paper we provide answers to the following research questions:

1 What are the *main topics* of the public discourse about MOOCs?
2 How has the coverage of MOOCs in public media *changed over time*?
3 *Who is reporting* about MOOCs and how frequently?

The importance of identifying key MOOC challenges is critical to the success of MOOCs as the public perception can contend and even undermine adoption and broader acceptance. For example, the recent closure of inBloom (inBloom, Inc., 2014) — a non-profit organization focused on bringing data analytics into schools — is an example how a public image can have a major effect on the adoption of educational technology (Singer, 2014). Despite the state-of-the-art analytics platform and 100 million dollars in funding received from the Bill and Melinda Gates, and Carnegie foundations — due to the serious concerns from teachers, parents, legal authorities, and education activists regarding privacy of students' personal data raised in the public media — inBloom had to cease their operations (Singer, 2014). With recent media articles related to "anti-MOOCs" (Watters, 2013), "after-MOOC hype" (Stewart, 2013; Young, 2013), and their failure to radically change global education (Lewin, 2013), it is essential to investigate the topics of current MOOC public debates in order to avoid a similar fate. Given the large number of MOOC stakeholders (e.g., students, parents, university professors, prospective employers, education policy makers, university administrators, government, educational technology vendors), and the importance of higher education, the image of MOOCs in mainstream media plays an important role on the overall success of MOOCs and online education.

In the field of journalism and mass communication research, content analysis (Riffe & Freitag, 1997) and discourse analysis (Dijk, 1985) represent two common approaches typically conducted on published media reports. They are also established methods in educational research (De Wever, Schellens, Valcke, & Van Keer, 2006; Rogers, Malancharuvil-Berkes, Mosley, Hui, & Joseph, 2005), with content analysis being frequently used in the fields of e-learning and computer-supported collaborative learning (CSCL) for

the analysis of student discussion messages and other learning products (De Wever et al., 2006; Donnelly & Gardner, 2011).

Despite significant MOOC-related public debate, only a MRI project report by Selwyn and Bulfin (2014) — and a recent article by Bulfin, Pangrazio, and Selwyn (2014) — analyzed the MOOC trends in the general media. Bulfin et. al. (2014) showed the preliminary results of a large-scale study of MOOC publications in the mainstream media. Using critical discourse analysis (CDA), Bulfin et. al. (2014) looked at 457 articles and identified 15 distinctive themes involving MOOCs in the mainstream media. According to Selwyn and Bulfin (2014), MOOCs are currently seen as a relatively *"safe and controllable change in education"* (p. 3) based on *"an economic rather than a pedagogic form, driven by venture capitalism, turning university staff into entrepreneurs"* (p. 3). Selwyn and Bulfin (2014) also observed limited acknowledgment of the early works done by the open education researchers who first introduced MOOCs. MOOCs are promoted as free primarily in the financial sense, contradicting the original idea of MOOCs and openness in education (Selwyn & Bulfin, 2014).

The primary difference between the study by Bulfin, Pangrazio, and Selwyn (2014) and the study presented in this paper is that our dataset is almost nine times larger and thus more comprehensive. Secondly, in addition to a larger number of articles included our approach is less labor intensive, as we adopted an automated data mining technique for topic modeling in the document corpora. Given that our method is fully automated, it can be used for continuous monitoring of MOOCs in mainstream media without a need for labor intensive coding of messages. This can provide a necessary breadth of coverage that can be successfully combined with critical discourse reports for a more comprehensive overview of the developments in the public discussions about MOOCs.

Methods

Dataset

For our study, we looked at the news article archives available through the Factiva platform (Dow Jones & Company, 2014), which is a business information and research tool developed by the Reuters news agency and Dow Jones & Company. We focused on the news articles from the Factiva platform, as it is one of the largest databases of both free and licensed news articles in the world, containing millions of news articles from almost all countries in the world in the last 35 years (Dow Jones & Company, 2014). In order to extract only MOOC-related articles, we searched for all English language articles from Factiva's Education and E-learning categories containing either "MOOC(s)" or "Massive Open Online Course(s)" terms. As we wanted to cover the whole period of MOOC development from 2008, we searched for articles from 2008 up to the end of the first half of 2014. In total, we extracted 4,024 articles from 591 different news sources.

As the Factiva database contains a broad range of documents besides news articles, after the initial data collection we manually examined the quality of the extracted data. We observed two types of documents which were removed from our dataset: i) formal governmental reports (e.g., EU education reports), and ii) transcripts of interviews, typically from people in the education sector, that did not focus on MOOCs per se, but

contained some of our search keywords. In the case of government reports, they were removed, as they were different from typical newspaper articles and were not articles published by the mainstream media (although they could influence the public discourse). With respect to removed interview articles, we evaluated whether MOOCs were an important topic in the interviews. For example, in many cases that we omitted, the "MOOC" keyword appeared only once in the interview, and solely as an element of a long enumeration (e.g., in a list of recent trends in education). We removed those interview articles as they would negatively affect results in two ways: Firstly, by affecting the distributions of word co-occurrences on which all probabilistic topic modeling methods depend, and secondly by inflating the number of articles for some of the discovered topics. Both types of documents were, in general, much longer than typical newspaper articles, so we were able to easily remove them from our dataset. In total, we removed 66 documents leaving the sample of 3,958 news articles for our analysis.

To confirm the validity of our dataset, we used the popular Google Trends service (Google, Inc., 2014) to check for the popularity of the MOOC-related news articles. The Google Trends service is based on Google's search engine and shows the frequency of searches for a particular term. Given the popularity of Google's search, the data from Google Trends is shown to be a reliable predictor of the current and past interests in many different fields (Choi & Varian, 2012; Rech, 2007). We focused only on MOOC-related news searches on Google, as we wanted to check whether the observed changes in the number of MOOC articles over time in our dataset followed a similar pattern as the popularity of MOOC-related news searches. Although we focused on the analysis of MOOC-related news articles written in English, we decided to use Google's global trending for MOOC-related news as: i) we are interested in the overall worldwide debate around MOOCs, and our goal for this search was to validate our dataset against MOOCs' global trends, and ii) English news articles are often translated into other languages and thus the worldwide trending of MOOC-related news should be aligned with the distribution of the English-language news articles from Factiva.

Analysis

In order to examine the important trends in the mainstream media on MOOCs, we used Latent Dirichlet Allocation (LDA) (Blei, Ng, & Jordan, 2003), a popular topic modeling technique for automatic discovery of key themes in a document corpora. The general idea behind LDA is that words that i) co-occur frequently in many documents probably belong to the same topic, and ii) documents can be about many topics at the same time. In LDA, each document is considered a mixture of different topics, while each word is modeled as a multivariate distribution across all possible topics with word co-occurrence being used to shape word-topic associations. LDA is increasingly becoming a key technique for topic modeling due to its simplicity and the usefulness of the discovered topics (Crain, Zhou, Yang, & Zha, 2012). LDA has been applied in many different contexts, including newspaper articles (Wei & Croft, 2006) and historical newspaper articles from the 19th century (Yang, Torget, & Mihalcea, 2011).

Using LDA, we produced a list of topics together with the most frequent words for each one of them, as well as the list of topics for each article. As an implementation platform we used

the **R** programming language (R Core Team, 2013) and its `topicmodels` LDA library (Grun & Hornik, 2014). The first step in our analysis was data pre-processing which consisted of i) word stemming, ii) numbers, URLs, and stop words removal, and iii) the removal of very short words (i.e., words shorter than three characters). This resulted in extraction of 32,589 unique terms. However, as most of the terms appeared in a tiny fraction of documents, we removed terms that did not appear in at least 5% of the documents. The main reason for this was the large reduction in terms of the computational complexity, with the number of unique terms dropping down to only 1,142 terms. In addition, the removal of very rare words improves the usability of the discovered topics by reducing the scarcity of the data that negatively affects the topic modeling algorithms (Hong & Davison, 2010).

After the removal of rare words we also removed frequent, but non-important words from each document, as they were not useful for topic extraction process. To measure the importance of each word for each document in our corpus, we applied the popular and commonly used TF-IDF metric (Manning, Raghavan, & Schütze, 2008). We removed words that were below 90% of the median TF-IDF value to make sure that the most frequently occurring words had been removed. This further reduced the number of analyzed terms down to 757 terms.

Since LDA requires as its input a number of topics in a corpus, we used the maximum log-likelihood optimization method for determining the optimal number of topics, as described by Ponweiser (2012). Given that this optimization method requires performing LDA procedure several hundred times, due to the large number of documents in our dataset, we randomly selected 20% of the data to perform this optimization. After the selection of the optimal number of topics, we used the complete dataset and assigned each news article to the most likely topic. In about 10% of the articles, two or more topics were identified as equally most likely, in which case the particular article was assigned to all of the identified topics. Thus, with the total of 3,958 articles, we obtained 4,486 article-topic assignments.

After the identification of the key MOOC topics, we looked at the distribution of articles from each identified topic over time. As one of the questions of our study was the investigation of the change of discourse in the mainstream media related to MOOCs, we looked at the absolute number of articles for each topic across annual quartiles. This enabled us to check which topics were most frequent at the start of the "MOOC hype" and which became more important over time, as this might provide some insights into the important aspects of MOOCs that research community needs to address.

Results

Figure 1 shows the distribution of news articles across the annual quartiles. Almost all articles were from 2012 to 2014, with only three articles written before 2012: two in the first quartile of 2009 and one in the third quartile of 2010. There were no articles in 2011, which was surprising given that the first xMOOCs started in the fall of 2011. Likewise, there were almost five times more articles written in 2013 (N=2,484) than in 2012 (N=563), which is also interesting, particularly since the "year of the MOOCs" was coined in 2012.

To further validate our dataset, we compared the distribution of articles with the Google Trends scores for MOOC-related news. Figure 2 shows the changes in popularity of MOOC-

related news in the Google search. In general, MOOC-related search trends and the distribution of articles in our dataset followed similar patterns, providing an additional verification of the validity of our dataset to represent the coverage of the MOOC topic in the mainstream media.

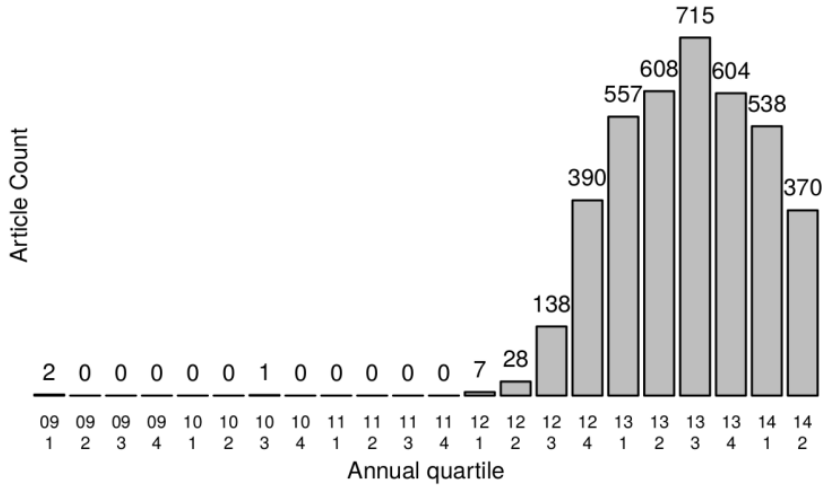

Figure 1*: Numbers of articles per quartile for the period covered by the study*

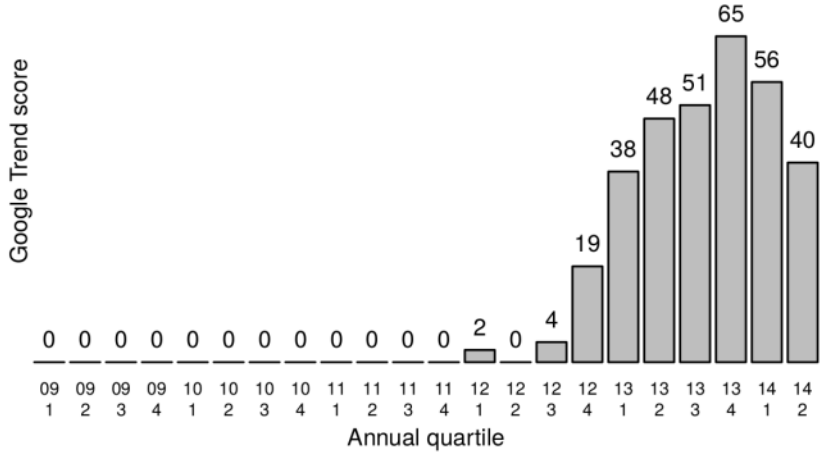

Figure 2*: Google Trends scores for online news containing 'MOOC' term per quartile for the period covered by the study*

The distribution of the number of words per article is shown in Figure 3. It reasonably follows the normal distribution (mean=761 words, SD=564 words), with a longer tail on the right (as the article length cannot be negative). Based on the data provided by the Project for Excellence in Journalism (2004), we can conclude that MOOC-related articles did not deviate from the average newspaper length which is around 800 words.

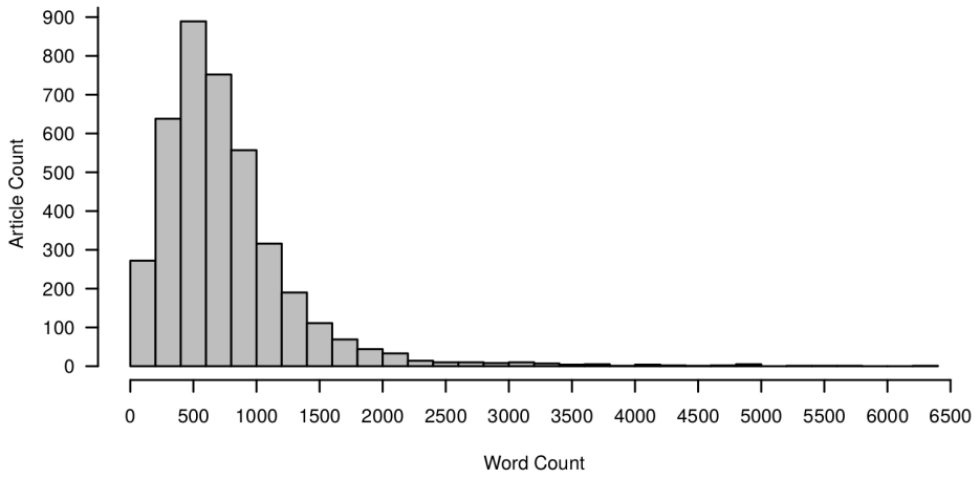

Figure 3: Number of words across all news articles. Mean=761 words, SD=564 words

With respect to different news sources, we collected the data from 591 different sources with the mean of nine articles per source. The number of articles across different news sources is shown in Figure 4. As with the most count data, the number of articles per source reasonably follows the Poisson distribution with the mode of one article per source.

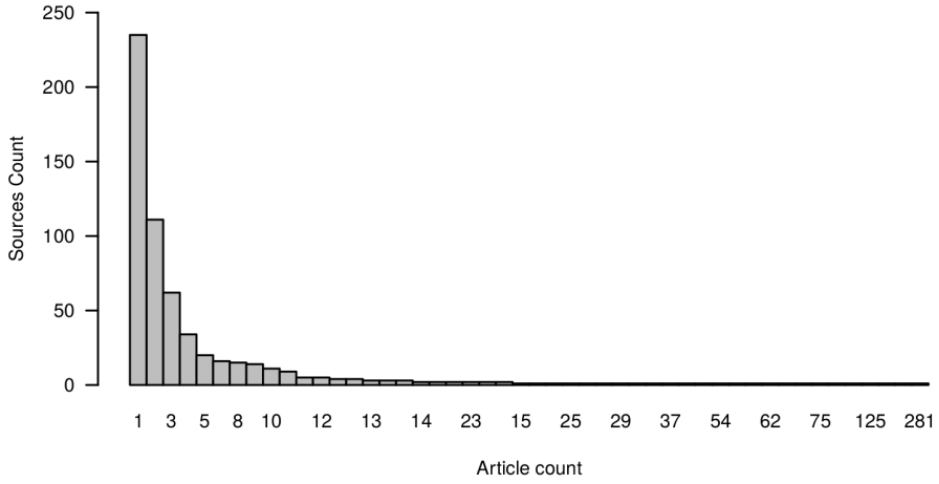

Figure 4: Number of articles across all news sources included in the study. Mean=9 articles, SD=19 articles

Table 1 shows the top twenty news sources and the corresponding number of articles. The source that reported the most about MOOCs is U-Wire (Uloop, Inc., 2014), which is a network of student journalist from more than 800 colleges and universities across the USA. Interestingly, many business and financial newspapers (e.g., The Australian Financial Review, Financial Times, and The Wall Street Journal) reported extensively on MOOCs. Likewise, there are many news sources from Australia in the top of the list, which was an unexpected finding, as the main MOOC providers and early university partners are from the United States. Finally, as expected, publications specifically focused on education (e.g., The

Chronicle of Higher Education and The Times Higher Education Supplement) also extensively covered MOOCs and MOOCs-related topics.

Table 1: Twenty most important news sources

#	Source	Article Count	#	Source	Article Count
1	U-Wire	281	11	The Australian	66
2	The Australian Financial Review	162	12	Business Wire	62
3	Chronicle of Higher Education	143	13	Associated Press Newswires	61
4	The Times Higher Education Supplement	125	14	Education Letter	60
5	PR Newswire (U.S.)	102	15	CMP TechWeb	54
6	The Conversation	83	16	theAustralian.com.au	51
7	Financial Times (FT.Com)	76	17	Financial Times	42
8	NYTimes.com Feed	76	18	The Wall Street Journal	38
9	The New York Times	75	19	The Wall Street Journal Online	38
10	Washington Post.com	69	20	Silicon Valley/San Jose Business Journal Online	37

Figure 5 shows the log-likelihood of the topic modeling with the different number of topics. The optimal number of topics was found to be 92, which was used as the number of topics for the further analysis. Figure 6 shows the number of articles for each topic in the 92-topic solution that we selected. In order to evaluate and label the discovered topics, we looked at the content of the articles assigned to each topic, as well as the list of most important words for each topic (Table 2).

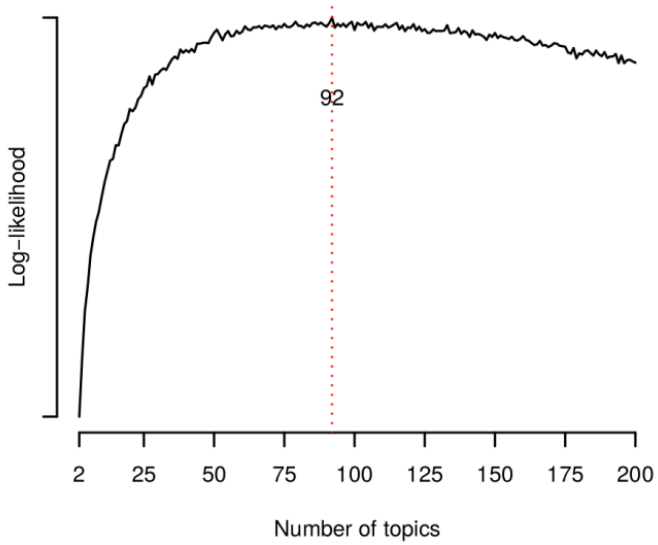

Figure 5: Log-likelihood of different topic solutions

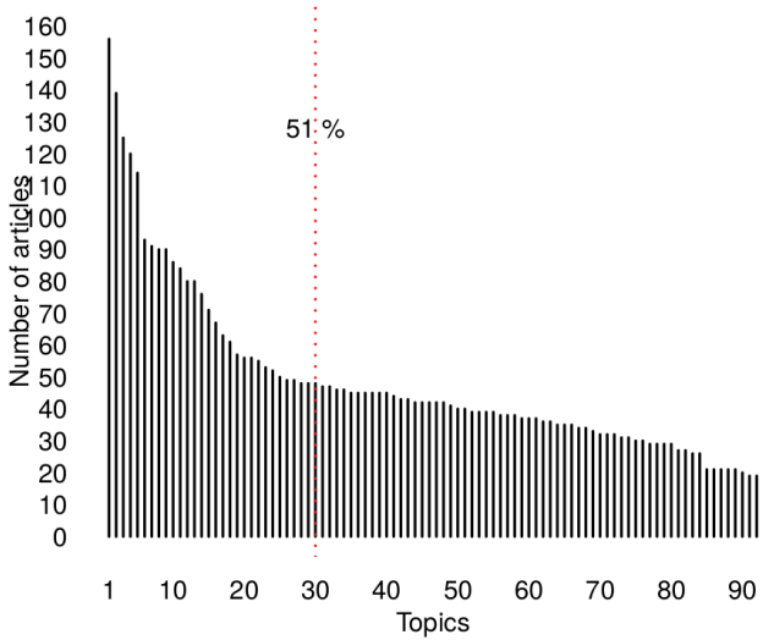

Figure 6: Topic frequencies in optimal, 92-topic solution

In the remainder of the paper, we focus on the top 30 most popular topics, which cumulatively covered just slightly over the half of the article-topic assignments (i.e., about 51%). Table 2 shows label, number of assigned articles, and the list of the ten most characteristic terms for each topic. The most discussed MOOC topics in the mainstream media were related to different MOOC providers, their partnerships with the world's most prestigious universities, and announcements of their new course offerings. Furthermore, rising interests in MOOCs across the world (e.g., Australia, China, and India) made another important group of topics that were frequently discussed. Finally, different aspects of MOOCs (e.g., accreditation, certificates, employability, student loans, flipped classroom, and government regulation) were a large part of MOOC-related discussions in the mainstream media.

To study the trends in the public discourse about MOOCs, we looked at the change in the number of topics over time. Even though our initial goal was to investigate the development of public interest in MOOCs starting from 2008, given that there were only three articles before 2012, we omitted them from this part of our analysis and focused on the period from 2012 onwards. Figure 1 shows the change in the number of articles over time for the top 30 topics. The first four topics related to MOOC providers suffered a dramatic drop in interests over time. On the other hand, some of the topics — such as business and management of MOOCs, government-related issues, employability, mobile computing, conference talks, and data analytics — witnessed an increase in public interest over time. In the next section, we discuss in detail those findings and their implications.

Table 2: Ten most important terms of the top thirty discovered topics

#	Topic Label	N	Distinctive Terms
1	EdX	156	edx, mit, agarwal, join, anant, profit, consortium, berkeley, blended, introduction
2	Coursera	139	coursera, koller, partner, stanford, andrew, founder, daphne, pennsylvanium, udacity, princeton
3	FutureLearn	125	futurelearn, british, london, launch, chancellor, join, partner, david, platform, council
4	Udacity	120	stanford, udacity, thrun, intelligence, artificial, princeton, sebastian, elite, coursera, google
5	MOOCs in Australia	114	international, australian, australium, chancellor, tertiary, overseas, south, enrolment, staff, sector
6	MOOC accreditation	93	credit, college, council, accept, transfer, american, award, toward, grant, adult
7	Business and management MOOCs	91	business, management, dean, executive, manager, finance, corporate, marketing, administration, professional
8	Assessment in MOOCs	90	forum, assignment, video, peer, quiz, grade, watch, final, assistant, minute
9	MOOCs as community college alternative	90	college, community, tuition, adult, throughout, meanwhile, review, accept, fully, reduce
10	MOOCs and cuts in educational funding	86	funding, government, budget, cut, fund, sector, private, billion, policy, reduce
11	MOOCs in India	84	indium, indian, development, community, initiative, skill, collaboration, secretary, visit, partnership
12	MOOCs in California	80	san, californium, udacity, jose, pass, pilot, provider, rate, credit, math
13	MOOCs and growing number of students	80	per, cent, rate, enrolment, average, age, estimate, march, billion, undergraduate
14	MOOCs and problem of student debts	76	college, debt, loan, income, tuition, rate, financial, graduation, family, low
15	MOOCs in the news	71	communication, distribute, uwire, news, opinion, topic, email, concern, hall, address
16	MOOCs in China	67	china, chinese, platform, language, popular, power, website, promote, join, com
17	MOOC startups	63	startup, valley, silicon, business, article, venture, founder, employee, corporate, journal
18	Flipped classroom	61	video, flip, watch, homework, content, tool, method, interactive, minute, concept
19	MOOC conferences	57	conference, event, session, host, speaker, annual, leader, aim, presentation, speak
20	openHPI	56	participant, platform, registration, introduction, learner, register, topic, forum, launch, user
21	MOOCs and virtual classrooms	56	virtual, live, session, teacher, educator, contact, connect, com, award, software
22	Course Builder	55	web, site, google, website, search, org, com, topic, link, project
23	MOOCs and government	53	government, national, sector, minister, council, private, union, infrastructure, development, local
24	Critical review of MOOCs	52	fee, qualification, lecturer, undergraduate, third, towards, assessment, mark, provider, introduction
25	Mobile computing and MOOCs	50	media, mobile, device, app, tablet, user, web, enable, video, content

26	MOOCs and distance education benefits	49	distance, learner, tutor, development, management, attend, chance, interact, contact, accessible
27	Georgia Tech and Udacity MSc	49	tech, georgium, master, udacity, january, low, admit, initial, potentially, toward
28	MOOC certificates	48	certificate, completion, certification, platform, industry, register, assignment, seven, coursera, fee
29	Data analytics in MOOCs	48	datum, software, analyze, analysis, track, user, product, tool, valuable, record
30	MOOCs and employability	48	skill, employer, career, gap, employee, talent, technical, practical, hire, practice

Discussion

The results of the top publishers of MOOC-related news (Table 1) show that — other than education-related news sources — *financial and business newspapers reported extensively on the topic of MOOCs*. The likely reason for this is the fact that MOOC startups raised a significant amount of investment and venture capital, with the biggest one time investment being $60 million by MIT and Harvard university into edX (Desantis, 2012). Additional funding came as several early university systems, such as University of Texas, joined edX (Mildenberg, 2012). This is aligned with the findings of Selwyn and Bulfin (2014) who reported as the most frequently discussed topic "size and scale" (which also includes the size of the investments). Given that MOOCs are driven by capital investment (Selwyn & Bulfin, 2014), the interest of financial newspapers in MOOCs is unsurprising. This explains why MOOC providers (i.e., edX, Coursera, Udacity, and FutureLearn) are identified as the top four topics in our dataset. However, this opens a question as to what extent MOOC providers are driven by research in online and distance education and to what extent they are driven by business and financial goals of particular providers — especially for-profit providers. A disconnect between existing body of research knowledge in online and distance education and MOOC designs (especially early ones) can often be heard on different forums (Gasevic, 2013). Therefore, research that looks at the quality assurance and best pedagogical principles in MOOCs — especially those offered by for-profit organizations — seems to be an important question for the future research.

The distribution of articles across annual quartiles (Figure 1) reveals the *trend of decreasing coverage of MOOCs over time*. In only nine months — between the third quartile of 2013 and the second quartile of 2014 — the number of MOOC articles dropped by almost 50%. Keeping in mind the decrease in the MOOC coverage, it is not surprising that many of the discovered topics witnessed a decrease in their popularity over time. The top four topics related to key MOOC providers suffered a dramatic decline in their popularity over time. What is interesting is that edX and Coursera topics had their 'second' revival in the first quartile of 2014, before declining for the second time. In addition, some of more recent MOOC platforms — such as Google's Course Builder and openHPI by Hasso Plattner Institute — were also discussed, albeit in less volume. OpenHPI is particularly interesting, as it is the only MOOC platform in the top 30 topics that showed an increased interest over time. With its location in Europe (Germany), it is interesting to note the attention of the mainstream media to MOOC providers that come from non-English speaking regions. This could be a sign of a broader adoption of the MOOC phenomena in the attempt to better

cater to the needs of different populations, regions, and economies. Therefore, MOOC localization seems to be an important research topic for future studies.

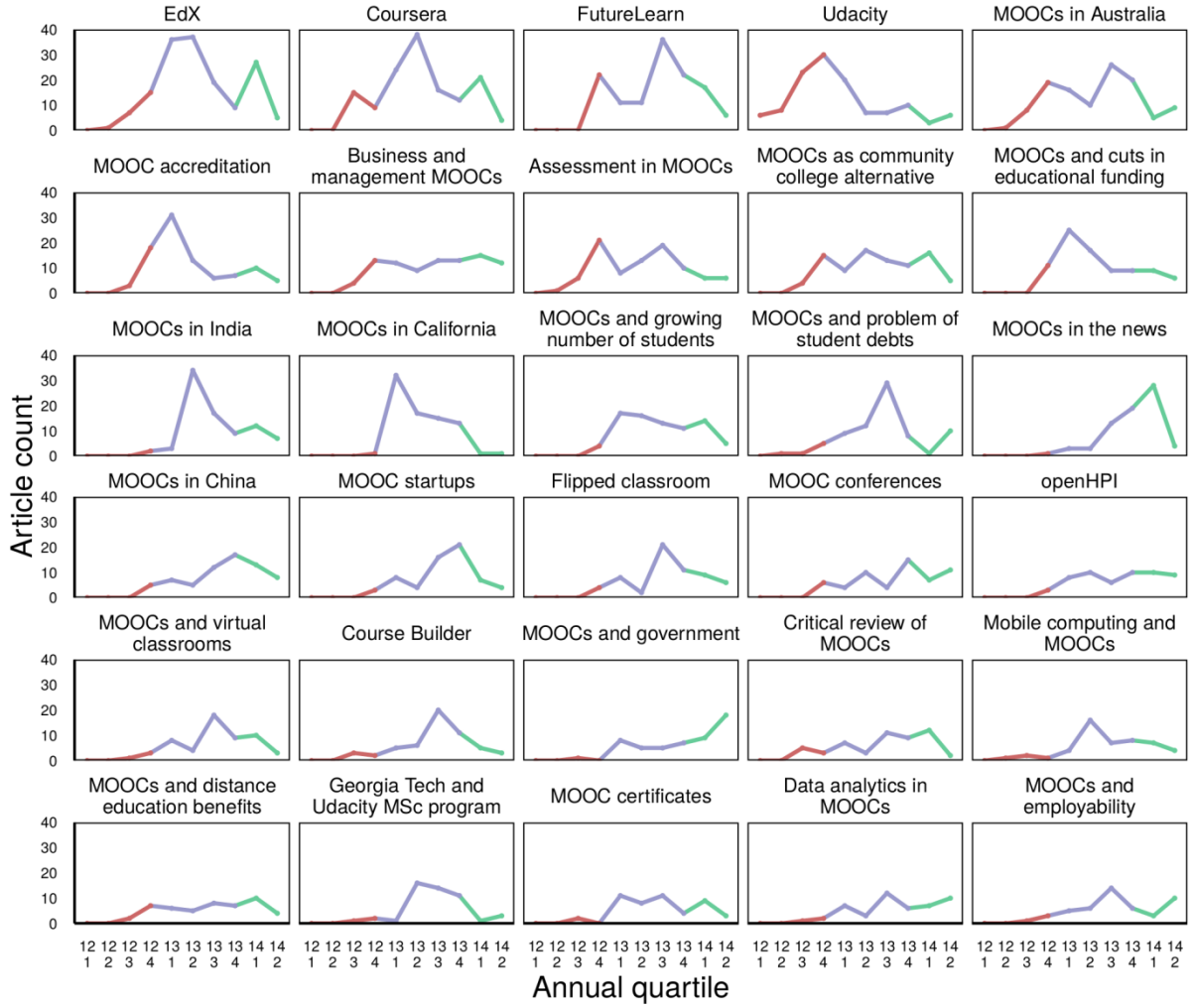

Figure 7: Change in top 30 topics over time. Red, blue and green indicate quartiles of 2012, 2013 and 2014

Another important set of topics which were prominent during 2013 were *uses of MOOCs across the world*, a finding that was also pointed out by Selwyn and Bulfin (2014) in their report. During early 2013, MOOCs were one of the most discussed topics in India. This can be explained by India's large population and the growing need for affordable higher education (Pandey, 2014). The coverage of MOOCs in China had slower progress and peaked by the end of 2013. In addition to China and India, Australia and the United States (specifically California) were two regions of the world that were frequently discussed in the news, with MOOCs in Australia being the fifth most discussed topic overall, just slightly less discussed than the top four MOOC providers. A probable reason for this is the early MOOC involvement of many Australian universities that started offering their own MOOCs (e.g., University of New England, University of Western Australia, University of New South Wales, University of Melbourne), while Open Universities Australia (OUA) developed their

own Open2Study MOOC platform (Counihan, 2013). Likewise, in California MOOCs received significant media attention. Given that original xMOOCs were offered by Stanford University professors and that both Coursera and Udacity are Silicon Valley startups, this is not surprising. In addition, an important collaboration project to improve the California state university system, started by Udacity and San Jose State University, was extensively covered in the news (Hepler, 2013).

While the total number of news articles about MOOCs is decreasing, a certain number of topics show an overall increase in their coverage over time. Those topics include MOOCs and government, data analytics and MOOCs, MOOCs and employment, business and management MOOCs, reports from MOOC conferences, and openHPI platform. It is interesting to observe the increasing trend around government-related discourse. MOOCs are seen as a way of transforming higher education by many governments, including governments of US (Rajan, 2013), UK (Collins, 2014), China (Forestier, 2013) and Nigeria (Ogunmola, 2013). Likewise, the discussion around big data and analytics is also gaining momentum, which might be explained by the recent developments in the Learning Analytics and Educational Data Mining fields (Baker & Siemens, 2013), which have grown considerably over the years (Romero & Ventura, 2010; Siemens, 2012a). The concerns related to the student retention and low completion rates likely emphasized a need for understanding factors that drive success of students in MOOCs. Likewise, adaptation to the needs of individual students and understanding of the student personal profiles (e.g., their knowledge graphs) is another important reason why data-driven methods received considerable attention, which will likely persist in the future. The need for continuous learning in the modern workplace triggered a debate around the role of MOOCs in the modern education space. If a student who took several MOOCs has a reasonable employability in the contemporary market place, then universities — particularly smaller universities and community colleges — need to adapt to this new reality (Matthews, 2013). We can also see that MOOCs are being used as a tool for delivering business and management MOOCs, which is particularly useful for many industry professionals who are transitioning to management positions. Therefore, investigating the position of MOOCs in this new and diversified educational ecosystem — both globally and regionally — is an important research direction which may inform higher education institutions, governments, and private and public sector organizations about the new ways of credentialing and skill recognition.

Finally, the current critical discourse about MOOCs — captured by a single topic — is primarily focused on the failure of MOOCs to radically change the global education. The fact that there is no single "isolated" topic of critique identified suggests that the current MOOC critique is not focused on any particular aspect of MOOCs, but rather on the overall MOOC experience. While critical discussion is an important ingredient of research progression, it is equally important to make sure that the major criticism voiced in the mainstream media is interrogated thoroughly. Future studies that will aim to consolidate understanding of the major concerns in the MOOC space would be a value source that could inform future research. For example, studies that would engage a diverse spectrum of the major stakeholders could try to develop a certain level of consensus of the critical points of

concern that warrant immediate future research. Such studies could be specifically designed to target different regions to better understand and cater to their specific needs.

Limitations

The primary advantage of our approach over critical discourse studies such as the study by Selwyn and Bulfin (2014) is the size of the dataset that is analyzed and the fully automated analysis method. The automation of analysis is important, as it enables continuous monitoring and evaluation of the changes in MOOC public discussion over time. This is not possible with research methods that require extensive labor-intensive manual coding of news articles, as is the case in critical discourse analysis. In our future work, we plan to evaluate and report on the changes in the MOOC public discourse for the second part of 2014, as well as in the future years.

The use of a fully automated procedure also has certain disadvantages. The primary disadvantage is that our analysis does not provide the same level of sophistication and depth as manual critical discourse analysis conducted by an expert researcher. Given that our study focuses on "large numbers", we look at the most frequent and most discussed topics without regards to their source or their overall significance. Hence, we argue that the combination of both types of studies enables for the necessary depth and breadth of analysis of the MOOC coverage in the mainstream media.

The adopted analysis technique also requires selection of several important parameters, most importantly the number of topics to discover. Particular selections of those parameters can significantly affect final results of the analysis, as indicated by McCallum, Mimno, and Wallach (2009). Nonetheless, as with any statistical and data mining procedure, the final results must be evaluated in the context of a given problem, in order to discard meaningless patterns and noise that may appear significant.

Besides technical limitations, for our study we used only English-language articles and thus our analysis might miss some important themes and topics contained in news articles in other languages. Still, given that important news articles are typically translated for their worldwide distribution, we believe that this limitation should not severely impact the validity of our findings.

Conclusion

Understanding of the key trends in MOOC-related public debate is essential for guiding MOOC research towards issues with the highest societal and public interest. In this paper, we presented the results of a study that looked at the most prominent themes and topics in the public discussion and debate around Massive Open Online Courses (MOOCs) and their changes over time. Based on topic modeling — a fully automated data mining technique — we analyzed 3,958 news articles and identified 30 most important topics of MOOC-related discussion. Our analysis revealed several important topics in MOOC public debate and also some general trends related to MOOC public discussions:

1 There is a significant overall decrease in the MOOC press coverage with almost a 50% decline in the public coverage of MOOCs during the nine months from the third quartile of 2013 until the second quartile of 2014.

2 Besides traditionally education-related news sources, financial and business news sources significantly covered the developments in the MOOC world, focusing on the large investments in MOOCs startups and other educational technology companies.
3 Key MOOC providers (i.e., edX, Coursera, Udacity, and FutureLearn) were the primary focus of the news reports. However, this trend is also declining, with most of the MOOC providers receiving a smaller fraction of the press coverage during the first half of 2014.
4 There is a significant discussion related to the MOOC adoption in the different parts of the world such as India, China, USA (California in particular), and Australia.
5 A surprisingly large number of news publishers from Australia extensively covered MOOC-related news, and this resulted in a large number of news articles dedicated to MOOCs in Australia.
6 While the total number of MOOC-related news articles is declining, the number of government-related and data and analytics related articles is increasing. This suggests a rising importance of state-level interest related to MOOCs and the use of analytics for enhancing the MOOC learning experience.
7 Current critique of MOOCs in the mainstream media is general and mostly focused on the failed "revolution in education".

In summary, the public opinion of MOOCs has changed significantly over the past several years. While the total number of news reports shows a clear declining trend, the quality of the discussions appears to be increasing. This can be seen by the shift in the discourse from the different MOOC providers to the qualitative aspects of MOOCs and their position is the global educational landscape. The previous hype around million dollar investments and proclamations of 'disruptive change' has been replaced with more balanced and productive discussions related to the position of MOOCs in the broader spectrum of educational modalities. By looking at the problems of government regulations, employability, and the use of analytics, the research community might provide some of the answers to the issues raised in MOOC public discussions, which might in turn lead MOOCs to the broader adoption and change of the broader educational practices.

Appendix

In order to evaluate and label the discovered topics, we investigated most important terms for each topic and the content of the assigned articles. Given the space allowed for this paper, Table 2 shows only top ten words for each topic. The more detailed list of 50 words for each topic — together with R source code and processed data set for this study — are publicly available at http://github.com/kovanovic/moocs_in_public_media.

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