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Virtually unlimited classrooms: Pedagogical practices in massive open online courses

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ABSTRACT

Massive open online courses (MOOCs) have become a prominent feature of the higher education discourse in recent years. Yet, little is known about the effectiveness of these online courses in engaging participants in the learning process. This study explores the range of pedagogical tools used in 24 MOOCs, including the epistemological and social dimensions of instruction, to consider the extent to which these courses provide students with high-quality, collaborative learning experiences. Findings suggest that the range of pedagogical practices currently used in MOOCs tends toward an objectivist-individual approach, with some efforts to incorporate more constructivist and group-oriented approaches. By examining MOOCs through the lens of engaged teaching and learning, this study raises concerns about the degree to which MOOCs are actually revolutionizing higher education by using technology to improve quality, and challenges educators to strive for more creative and empowering forms of open online learning.

1. Introduction

Online education is the fastest growing segment of higher education (Deming, Goldin, & Katz, 2012). More than 6.1 million students participated in a fully online course during fall 2010, a 10 percent increase over the previous year (Allen & Seaman, 2011). Online instruction, including web-facilitated, blended, hybrid, and fully online courses, has become a fixture of the higher education landscape during the past twenty years, with private, public, and for-profit institutions offering individual courses and degree programs that attempt to replicate and build upon the traditional classroom experience. In 2012, one particular form of online learning – the massive open online course (MOOC) – took center stage in the discourse and sparked debate about the potential of open online education to solve the challenges of access and affordability in higher education. In fact, *The New York Times* went so far as to declare 2012 as "The Year of the MOOC," (Pappano, 2012).

A MOOC is a model for education delivery typically defined as, "*massive*, with theoretically no limit to enrollment; *open*, allowing anyone to participate, usually at no cost; *online*, with learning activities typically taking place over the web; and a *course*, structured around a set of learning goals in a defined area of study" (Educause, 2013, p. 1). Instructors at hundreds of colleges and universities around the world are now offering MOOCs in a broad range of disciplines, from Dinosaur Paleobiology at the University of Alberta to Shakespeare at Wellesley College to Corporate Finance at the University of Pennsylvania. At the same time, a handful of key players, including Coursera, edX, and Udacity, have been instrumental in the development of the movement. According to Daphne Koller, co-founder of Coursera, MOOCs will transform, not disrupt, higher education and leverage technology to improve quality (Korn, 2013). She states, "We don't believe that computers should replace teachers. We think computers can enhance the work of teachers" (Korn, 2013, para. 17).

As a relatively new phenomenon in higher education, research related to MOOCs is limited. These open courses have the potential to challenge traditional notions of classroom, and even online, instruction, yet few empirical studies have examined student learning in MOOCs and little is known about the ways that these courses may challenge the growing stratification of educational opportunities globally. The original MOOCs set out to create an open, collaborative online learning community centered around "the active engagement of several hundred to several thousand 'students' who self-organize their participation according to learning goals, prior knowledge and skills, and common interests," (McAuley, Stewart, Siemens, & Cormier, 2010, p. 4). These learner-centered pedagogical practices and constructivist approaches encouraged student engagement in the learning process. Yet, in many ways the goals of the MOOC movement have shifted to encompass the massification of existing courses and the potential for revenue generation, with elite American universities and private companies leading the charge. The purpose of this study is to consider the extent to which MOOCs provide students with high-quality, collaborative learning experiences. Through case study analysis, we examine the range of pedagogical practices utilized in 24 MOOCs offered by a diverse group of providers and consider how these practices contribute to student engagement in the learning process.

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Three main research questions guide the study, including: (1) What instructional tools and pedagogical practices are being utilized in MOOCs? (2) How are new digital and networked technologies impacting the delivery of MOOCs? (3) To what extent are MOOCs able to provide a space for critical inquiry and active student engagement in the learning process? In the following section, we will provide a brief introduction to the relevant literature on MOOCs and student engagement in online learning environments. We will then discuss the study methodology, including constructivist learning theories and study methods, followed by a presentation of study findings and a discussion of the range and role of pedagogical practices in MOOCs.

2. Literature review

Massive open online courses (MOOCs) have grown out of the Open Educational Resources (OER) movement that flourished in the 1990s, when new online technologies paved the way for interactive and collaborative computer-based learning (Bonk, 2009). OER is defined as educational resources offered online for free to educators, students, and self-learners to enhance teaching and learning (McMartin, 2008; Organization for Economic Cooperation and Development [OECD], 2007). The OER movement "aims to break down…barriers and to encourage and enable sharing content freely" (OECD, 2007, p. 30). Advocates argue that open online education enhances higher education by increasing access to educational materials previously reserved for a limited number of enrolled students and by improving instruction through shared materials and the feedback among educators and learners (Bissell, 2009; Huijser, Bedford, & Bull, 2008). Successful implementation requires a combination of technology, support from faculty and institutional leaders, open licensing, and a diverse community of educators and learners ready to engage in the process (Bissell, 2009; McMartin, 2008). As digital technologies progressed to facilitate more advanced online interaction and collaboration, the principles of OER have been utilized to develop a new kind of open online course.

2.1. Massive open online courses

The term "massive open online course," or MOOC, was first used to describe a course on learning theory taught by George Siemens and Stephen Downes at the University of Manitoba in 2008. According to Downes, the idea was to "invite the rest of the world to join the 25 students who were taking the course for credit" (Parry, 2010, para. 2). The course attracted 2300 students, and has since become "a landmark in the small but growing push toward 'open teaching'" (Parry, 2010, para. 4). The innovative 12-week open online course, Connectivism and Connective Knowledge, was designed as a collaborative learning experience. According to the 2011 course website, the course was based on four types of activities, namely: (1) to "aggregate" materials, or select course readings and resources of interest to the individual; (2) to "remix" those materials, or catalog the chosen content on a blog, discussion board, or other interactive format; (3) to "repurpose" tools to create one's own content and contribution to the discourse; and (4) to "feed forward" one's own thoughts and interpretations in a public forum (http://cck11.mooc.ca/). Students were not required to share their materials publicly but it was encouraged as an integral part of connectivist learning.

Siemens (2005a) and Downes (2007) have advanced a connectivist theory of learning that integrates principles of chaos, network, complexity, and self-organization theories. According to Siemens (2005a), rapid advances in information and communication technology have changed the landscape of learning and knowledge production, and "including technology and connection making as learning activities begins to move learning theories into a digital age" (p. 3). Within the theory, learning networks encompass data, information, knowledge and meaning, and the optimal environment for meaning generation is an open, adaptive, and reflective network that recognizes patterns and incorporates both cognition and emotional response. Siemens (2005b) argues that more emphasis should be placed on advancing the learner's skills in navigating and analyzing information. For Siemens, Downes, and other advocates of open learning, the MOOC grew out of a desire to utilize technology to create a platform for greater access, collaboration and engagement in the learning process.

According to Cormier and Gillis (2010), a MOOC is an online course that engages students in the learning process, offers a way for students to connect and collaborate, and provides a platform where course materials are shared and negotiated among participants. MOOCs also emphasize participant autonomy, creating a broad form of legitimate peripheral participation where individuals negotiate their own level of engagement (McAuley et al., 2010). The pedagogical model driving the initial development of MOOCs focused on incorporating high levels of learner control, offering synchronous, or real-time, sessions with the facilitator and other speakers, providing a digital artifact that summarized course activities (i.e. participant blogs, posts, online discussion, external resources), developing dynamic social systems as a means of participant organization and collaboration, and emphasizing the criticality of creation in the learning process (McAuley et al., 2010). Further, the early MOOCs were designed to be tuition-free, openly accessible courses that did not generally incorporate formal assessment or grading (Levy, 2011).

MOOCs hit the mainstream in 2012 when private companies including Coursera and Udacity were established, and set out to partner with top U.S. universities to develop these open courses for mass consumption, and potential revenue generation. As mentioned previously, MOOCs took center stage in the higher education discourse during this period with enthusiasts pointing to the power of technology to lower costs, increase access, and generate support from industry and the public at large. Advocates argue that MOOCs are helping to revolutionize higher education because "nothing has more potential to lift more people out of poverty" by providing access to an affordable education for employment (Friedman, 2013, para. 1). Further, they note that these courses offer an alternative to location-based education and "undermine the individually crafted course model that sustains the 'college credit monopoly'" (Mazoué, 2013, para. 5). Yet not everyone is convinced that MOOCs will "disrupt" higher education in such positive and productive ways. Many faculty members and higher education analysts remain skeptical that MOOCs offer a viable alternative to traditional face-to-face or online education models with regard to instruction, student learning, and access (Allen & Seaman, 2013; Lewin, 2013; Meisenhelder, 2013; Rhoads, Berdan, & Toven-Lindsey, 2013).

Empirical research on teaching strategies and learning outcomes associated with MOOCs is limited. As courses designed to accommodate unlimited enrollments, MOOCs offer minimal support mechanisms and require that participants be self-directed and have a level of critical literacy adequate to navigate the course and engage in the learning community (Kop, 2011). While more experienced and independent students may thrive in this environment, many participants struggle with the lack of structure and instructional support inherent in these courses (Kop, Fournier, & Mak, 2011). In addition, the commercialization of educational materials is changing the way institutions of higher education interact with the private-sector marketplace and share knowledge with students and society at large (Rhoades & Slaughter, 2004). Considering the limitations of research related to MOOCs, studies of student engagement and pedagogy in traditional online learning environments offer a useful point of reference for this study.

2.2. Engagement and pedagogy in online learning communities

Online learning has become an increasingly important part of U.S. higher education throughout the past several decades, with more than 30% of all college students participating in at least one online course (Allen & Seaman, 2011). By utilizing the latest computer-mediated technology, online courses offer students a wide range of engaging and interactive learning environments that have been shown to foster satisfaction, motivation, and persistence among participants (Arbaugh

& Benbunan-Fich, 2006; Kuh, 2003; Morris, Finnegan, & Wu, 2005; Swan, 2001). Intentional course design that facilitates structured peer interaction, including discussion boards, wikis, and video conferencing, contributes to active learning and critical reflection (Song, Singleton, Hill, & Koh, 2004; Swan, 2001).

Online courses encourage students, as independent learners, to develop skills of personal reflection and abstract conceptualization (Aragon, Johnson, & Shaik, 2002; Vonderwell, Liang, & Alderman, 2007). Yet, Garrison, Anderson, and Archer's (2010) model for a "community of inquiry" in computer-mediated learning environments articulates the need for social presence, cognitive presence, and teaching presence to facilitate critical inquiry and collaborative learning. They argue that online courses should be designed to facilitate meaning making and authentic personal interactions.

Instructors in traditional online learning spaces, with limited enrollments and fixed timelines, are often active participants in the learning process and interact with students on a regular basis despite the lack of face-to-face class time. Research indicates that students in online courses may be more successful and satisfied when instructors provide clear objectives and requirements for the course (Morris et al., 2005), focus on creating a collaborative learning environment (Arbaugh, 2000), offer high levels of instructor–student interactions (Swan, 2001), and deliver meaningful feedback to participants (Eom, Wen, & Ashill, 2006).

While research related to traditional online learning environments provides a strong foundation for the development of effective teaching practices in MOOCs, these open access courses present new challenges for instructors and learners. Therefore, a critical analysis of the pedagogical practices used in MOOCs is both timely and instructive. Ongoing evaluation, feedback from users, and pedagogical considerations are essential to the growth and success of open online education (Thille, 2008).

3. Engaged teaching and learning

Student-centered pedagogy has taken a more prominent position within the higher education discourse in recent decades as educators have challenged traditional modes of teaching focused on lectures and testing (Hannafin & Land, 1997; Mascolo, 2009). In a student-centered approach, the instructor guides and supports students as they develop their own understanding of the concepts as opposed to sharing relevant information and expertise with a passive recipient. Advances in instructional technology have also contributed to this discussion. Learner-centered technologies can offer "greater opportunity to experience learning activities that are internally driven and constructed, goal oriented and reflective, personally meaningful and authentic, collaborative and socially negotiated, and adaptive to individual needs and cultural backgrounds" (Bonk & Cunningham, 1998, pg. 30). As the physical location of participants becomes less important, students' interests and expertise coupled with the use of appropriate pedagogical tools can be a determining factor in creating an engaging and collaborative online community.

Learner-centered education draws its origins from constructivist development theory and the progressive education movement of the 1990s (Mascolo, 2009). Within the constructivist epistemology, there are two main approaches including cognitive constructivism and social constructivism (Powell & Kalina, 2009). Cognitive constructivism focuses on the individual development of knowledge through interaction with the environment, while social constructivism is concerned with student dialogue, interaction, negotiation and the social context in which learning takes place (Bonk & Cunningham, 1998). According to socio-cultural theorists, learning is an integral part of human participation in the world and is influenced by both cognitive and social processes (Lave & Wenger, 1991; Vygotsky, 1978).

Cognitive constructivism is rooted in Piaget's theory of cognitive development, which argues that humans must construct their own knowledge as opposed to merely receiving information (Powell & Kalina, 2009). Instruction therefore focuses on students' understanding of primary sources and interactive materials, including open-ended questions that promote personal inquiry and discovery. Collaboration and peer interaction may be part of the learning but their importance is in modeling and supporting the development of new individual metacognitive skills (Bonk & Cunningham, 1998).

Social constructivism, on the other hand, places dialogue and collaboration at the center of the learning process. Based on Vygotsky's theories of development, social constructivism focuses on the ways that one's environment and interactions, along with various forms of support and scaffolding, impact the individual learning process (Lave & Wenger, 1991; Powell & Kalina, 2009). Cognition is therefore not solely an individual phenomenon but one rooted in social and cultural interaction (Kaptelinin, 1996; Kozulin, Gindis, Ageyev, & Miller, 2003), and meaning is negotiated through language, interaction, and activity (Lave, 1991). "Knowledge is created and recreated between people, as they bring their personal experience and information derived from other sources to bear on solving some particular problem" (Wells, 2000, p. 63). Individual learning is dependent on the institutions, settings, and cultural context of the learner (Bonk & Cunningham, 1998).

Situated learning theory, as advanced by Lave (1991), draws from both cognitive and social constructivism and argues that "learning, thinking and knowing are relations among people engaged in activity in, with and arising from the socially and culturally structured world" (p. 67). From this view, individuals are engaged in communities of practice, and move from peripheral participation to a more engaged, central position as their expertise and connection to the community increase (Lave, 1991). Curriculum is grounded in real world contexts, and instructors focus on mentoring and coaching students to encourage exploration and reflection among participants. Learners engage in socio-cultural transformation in the context of shared practice, whether activities are completed alone or in collaboration with members of a given community (Lave & Wenger, 1991). As stated previously, McAuley et al. (2010) argue that collaborative MOOCs offer students the opportunity to engage in legitimate peripheral participation since these courses are based on learner autonomy and self-directed engagement in the online community of learners.

Critical pedagogy, as defined by Giroux (2001), is closely aligned with theories of constructivism and situated learning. According to Giroux, pedagogy is more than the simple transmission of expertise. Students construct knowledge through careful personal reflection and collaboration with the instructor and their peers. In addition, individuals benefit from the opportunity to connect course content to their own experiences and social context. Giroux (2011) argues that universities have become more closely aligned with the marketplace and corporate interests, to the detriment of public space and critical inquiry. Instead of focusing on the development of a substantive democracy, corporate interests encourage self-interest and consumerism, and education runs the risk of becoming little more than job training. In contrast, Giroux's (2011) concept of "public time" focuses on pedagogical practices where all participants engage in critical dialogue, affirming their role as social agents. For Giroux, all forms of higher education should provide a space for dialogue, questioning, and dissent, even in fields and courses dominated by objectivist approaches to teaching and learning. It is important then that online learning does not expand access at the expense of collaborative learning communities and opportunities for critical engagement in the learning process.

3.1. Collaborative learning in online environments

Constructivist theories of learning have become an important feature of many online learning environments. Herrington and Oliver (1999) assert that meaningful learning can be achieved using computer technology when it is positioned within the social, cultural, and physical context of the learner, and the activities are authentic and practical. Vygotsky's notion of collaborative learning can be seen in online

learning environments that use computer-mediated speech and text as forms of modeling, and that enhance individual cognition by providing space for reflection and revision of written artifacts (Warschauer, 1997). "The text-mediational view links the concepts of expression, interaction, reflection, problem solving, critical thinking, and literacy with the various uses of talk, text, inquiry, and collaboration in the classroom" (Warschauer, 1997, p. 472). With major advances in social media and other networked technology such as video conferencing and file sharing platforms, online collaboration has become even more fluid and dynamic.

As previously stated, establishing a strong sense of community among online learners has been shown to encourage higher levels of satisfaction, persistence, engagement, and cognition (Morris et al., 2005; Rovai, 2002; Swan, 2001). Inter-subjectivity, or the development of shared understanding, also contributes to student learning because as individuals find common ground they are able to contribute ideas, test assumptions, negotiate meanings, and build new knowledge (Bonk & Cunningham, 1998). Further, Lai (2011) points out that online education opens the door to more fluid movement between formal and informal learning environments, and the opportunity to prepare students to be self-directed, life-long learners. The strategies that students utilize in formal learning environments can encourage critical inquiry and engagement in social networking sites and interest-based communities. At the same time, students engage in different strategies while participating in these less formal settings, which in turn can influence formal learning communities.

The Community of Inquiry framework (Garrison, Anderson, & Archer, 2001, Garrison et al., 2010), discussed previously, provides a useful point of reference for constructivist practices in online learning environments. According to Garrison (2007), cognitive presence "is defined as the exploration, construction, resolution and confirmation of understanding through collaboration and reflection in a community of inquiry" (p. 65). Ideally, participants would move beyond a basic understanding of a particular problem toward a more holistic view that incorporates the integration and application of various concepts. Yet, research indicates that this type of collaborative inquiry does not often move beyond the first stage and teaching presence, or the role of the instructor, may be an important factor in predicting this more complex analytical approach (Garrison, 2007). Student-centered teaching approaches such as scaffolding, modeling, and providing ongoing feedback and encouragement, can go a long way in helping individuals and learning communities gain a deeper understanding of course concepts (Bonk & Cunningham, 1998). According to Garrison (2007), effective teaching presence incorporates course design, facilitation, and direct instruction, and encourages instructors to be highly engaged in the learning process without dominating the discourse and limiting opportunities for student collaboration.

4. Methodology

As previously discussed, MOOCs challenge traditional notions of teaching and learning by moving beyond the limits of time and place to include any student who wishes to participate. In this study, we investigate the various instructional techniques present in MOOCs and consider how these tools might impact student engagement in the learning process. To support this line of inquiry, we utilize a framework developed by Arbaugh and Benbunan-Fich (2006) to examine the epistemological and social dimensions of teaching in online education.

4.1. Teaching Approach Framework

Arbaugh and Benbunan-Fich (2006) developed a theory-driven framework to "examine the relationship between teaching approaches and online learning environments in terms of student learning and satisfaction" (p. 436). As illustrated in Table 1, their Teaching Approach Framework is based on the epistemological and social dimensions of instruction, including two intersecting continua from objectivist to constructivist knowledge and individual to group learning. These four teaching approaches encompass a broad range of pedagogical practices in online learning environments.

In the Teaching Approach Framework, objectivist and constructivist dimensions are used to consider "how knowledge is delivered to the students" while the continuum of individual to group learning focuses on the social dimensions of cognition, or "whether learning is expected to occur by way of individual or group-based methods" (p. 436). According to Arbaugh and Benbunan-Fich (2006), the main assumption of the objectivist approach is a "single objective reality" while the goal of learning is to "understand and assimilate that reality" (p. 436). In contrast, a constructivist method is based on the assumption that knowledge is created and developed by learners.

The constructivist-individual approach assumes that "knowledge is constructed in the students' head" while the constructivist-group approach assumes that knowledge is "socially constructed in the world" (p. 436). Instead of solely providing students with instructional sequences, constructivist teachers utilize problem solving and meaningful tasks based on context. This constructivist-group approach aligns with notions of engaged and critical pedagogy where students are active participants in the learning process, articulate their beliefs, and connect their education to real-world experiences (Giroux, 2011; Hooks, 2009). This framework is a useful tool to consider the wide range of pedagogical tools being used in MOOCs, and how various teaching approaches impact learning and engagement among participants.

4.2. Methods

This study utilizes qualitative multi-case study analysis to examine the wide range of pedagogical practices used in MOOCs. A case study involves a thorough examination of a particular event, subject, or phenomenon (Bogdan & Knopp Biklen, 2007; Cohen, Manion, & Morrison, 2000) with special attention to the surrounding context and circumstances (Creswell, 2014; Merriam, 1998). It does not have to involve a single person but can represent "whatever 'bounded system'… is of interest" (Stake, 1978, p. 7). Case studies focus on "holistic description and explanation" and provide a framework for a deeper understanding of a particular phenomenon through thick description and the illumination of broader meaning (Merriam, 1998, p. 192–193). In this study, we define the case as a single MOOC and we examined 24 such cases.

4.2.1. Sample

We utilized Biglan's (1973) model for categorizing academic disciplines to select 24 university-level MOOCs that represent a broad range of topics and disciplines, including the social sciences, humanities and STEM fields (see Table 2). Biglan clusters academic disciplines along three dimensions based on subject matter: (1) hard and soft sciences, as defined by the degree to which foundational and agreed-upon paradigms shape the field, (2) pure and applied (relating to the level of practical application), and (3) "concern with life systems" (p. 204).

Our goal in this study was not to provide a comprehensive list of MOOCs but instead we present a diverse sample of courses and instructional tools and offer a critical analysis of their implications for course design and student engagement. Through purposive case sampling (Arnold, 1970), we selected MOOCs from 16 course platforms that represent a broad range of open course content and delivery, and included public and private universities, private companies, and not-for-profit enterprises. For a complete list of course providers included in this study, see Appendix A.

4.2.2. Data collection

Participant observation is a primary source of data collection for observational case study analysis (Bogdan & Knopp Biklen, 2007). This study presented an atypical environment for observation in that MOOCs have no physical meeting place and accommodate unlimited

Table 1
Teaching Approach Framework (Arbaugh & Benbunan-Fich, 2006).

		Social dimension	
		Individual	Group
Epistemological dimension	Objectivist	Single objective reality. Knowledge is transmitted. Abstract instruction out of context. Emphasis on instructional sequences. Individual mastery of material. Emphasis on learner–instructor interaction.	Single objective reality. Knowledge is transmitted. Instructional sequence combined with group activities. Working with peers reinforces learning and contextualizes concepts. Emphasis on learner–instructor and learner–learner interaction.
	Constructivist	Multiple realities. Knowledge is created individually. Engagement with the subject matter. Authentic tasks in meaningful contexts. Emphasis on learner content interaction.	Multiple realities. Knowledge is created. Collaborative construction of knowledge by interacting with peers. Authentic/meaningful group tasks. Emphasis on learner–content and learner–learner interaction.

student enrollment. Therefore, the research team collected data by reviewing the curriculum and content of the online courses and carefully categorizing pedagogical practices. As open-access courses, MOOCs do not require participants to provide personal information, engage with fellow students, or even complete their coursework and all course-related materials are publicly available to any interested party. Therefore, the research team was able to observe the various instructional elements present in each course without impacting the learning experience of other participants.

Lincoln and Guba (1986) argue that naturalistic inquiry requires rigorous methods, including prolonged engagement, triangulation, and thick narrative description, to strive for trustworthiness and authenticity in results. To gain a deeper understanding of the structure, design, context, and range of instructional tools used in the sample MOOCs, we surveyed the various teaching methods, completed select course modules, exams, and activities, and followed online discussion boards and other collaborative components. Students can generally move through MOOCs at their own pace, and, therefore, we were able to spend significant time examining course material and the different instructional elements of each course without concern for limited access or availability of materials.

4.2.3. Data analysis

We used Arbaugh and Benbunan-Fich's (2006) Teaching Approach Framework to identify and categorize the various pedagogical tools present in the sample, including course schedules, lessons and content, assignments, quizzes and exams, grading, student collaboration, instructor interaction, and any additional resources. It should be noted that while Arbaugh and Benbunan-Fich employ their framework to articulate the cumulative teaching approach used in an online course, we used the four categories – objectivist-individual, objectivist-group, constructivist-individual and constructivist-group – to characterize the various pedagogical approaches used in different components within each course in the sample (we found it impossible to categorize an entire course given the array of teaching modalities employed in any one course). The goal of this study is to gain a better understanding of the range of pedagogical tools used in MOOCs, and it is therefore instructive to examine individual course components, such as lectures, exams, and discussions, in this manner. Table 3 provides information about the teaching approaches used in each course.

Table 2
MOOCs included in the study, according to the Biglan model.

	Hard	Soft
Pure life	Biology	Philosophy
	Biology	Sociology
	Biology	Social theory
Pure non-life	Statistics	Geography
	Statistics	English composition
	Physics	Poetry
Applied life	Medicine	Health and climate
	Nursing	Law
	Public health	Gaming
Applied non-life	Chemical engineering	Product development
	Engineering	Development economics
	Computer graphics	Macroeconomics

5. Findings

The introduction of MOOCs into the higher education landscape is challenging the way educators conceptualize teaching and learning, and traditional notions of online education. Instead of offering online courses with limited enrollments and finding ways to encourage student–instructor interaction online, MOOCs often rely on automated instructional tools to take the place of real-time teaching. Although there is significant variation in pedagogical approaches, the majority of courses still utilize elements that are common in traditional classrooms, including lectures, multiple-choice assessments, and topical group discussions. In the following sections, we present our findings using the four categories of the Teaching Approach Framework. Tables 4 through 7 also provide an overview of the modes of instruction, assessment, and interaction found in each course.

5.1. Objectivist-individual approach

All of the MOOCs included in this study utilized the objectivist-individual approach in some way, as seen in Table 3. This instructional approach relies on the assumption of a single objective reality, and focuses on the transmission of knowledge with an emphasis on instructional sequence and individual mastery (Arbaugh & Benbunan-Fich, 2006). It is not surprising that MOOCs would feature extensive use of an objectivist-individual teaching method considering that nearly all forms of traditional face-to-face teaching and online learning utilize this approach. Teaching and learning inherently involve the transfer of information from an expert to the novice, and therefore it can be useful and efficient to use the objectivist-individual approach. At the same time, research indicates that students are more satisfied with online courses that include higher levels of interaction and reflection (Arbaugh, 2000; Vonderwell et al., 2007).

The courses in this study utilized a range of instructional tools to facilitate an objectivist-individual teaching approach, including video recordings, computer graphics, and text-based lessons, assignments, and assessments. Eighteen courses (75%) made extensive use of text-based lessons and readings to provide students with information (see Table 4). Some MOOCs were made up of text-based modules specifically designed for online learners with illustrations, simulations, and review questions built into the platform to encourage engagement with course content. An example of this approach would be a course designed by Carnegie Mellon University's Open Learning Initiative, which was

Table 3
MOOC course components, according to the Teaching Approach Framework.

	Objectivist-individual[a]	Objectivist-group[b]	Constructivist-individual[c]	Constructivist-group[d]
Hard				
Biology 1	x			
Biology 2	x			
Biology 3	x	x		
Chemical engineering	x			
Computer graphics	x	x	x	
Engineering	x			
Medicine	x	x		
Nursing	x	x	x	x
Physics	x	x	x	
Public health	x			
Statistics 1	x	x		
Statistics 2	x	x		
Soft				
Economics	x	x	x	x
English composition	x	x	x	x
Gaming	x	x	x	
Geography	x			
Health and climate	x	x	x	x
Law	x	x	x	x
Macroeconomics	x		x	
Philosophy	x	x	x	x
Poetry	x			
Product development	x	x	x	x
Social theory	x			
Sociology	x	x	x	x

Note: This table illustrates the categorization of individual course components according to the Teaching Approach Framework by Arbaugh and Benbunan-Fich (2006) and not the overall pedagogical structure of each course.
[a] Pedagogical tools in this category include: recorded lectures, textbooks, multiple-choice and single-answer assessments.
[b] Pedagogical tools in this category include: discussion boards with question-and-answer exchange.
[c] Pedagogical tools in this category include: independent activities related to content, discussion board posts, interactive online labs, and links to external online resources.
[d] Pedagogical tools in this category include: peer-reviewed writing assignments, threaded/thematic discussion board dialogue, instructor questions/prompts for discussion, and live video conference/events with instructor.

"designed with learning activities dispersed throughout the content" as well as "self-assessments, in combination with clear learning objectives" that independent learners can use to ensure that they are mastering the material without the help of an instructor or peers (http://oli.cmu.edu/learn-with-oli/get-tips-for-better-learning/). Other courses used open source textbooks, online resources specifically developed for the course, or links to academic content that is freely available on the Internet.

Instructors in 22 courses (92%) utilized video recordings in some way to share information, including PowerPoint slides with voiceover instruction, recordings of the instructor speaking directly into the camera, an animated whiteboard where the instructor could "draw" text and formulas, recordings from a traditional classroom setting, and full animation or use of an avatar (see Table 4). The Open Yale Course in this study, for example, was made up of videos of the instructor lecturing in a traditional classroom, along with a course reading list and some additional resources. The idea is that participants can be a "fly on the wall" in a course taught at one of the most prestigious universities in the world, but there is no opportunity to engage with other students or the instructor directly. Yet, as the following section will illustrate, some MOOCs have incorporated more collaborative elements and new ways to assess learning with the help of advances in computer-mediated technology.

5.2. Objectivist-group approach

Although group interaction was not necessarily a requirement for course completion, a number of MOOCs in the sample tried to build collaborative activities into the curriculum to encourage engagement among peers. According to Arbaugh and Benbunan-Fich (2006), "Collaborative activities allow learners greater opportunities for increased social presence and a greater sense of online community, both of which have been associated with positive online course outcomes" (p. 439). Based on the sample, a group-oriented approach was more common in MOOCs that have a specified start and end date. Forty-six% (11) of the MOOCs in this study used a pre-determined timeline for instruction. In these courses, students generally moved through the material at the same time, accessing information as it became available each week and submitting assignments and exams by specific deadlines, all of which lends itself to higher levels of group dialogue and even collaboration.

The objectivist-group approach is still based on a "one-way transmission of objective content from the instructor to the student" but it also "requires the students to work together and cooperate in completing group assignments" (Arbaugh & Benbunan-Fich, 2006, p. 438). Among the courses in the sample, instructors did not incorporate group assignments very often and those that did were not generally using a highly constructivist approach. One pedagogical tool that was used quite frequently to encourage interaction among students was the online discussion board. Discussion boards were present in more than 65% of the sample (see Table 5). Participation varied greatly with some courses having very limited activity, others including only concrete question-and-answer style exchanges between students, and a few enjoying a more constructivist orientation with extensive discussion and threaded conversations between groups of students.

For example, thousands of students have taken one of the statistics courses from the sample since its inception. As an open-access course with no specific start and end date or restrictions for accessing materials, students work through the material alone and can post questions to the discussion board if they need help figuring out a concept or completing a particular assignment. This particular course includes an extensive discussion board with hundreds of topics, but the vast majority of these posts offer limited threaded conversation among students. For example, one topic entitled, "how do you plot graphs using Python," had only 37 posts where students answered this question in various ways but the thread had been viewed more than 25,000

Table 4
Mode of instruction.

	Text/digital textbook	Illustrations; simulations[a]	White board voiceover[b]	Power point slides (PPT)	PPT w/voiceover[c]	Instructor talking to camera[d]	Recorded traditional lecture[e]	Animation/avatar[f]
Hard								
Biology 1	x	x						
Biology 2	x	x						x
Biology 3							x	
Chemical engineering	x				x	x		
Computer graphics	x	x			x	x		
Engineering	x	x			x			
Medicine	x				x	x		
Nursing	x				x	x		
Physics			x			x		
Public health					x		x	
Statistics 1	x			x		x		
Statistics 2			x			x		
Percentage within group	*67*	*33*	*17*	*8*	*50*	*58*	*17*	*8*
Soft								
Economics					x	x		
English composition	x				x	x		
Gaming	x	x						x
Geography	x	x						
Health and climate	x				x			
Law	x	x		x		x		
Macroeconomics	x	x			x	x		x
Philosophy	x			x			x	
Poetry						x		
Product development	x	x			x	x		
Philosophy	x						x	
Sociology	x				x	x		
Percentage within group	*83*	*42*	*0*	*17*	*50*	*58*	*17*	*17*
Percentage of total	75	38	8	13	50	58	17	13

[a] Category includes static digital images and interactive digital images. Both were used to help further explain concepts in the curriculum.
[b] Category includes digital whiteboard image with instructor drawing text and images while talking to the student. Instructor's face is generally not visible.
[c] Category includes video capture of PowerPoint slides with voiceover from instructor to help explain concepts.
[d] Category includes video capture of course instructor talking directly into the camera. Often coupled with PowerPoint slides, whiteboard, etc.
[e] Category includes video capture of classroom with instructor lecturing to a room of students. Often includes chalkboard, whiteboard, or other tools.
[f] Category includes use of avatar as instructor, with recorded voiceover, or use of animation/animated figures to teach course concepts.

times. One can imagine that students search and review old posts to help answer their questions as they work independently to complete the MOOC. In this way, the discussion board does not necessarily provide a platform for collaborative group learning in this course. Yet, even in an open course where students are working on the materials independently and only a small percentage of students actively participate in online discussions, the discussion board still appears to be a valuable resource for these independent learners.

5.3. Constructivist-individual approach

According to Arbaugh and Benbunan-Fich (2006), the constructivist-individual teaching approach "assumes that students construct their own knowledge independently by actively interacting with the subject matter and combining information from different sources" (p. 438). A number of courses in the sample used instructional methods that encouraged students to interact with course material, consider external sources, and articulate their own understanding of particular topics. Eight of the 24 MOOCs in the sample, or one third, used open-ended, short-response questions in assignments and quizzes (see Tables 6 and 7). Students could generally compare their own response to a computer-generated or static answer key provided by the instructor, but five courses also included open-ended questions without supplying a correct response or explanation. Many courses also encouraged students to utilize external resources, including websites, open access textbooks, reports, and online labs and simulations.

Six MOOCs, or 25% of the sample, incorporated independent activities into course curriculum to encourage students to engage with the material and put their learning in context (see Table 6). Some activities were required while others provided optional practice for students. The instructor in the physics course, for example, asked students to conduct their own experiments including calculating the circumference of the earth by measuring shadows. Although this assignment was not graded, it gave students the opportunity to apply the principles presented by the instructor in a real world setting. Yet, as an optional assignment, it is difficult to know whether or not students actually utilized this activity to deepen their understanding of physics.

Another example was an optional assignment in the nursing course that encouraged students to make a list of all the people that patients in their particular unit interact with each day, and to consider how these health care providers and support staff might coordinate their care in more effective and efficient ways based on the principles introduced in the course. Again, as an optional assignment, students would have to be self-motivated to go above and beyond the requirements of the course to complete this activity but it does offer students a concrete example of how the course principles might affect their professional setting.

5.4. Constructivist-group approach

The constructivist-group teaching approach encourages the highest level of collaboration and critical inquiry among participants because "students have to interact with others in the knowledge construction process" (Arbaugh & Benbunan-Fich, 2006, p. 438). While none of the MOOCs in this study utilized this approach for the majority of course activities, one third of the courses incorporated a constructivist-group activity in some way, including peer-reviewed writing assignments, required group activities or debates on the discussion board, and live video conferencing with the instructor (see Table 3).

Instructors in five of the courses posed open-ended questions and required students to submit written responses that were then redistributed

Table 5
Mode of interaction among peers and with the instructor.

	Student interaction				*Instructor/TA interaction*		
	Discussion board Q&A[a]	Discussion board dialogue[b]	Discussion prompts[c]	Chat/Study groups[d]	Static posts	Active on discussion board	Synchronous, "live" event[e]
Hard							
Biology 1							
Biology 2							
Biology 3	x			x			
Chemical engineering							
Computer graphics	x	x		x	x	x	
Engineering							
Medicine	x	x		x	x		
Nursing							
Physics	x				x		
Public health							
Statistics 1	x	x			x		
Statistics 2	x			x		x	
Percentage within group	*50*	*25*	*0*	*33*	*33*	*17*	*0*
Soft							
Economics	x	x	x			x	
English composition	x	x		x	x		
Gaming	x	x				x	
Geography							
Health and climate	x	x	x		x		x
Law	x	x	x	x		x	
Macroeconomics	x		x				
Philosophy	x	x	x		x	x	
Poetry	x					x	
Product development	x	x	x		x		
Philosophy							
Sociology	x	x			x		x
Percentage within group	*83*	*67*	*50*	*17*	*42*	*42*	*17*
Percentage of total	67	46	25	25	38	29	8

[a] Category includes courses where discussion board served as a platform for question and answer sessions as opposed to discussion/dialogue among participants.
[b] Category includes courses where discussion board served as a platform for threaded, back-and-forth dialogue among participants.
[c] Category includes courses where instructor posted prompts on the discussion board, students were asked to pose questions for discussion on the boards, etc.
[d] Category includes those courses that offered platform for chat or study groups, student-led study groups, etc. Designation does not equate to significant use by participants.
[e] Category includes synchronous or "live" sessions hosted by instructor/TA such as virtual office hours, webcasts, and Skype chats with select students broadcast for full class.

and reviewed by fellow students. Typically, students who submitted a written response critiqued the writing of a handful of their peers using a grading rubric supplied by the instructor. Students earned points for participation more than substance, and course discussion boards evidenced mixed reviews of the effectiveness of the peer-review process with comments about the helpfulness of feedback, challenges of cultural differences, and uncertainty about assignment parameters.

More than 45% of the MOOCs in this study featured some level of topical student dialogue on discussion boards (see Table 5). Some instructors posted open-ended questions or prompts to spur dialogue, while other courses provided students with a platform to create optional study groups or engage in independent online chat with peers. The instructor of the philosophy course, for example, polled students for their opinion about a particular societal phenomenon and then required students to discuss in groups. One thread arguing against the "effectiveness of torture" included more than 200 comments and extensive dialogue between students about this topic. Yet, this thread was the outlier and the vast majority of discussion prompts garnered limited discussion with only a handful of peer responses or none at all.

A course on human health and climate change provided the best example of a required group activity with a constructivist approach that was incorporated into the course curriculum. In this particular course, students signed up to participate in one of more than 40 "discussion solution groups" (DSG) and then responded to a prompt from the instructor to provide an example of a "best in class" company/organization in that category. Students voted for their favorite responses and the top ten selections moved on to the next round of the activity.

This DSG activity included three rounds of postings and voting that built on each other to engage students in discussion about specific topics of interest. Thousands of students participated in DSGs through each round and voted for their favorite posts at each opportunity. In response to one DSG, a teaching assistant posted a personal comment praising the group for their participation, courtesy, and thoughtful responses, stating that it was "exactly as we envisioned for an interactive student dialogue."

While peer-reviewed assignments can be a highly useful tool in MOOCs to facilitate open-ended writing assignments and engagement with course material, students are still completing these activities independently with limited opportunity for collaboration. Even discussion board assignments where students are required to post a response to a particular prompt from the instructor do not necessarily encourage group collaboration and learning since students generally just respond to the question and do not engage in a robust dialogue on a particular topic. This trend was evident in the criminal law course where the instructor required students to comment on a specific topic each week, such as capital punishment or the insanity defense. Many students completed this course requirement by posting a response but there was minimal follow-up discussion or critical dialogue among participants related to these postings. In the following section, we will discuss the range of pedagogical practices found in the study sample and consider whether or not these teaching methods provide students with a space to connect the lessons to their own lives in meaningful and critical ways.

6. Discussion

MOOCs have sparked an intense new debate about the role of technology in shaping higher education. As open online learning spaces, these courses have the potential to open access to new skills and

Table 6
Mode of assessment — assignments.

	Optional	Required	Multiple choice[a]	Open ended[b]	Activity[c]	Discussion board post[d]	External resources[e]
Hard							
Biology 1	x		x		x		x
Biology 2							
Biology 3	x		x	x			
Chemical engineering							
Computer graphics		x		x	x		x
Engineering							
Medicine							
Nursing							
Physics	x				x		x
Public health							
Statistics 1	x	x	x	x			x
Statistics 2	x	x	x		x		
Percentage within group	*42*	*25*	*33*	*25*	*33*	*0*	*33*
Soft							
Economics	x		x			x	
English composition	x	x		x	x	x	
Gaming							
Geography	x				x		
Health and climate	x	x	x	x			
Law				x		x	x
Macroeconomics		x		x			x
Philosophy	x		x			x	
Poetry	x			x			
Product development				x		x	
Philosophy							
Sociology		x		x			
Percentage within group	*50*	*33*	*25*	*58*	*17*	*42*	*17*
Percentage of total	42	29	29	42	25	21	25

[a] Category includes multiple choice questions that offered either computer -generated response or static answer key.
[b] Category includes open-ended questions posed to students. Responses varied, included computer generated answer, static answer key, and no answer/response.
[c] Category includes a wide range of activities that students needed to complete on their own, such as measurements, talking to colleagues, and researching topics.
[d] Category includes students being asked to post comments on the course discussion board, and could include commenting/voting on posts from peers or the instructor.
[e] Category includes assignments that required the use of materials external to the course. Links to external resources may or may not have been included.

knowledge to large numbers of students. Yet, there are inherent challenges in trying to automate instruction for an unlimited audience. Completion rates have been extremely low in MOOCs, averaging 7% according to one report (Parr, 2013), which points to limitations in the design and execution of these courses. Even if many participants have no intention of finishing their course and earning a certificate, a completion rate of less than 10% indicates that many open online courses are not designed to effectively incorporate a "community of inquiry" with the teaching, social and cognitive presence that Garrison et al. (2001) have shown to encourage satisfaction and persistence among participants.

In this study, we examined the epistemological and social dimensions of teaching in open online education, and our findings suggest that the range of pedagogical practices currently used in MOOCs tends toward an objectivist-individual approach. While all of the courses in our sample used elements of this teaching approach, examples of effective constructivist-group approaches were much less common. Discussion boards were available in the majority of courses, but most were used by peers or teaching assistants to explain specific assignments or concepts as opposed to facilitating meaningful collaboration and group-oriented knowledge construction. Instructors in a few of the MOOCs used the boards to supplement their instruction by posting discussion topics, requiring student comments, or incorporating group activities into the curriculum. Results were mixed. The challenge lies in creating a community of learners and facilitating collaborative activities that give students an opportunity to deepen their understanding and learn from each other.

The dominance of the objectivist approach raises questions about the kind of knowledge that is valued in open online education and the current limitations of this platform. Further, those who produce MOOCs are in a privileged position when it comes to deciding what subjects and course content are created and distributed for a mass audience. Open Course Ware initiatives, for example, tend to focus on knowledge and information that can be defined in relatively concrete ways that are more easily assessed through multiple-choice and single-answer tests of comprehension (Rhoads et al., 2013). If the central goal of MOOC instructors and providers is to increase efficiency by making instruction scalable to an unlimited audience, then an objectivist-individual approach would be appropriate and even desirable. But if educators want to broaden access to meaningful learning opportunities and use technology to enhance instructional quality (Korn, 2013) then the simple transfer of knowledge from expert to novice is not enough.

Giroux (2011) argues that the influence of market interests and the notion of corporate time, "accentuates privatized and competitive modes of intellectual activity, largely removed from public obligations and social responsibilities" (chapter 6, para. 17). In this model, job training is prioritized over the development of political agency and social responsibility. Giroux goes on to state that, "shorthand, quantification and measurements become dominant modes of thought" (2011, chapter 6, para. 18). Learners are tasked with digesting specific knowledge that can be easily measured and translated into capital. While the development of transferable skills is valuable, education should also empower students to critically evaluate information and actively participate in social discourse.

One might argue that an objectivist-individual approach is well suited for many science and math courses, which constitute the majority of MOOCs (Educause, 2013). Based on the study sample, MOOCs in the hard sciences were less likely to incorporate constructivist teaching approaches, as compared to those courses in other fields. These findings mirror common themes among different disciplines within academia more broadly. According to Biglan (1973), the hard sciences assume a single paradigm that defines appropriate problems for study and methods to use. Yet, learning is still situated in a particular context

Table 7
Mode of assessment — exams and quizzes.

	Multiple choice	Fill in the blank[a]	Open ended short[b]	Open ended long[c]	Multiple attempts allowed	Certificate of completion[d]	Optional exam for credit[e]
Hard							
Biology 1	x		x		x		
Biology 2	x						x
Biology 3	x		x		x		
Chemical engineering							
Computer graphics						x	
Engineering	x		x		x	x	
Medicine	x					x	
Nursing							x
Physics	x	x				x	
Public health							
Statistics 1	x	x				x	
Statistics 2	x	x				x	
Percentage within group	*67*	*25*	*25*	*0*	*25*	*50*	*17*
Soft							
Economics	x		x		x	x	
English composition				x		x	
Gaming			x			x	
Geography	x		x				x
Health and climate	x		x			x	
Law	x				x		
Macroeconomics	x		x			x	x
Philosophy	x					x	
Poetry							
Product development							x
Philosophy							
Sociology				x		x	
Percentage within group	*50*	*0*	*42*	*17*	*17*	*58*	*25*
Percentage of total	58	13	33	8	21	52	21

[a] Category includes assessment where students were required to offer a numerical response, often to an equation.
[b] Category includes short-response formats, typically students received computer-generated stock answer to compare, answer key.
[c] Category includes courses that incorporated peer-reviewed essays into student assessment.
[d] Course provider would generate a certificate stating that the study completed the course with a particular grade/percentage.
[e] Category includes courses linked to institutions of higher education with option to enroll for credit; option to sign up for specific exams (ie. CLEP) to earn credit.

and students engage with curriculum based on their lived experiences within their social environment (Lave & Wenger, 1991). A constructivist teaching approach, even in a hard science course, would help students to gain a deeper understanding of the material and build a foundation for more advanced study and mastery (Freeman, Haak, & Wenderoth, 2011; Haak, HilleRisLambers, Pitre, & Freeman, 2011).

Even though the objectivist-individual teaching approach was prevalent within the sample, nearly half of the courses incorporated at least one instructional tool that encouraged participants to construct their own understanding of course content through self-reflection, activities that link curriculum to real world settings, or interaction with fellow learners. According to Arbaugh and Benbunan-Fich (2006), students benefit from active, collaborative teaching approaches because they prioritize interaction between the learners themselves and situate students at the center of the knowledge construction process. Individuals learn in the context of their social and cultural environment (Lave & Wenger, 1991), and their learning is maximized when they interact with peers, educators, and experts (Vygotsky, 1978). While there is great value in independent learning, social learning encourages students to articulate their own beliefs and experiences, listen to the opinions of others, and find consensus in divergent viewpoints.

One of the major challenges for MOOC instructors is to break away from the traditional "sage on a stage" model of teaching that is prevalent in both traditional and online learning environments, and further opportunities for interaction and engagement between students and the instructor. As the literature discussed, students in online learning environments benefit from meaningful contact with their instructor (Eom et al., 2006; Swan, 2001). At present, most students who complete a MOOC have already earned a college degree (Kolowich, 2013) and are more likely to be comfortable in an academic setting. Therefore, increasing access to education through participation in MOOCs will require careful attention to pedagogical practices that support a wide range of students and create engaging and inclusive dialogue and collaboration. Otherwise, MOOCs run the risk of merely replicating the flawed system of large, lecture-style courses prevalent in public institutions that do little to encourage student persistence and achievement.

Finally, advocates argue that MOOCs are leveraging technology to "transform" and "disrupt" higher education, and create a "revolution" within a struggling system. Instead of settling for the status quo, MOOCs have the potential to open up knowledge to students around the world. Yet, at present, the major providers are developing open online courses that mimic traditional face-to-face courses with a focus on measurable learning outcomes that will translate into course credit at a variety of institutions. While this effort may help MOOC providers reach their goal of accessing coveted revenue streams within higher education, it also has the potential to stifle creativity among instructors and developers.

The original MOOC led by Siemens and Downes in 2008 was based on the idea that technology can be used to create an online community where students engage in the learning process by remixing and repurposing information according to their own interests and experiences. MOOCs that follow this model of a connectivist learning community focus on bringing together a network of individuals interested in working together to navigate and critically examine information around a particular topic and further the discourse with their own ideas and reflections. Many of the MOOCs being produced and distributed in recent years by private companies and elite universities bear little resemblance to this model of teaching and learning. While we are not arguing that all MOOCs should abandon structured curriculum and grading systems, it is important that instructors and developers not lose sight of the origins

of these innovative online courses and their potential to create dynamic communities of inquiry. MOOCs have grown out of the idea that technology can help educators to create social learning environments that defy space and time, and one can only hope that technologists will continue to push the boundaries of innovation for the sake of building community and engagement instead of focusing on profit margins.

7. Conclusion

This study raises some important concerns about the degree to which MOOCs are actually revolutionizing higher learning, given the tendency for the pedagogical strategies of MOOC instructors to be tied to objectivist views of knowledge. Relying primarily on one-directional relationships between instructor-based knowledge and students as recipients, as both constructivist theories and critical pedagogy highlight, is hardly conducive to the transformative forms of engaged learning seen as most valuable to encouraging both active learning and active democratic citizenship. Thus, if MOOCs are to achieve the revolutionary potential often claimed, advocates may want to reflect upon the origins of the movement and focus on developing and incorporating more creative and empowering forms of open online learning.

Appendix A. Listing of MOOC providers and platforms included in the study

Platform or provider	Website
Canvas Network	canvas.net
Coursera	coursera.org
Education Portal	education-portal.com
edX	edx.org
Faculty Project/Udemy	facultyproject.org
MR University	mruniversity.com
NovoEd	novoed.com
MIT Open Course Ware Scholar	ocw.mit.edu/courses/ocw-scholar
Carnegie Mellon University Open Learning Initiative	oli.cmu.edu
Open Michigan	open.umich.edu
OpenLearning	openlearning.com
Open Yale Courses	oyc.yale.edu
Saylor.org/Saylor University	saylor.org
Sofia Project	sofia.fhda.edu
Udacity	udacity.com
Webcast Berkeley	webcast.berkeley.edu

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