Characteristics of Massive Open Online Courses (MOOCs):
A Research Review, 2009-2012

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Abstract

This review of research explores characteristics associated with massive open online courses (MOOCs). Three key characteristics are revealed: varied definitions of openness, barriers to persistence, and a distinct structure that takes the form as one of two pedagogical approaches. The concept of openness shifts among different MOOCs, models, researchers, and facilitators. The high dropout rates show that the barriers to learning are a significant challenge. Research has focused on engagement, motivation, and presence to mitigate risks of learner isolation. The pedagogical structure of the connectivist MOOC model (cMOOC) incorporates a social, distributed, networked approach and significant learner autonomy that is geared towards adult lifelong learners interested in personal or professional development. This connectivist approach relates to situated and social learning theories such as social constructivism (Kop, 2011). By contrast, the design of the Stanford Artificial Intelligence (AI) model (xMOOC) uses conventional directed instruction in the context of formal postsecondary educational institutions. This traditional pedagogical approach is categorized as cognitive-behaviorist (Rodriguez, 2012). These two distinct MOOC models attract different audiences, use different learning approaches, and employ different teaching methods. The purpose of this review is to synthesize the research describing the phenomenon of MOOCs in informal and postsecondary online learning.

Massive open online courses (MOOCs) are a relatively new phenomenon sweeping higher education. By definition, MOOCs take place online. They could be affiliated with a university, but not necessarily. They are larger than typical college classes, sometimes much larger. They are open, which has multiple meanings evident in this research. While the literature is growing on this topic, it is yet limited. Scholars are taking notice of the literature around MOOCs in all its forms from conceptual to technical. Conference proceedings and magazine articles make up the majority of literature on MOOCs (Liyanagunawardena, Adams, & Williams, 2013). In order to better understand the characteristics associated with MOOCs, this review of literature focuses solely on original research published in scholarly journals. This emphasis on peer-reviewed research is an essential first step to form a more critical and comprehensive perspective by tempering the media hype. While most of the early scholarly research examines aspects of the cMOOC model, much of the hype and controversy surrounds the scaling innovation of the xMOOC model in postsecondary learning contexts. Naidu (2013) calls out the massive open online repetitions of failed pedagogy (MOORFAPs) and forecasts a transformation to massive open online learning opportunities (MOOLOs). Informed educators will be better equipped to make evidence-based decisions, foster the positive growth of this innovation, and adapt it for their own unique contexts. This research synthesis is framed by a within- and

between-study literature analysis (Onwuegbuzie, Leech, & Collins, 2012) and situated within the context of online teaching and learning.

Frameworks

Literature Analysis

A useful review of literature goes beyond a mere summary of articles by synthesizing the research on a given phenomenon. Onwuegbuzie, Leech, & Collins (2012) provide a framework for analyzing and interpreting literature sources in a rigorous way that calls for evidentiary warrant, transparency, and comprehensiveness. Both within- and between-study analyses are essential to a comprehensive literature review that examines multiple components within a research study as well as compares multiple components among studies. While most literature reviews compare findings, Onwuegbuzie, Leech, & Collins (2012) advocate for also comparing and contrasting other components, such as frameworks and methods. Along these same lines, Eisenhart (1998) offers a "groundswell" analogy in describing the hidden treasures that can spring from a comprehensive literature review. These treasures may disrupt conventional thinking, expose multiple perspectives from different contexts, and improve understanding and communication. Boote & Beile (2005), in their seminal work, also advocate for a cumulative research synthesis that is generative. They expound 12 criteria for a comprehensive literature review that is categorized in the following areas: coverage, synthesis, methodology, significance, and rhetoric. Maxwell (2006) points to the centrality of relevance and the importance of selectivity in literature reviews. In this research synthesis, these frameworks guide a review of the literature that aims to selectively identify relevant scholarly works and comprehensively evaluate components within and between sources.

Online Teaching and Learning

Given the limited peer-reviewed research on MOOCs, it is useful to make connections to existing literature related to online teaching and learning. However, the corpus related to online courses is vast, and comprehensive coverage would extend beyond the scope of this endeavor. Therefore, philosophical perspectives that influence contemporary online course design and facilitation provide a pedagogical framework and context for a discussion of MOOC research. Worldviews and their underlying assumptions explicitly or implicitly guide different MOOC design models. The following perspectives that influence the design and facilitation of online teaching and learning are simplified for the purpose of a discussion on MOOC research. Schuh & Barab (2008) contend that these worldviews, with their ontological and epistemological stances, drive educator decisions when confronted with situational variables in the context of teaching and designing online instruction. They define philosophical perspectives as objectivism, realism, empiricism, rationalism, idealism, relativism, and pragmatism. They classify psychological perspectives as behaviorism, cognitivism, cognitive constructivism, sociocultural/historicism, and situativity theory. Scholars describe theoretical perspectives as a continuum of assumptions ranging from behaviorist to cognitivist to constructivist, in which the focus shifts from passive teacher-led instruction to active student-centered learning (Dede, 2008; Ertmer & Newby, 1993). Roblyer & Doering (2013) espouse a perspective consisting of objectivist, directed instruction learning theories including behaviorist, information-processing, cognitive-behavioral, and systems theory on one hand and constructivist inquiry-based learning theories, such as social activism, social cognitivism, scaffolding, child development, discovery learning, and multiple

intelligences on the other hand. Duffy & Cunningham (1996) provide a comprehensive focus on constructivism and explicate (a) metaphors of the mind, such as mind-as-computer, mind-as-brain, and mind-as-rhizome; (b) key constructivist concepts, such as discovery learning, scaffolding, and cognitive apprenticeship; and (c) the shifting role of the educator. Finally, Swan (2005) advances constructivist models by explicating four theories for thinking about online learning: cognitive constructivism, constructionism, social constructivism, and situated learning/distributed cognition. This pedagogical framework, while cursory, is intended to highlight the importance of having a solid philosophical and psychological grounding for guiding design decisions while also providing a theoretical context for understanding MOOC research.

Statement of the Research Problem and Purpose

The purpose of this review of the research is to better understand the characteristics associated with MOOCs. A greater depth and breadth of knowledge can enhance future discourse on the merits and challenges surrounding MOOCs. This investigation illuminates research reported in scholarly peer-reviewed journals. The literature review was guided by the following within- and between-study research questions:

- Which frameworks ground research in MOOCs?
- What types of research methods and questions have been applied to MOOCs?
- What are the characteristics associated with MOOCs as reported in research published in scholarly journals?

Method

Search and Review Strategy

A systematic search and review strategy was employed beginning with a OneSearch Multiple Database search to identify databases containing articles about MOOCs. Second, separate database searches were conducted in Academic Search Premier, ERIC, Education Full Text, and Applied Science and Technology Full Text. Search terms with the Boolean operators included MOOC OR MOOCs AND Research. The limiter of scholarly (peer-reviewed) journals was selected. Third, the titles were reviewed to scan for duplication and relevance. Fourth, the articles were reviewed for original research. Inclusion criteria were: (a) appears in a peer-reviewed journal and (b) addresses research related to MOOCs. Exclusion criteria were: (a) not related to research on MOOCs and (b) does not contain original research. Finally, an ancestral review was employed to scan bibliographies of retained articles and the journals in which retained articles were published.

Search Outcome

Following the article search described above, 14 articles were selected for review. Article titles were perused for relevance and duplication, leaving 8 articles. After an article review, it was determined that 3 were not original research, leaving 5 articles. One additional article was retained after using ancestral and online journal review strategies, bringing the total count to 6 articles.

Quality Appraisal

All of the research articles selected for this literature review were published in peer-reviewed journals as a way to control for quality of reported data. It is assumed that the original

peer-review process addressed the quality of the evidence cited within each manuscript prior to publication. This exclusion proved to be a significant limiting factor in the number of articles retained. MOOCs, as a new phenomenon, have been hyped in magazines and blogs. Much discussion on this topic has occurred at conferences, based on the number of conference proceedings on this topic. However, very little scholarly research has been conducted to date. Given the growing trend, it is likely that we will see an increase in new research in this area in the years ahead. The six research studies selected for review were published between 2009 and 2012. The first MOOCs were implemented during the 2007-2008 academic year (Rodriguez, 2012), which is directly related to the limited number of scholarly articles on this topic. The studies were published in either *The International Review of Research in Open and Distance Learning* or *The European Journal of Open, Distance and E-Learning.* Several authors have contributed to more than one of the selected articles, however each study has varied research questions. Primarily studies of cMOOCs are represented in this research synthesis, creating an imbalance that can skew the review towards characteristics of the connectivist model alone. Table 1 provides information related to each of the selected research studies.

Table 1
Selected research studies

Author(s), Publication Date, & Title	MOOC Title, Type, & Date
deWaard, I., Abajian, S., Gallagher, M. S., Hogue, R., Keskin, N., Koutropoulos, A., & Rodriguez, O. C. (2011). Using mLearning and MOOCs to understand chaos, emergence, and complexity in education. *IRRODL*	• MobiMOOC, cMOOC, 2011
Fini, A. (2009). The Technological Dimension of a Massive Open Online Course: The Case of the CCK08 Course Tools. *IRRODL*	• Connectivism & Connective Knowledge (CCK08), cMOOC, 2008
Kop, R. (2011). The challenges to connectivist learning on open online networks: Learning experiences during a massive open online course. *IRRODL*	• Critical Literacies (CritLit), cMOOC, 2010 • Personal Learning Environments Networks & Knowledge Course (PLENK2010), cMOOC, 2010
Kop, R., Fournier, H., & Mak, J. S. F. (2011). A pedagogy of abundance or a pedagogy to support human beings? Participant support on massive open online courses. *IRRODL*	• Personal Learning Environments Networks & Knowledge Course (PLENK2010), cMOOC, 2010 • Connectivism & Connective Knowledge (CCK11), cMOOC, 2011
Koutropoulos, A., Gallagher, M. S., Abajian, S. C., deWaard, I., Hogue, R. J., Keskin, N. Ö., & Rodriguez, C. O. (2012). Emotive Vocabulary in MOOCs: Context & Participant Retention. *EURODL*	• MobiMOOC, cMOOC, 2011
Rodriguez, C. O. (2012). MOOCs and the AI-Stanford like Courses: Two Successful and Distinct Course Formats for Massive Open Online Courses. *EURODL*	• Artificial Intelligence (CS221), xMOOC, 2011 • Building a Search Engine (CS101), xMOOC, 2012 • Connectivism & Connective Knowledge

	(CCK08), cMOOC, 2008 • Personal Learning Environments Networks & Knowledge Course (PLENK2010), cMOOC, 2010 • MobiMOOC, cMOOC, 2011 • Online Learning Today & Tomorrow (EduMOOC), cMOOC, 2011

Data Abstraction and Synthesis

After being identified for this review, the articles were critiqued, analyzed, and synthesized. The result of this process is the identification and synthesis of characteristics associated with MOOCs that have been recognized by multiple scholars in a variety of research studies with unique research questions and approaches. Scholars selected a variety of methodological approaches for examining MOOCs based on each specific research question. Most of the research articles examined the cMOOC model in a select number of courses, primarily PLENK2010, MobiMOOC, and CCK08. Several scholars authored more than one article. Stephen Downes and George Siemens, who coined the term MOOC (Rodriguez, 2012), are not represented in the selected article list since their early work has not yet appeared in scholarly peer-reviewed journals, but rather in independently published reports or conference proceedings. Table 2 provides the research question(s) and the research approach.

Table 2
Research questions and approaches

Author(s)	Research Question(s)	Research Approach
deWaard et al.	Could MOOCs and the innovative elements of mLearning and social media add to a new educational equilibrium based on an analysis incorporating chaos theory, emergence, and complexity theory?	A case study with a sample of 40 MOOC participants who completed a post-course survey online during the spring of 2011.
Fini	What are the learners' views about the multi-tool environments adopted in the course? What are the suggestions for setting up multi-tool course environments?	A case study using an online survey with open-ended items and closed-ended rating scales. Measuring perceptions of 83 MOOC participants who completed the survey in the fall of 2008.
Kop	Are the four activities of aggregating, relating, creating, and sharing actually as important as envisaged by the course planners? Are the challenges identified from the literature (critical literacies, presence, and self-directed learning), actually perceived as being problematic?	A mixed methods approach consisting of surveys, observations, discourse analysis, and secondary learning analytics data analysis. The study took place during the summer and fall of 2010 on two MOOCs.
Kop et al.	How might emergent technologies influence the design of the learning environment and in particular the roles	A mixed methods approach that included three end-of-course surveys and a qualitative virtual ethnography

	of educators and learners in creating learning experiences in online networked learning environments?	involving observations and a focus group were encompassed in this case study of two MOOCs.
Koutropoulos et al.	Could emotive vocabulary serve as a mechanism for predicting future and continued participation in the MOOC?	A narrative inquiry approach with MOOC participants in the spring of 2008.
Rodriguez	What are the underlying views of knowledge and learning that inform the different MOOC models?	A comparative study with a mixed methods approach that compared two different MOOC formats examining six different MOOCs that took place between 2008 and 2011.

Results

Researchers used a variety of frameworks to ground research in MOOCs. These frameworks aligned with the range of questions and methodologies. Several key themes emerged from the synthesis of research on MOOCs: (a) openness: the varied definitions of openness; (b) barriers to persistence: high dropout and lurker rates show that barriers to learning are a significant challenge, and research has focused on engagement, motivation, and presence to mitigate learner isolation; and (c) structure: the two different MOOC formats—cMOOC and xMOOC—attract different audiences, use different learning approaches, and employ different teaching methods. Table 3 displays the key topics and a synthesis of the selected studies. See Appendix for word cloud visualizations of selected articles.

Table 3
A synthesis of selected studies

Author(s)	Top Word Cloud Tags	Synthesis
deWaard et al.	• MOOC/MOOCs • System • Learning • MobiMOOC • Self	This study was grounded in chaos theory as a framework to understand learning in the Knowledge Age. The authors identified a MOOC as a complex system in which the self played a key role in learning with a focus on interactive and open dialogue.
Fini	• Course • CCK08 • Tools • Learning • Open	This study was grounded in open and distance learning. Researchers discovered that the adult lifelong learners had a preference for simple, passive, time-saving tools in the multi-tool learning environment of a cMOOC. Technology skills and English language were identified as the main barriers to learning with this model.
Kop	• Learning • Open • Online • Participants • Environment	This study evaluated connectivist principles and the challenges faced by learners. The researcher identified three key focus areas (self-directed learning, presence, and critical literacies) as important to success in cMOOCs. The author found an additional need for novice learners to have a "walled garden" in which to feel valued and safe.

Kop et al.	• Learning • Pedagogy • Support • Participants • Course	This study used community of inquiry and conversational theory as frameworks to research the role of the facilitator, peer support, and learning structure, particularly for novice learners in the autonomous, networked learning environment of a cMOOC. The researchers focused on social, cognitive, and teaching presence to support engagement and retention.
Koutropoulos et al.	• Participants • Participation • Discussion • Social • Analysis	This study was grounded in theories of learner engagement and social presence. The authors used narrative and discourse analysis to discover that emotive vocabulary was not predictive of active participation. It was found to be common for novice learners to feel overwhelmed with the amount of information. Whereas advanced learners displayed more confidence with the tools, environment, and format, which led to more active engagement.
Rodriguez	• Course • Participants • Online • c-MOOCs • AI	This study was grounded in models of distance education pedagogy. The author used a comparison analysis that revealed two types of MOOC formats that are similar in the nature of massive openness, but different in their pedagogical approaches. While cMOOCs incorporated social aspects of learning in autonomous networked environments, xMOOCs used a traditional cognitive-behaviorist approach with the aim to scale up to reach a massive audience. Typically the xMOOC attracted a more massive number of younger STEM participants. While the cMOOC model attracted a smaller number of people who were more characterized as adult lifelong learners. High dropout rates were associated with both models.

Frameworks and Methods

Researchers used chaos theory (deWaard et al., 2011), open and distance learning (Fini, 2009), community of inquiry, conversation theory, (Kop et al., 2011), connectivist theory (Kop, 2011), learner engagement, social presence (Koutropoulus et al., 2012), and models of distance education pedagogy (Rodriguez, 2012) to frame the MOOC research. Many of the studies related to the social nature of learning and participant experiences in MOOCs (deWaard et al., 2011; Fini, 2009; Kop, 2011; Kop et al., 2011). Koutropoulus et al. (2012) framed their investigation into the influence of language by using conceptual frameworks related to social constructivism and social presence. Rodriguez (2012) framed his comparative study in cognitive-behaviorism, social constructivism, and connectivism. A variety of methodologies were used, including mixed methods (Kop, 2011; Kop et al., 2011), case study (deWaard et al., 2011; Fini, 2009), narrative inquiry (Koutropoulus et al., 2012), and a comparative study (Rodriguez, 2012).

Characteristics

Openness. Openness is one of the core components of a cMOOC, along with self-organization, connectedness, complexity, and chaos (deWaard et al., 2011). Openness of information flow is a vital characteristic of a self-organizing complex system and one that implies a system is willing to transform (deWaard et al., 2011). cMOOCs are situated within open and distance learning initiatives, which are characterized by (a) open technology and open software for educational purposes; (b) open content and open educational resources; and (c) open knowledge in which participants and facilitators openly share educational practices (Fini, 2009). Kop et al. (2011) refer to openness as open communication and open online participation in an open networked environment. The concept of open can also include open courses, open content, and open access (Koutropoulos et al., 2012). Finally, Rodriguez (2012) describes openness as related to several concepts, including: software that is open-source, registration is open to anyone, the curriculum is open or loosely structured, the sources of information are open, the assessment process is open, and the learners are open to a range of different learning environments. When comparing the two MOOC models—cMOOC and xMOOC, the concept of openness has different meanings. The xMOOC model is typically more structured and therefore less open to learner autonomy in aggregating and filtering resources, use of learner-selected tools, and forms of assessment.

Barriers to Persistence. Both MOOC models have issues of high drop out rates. To mitigate this issue, researchers have examined the barriers to learning in this new environment. Kop et al. (2011) examined participant support in the context of the community of inquiry framework of teaching, cognitive, and social presence. When Fini (2009) explored tool usage, it was discovered that technology skills were impediments to learning given the wide variety of tools used in the course. For non-native English speakers, language skills could be an impediment when web conferencing sessions were facilitated in English. For novice learners, the chaotic nature of the cMOOC was problematic since there was a lack of a coherent, centralized structure and the students' learning was not summarized or synthesized (Kop et al., 2011). Furthermore, time zone differences, difficulty meeting up with others online, technology skills, and challenges to making social connections were identified as barriers to learning that may contribute to the high lurker or drop out rates (Kop et al., 2011). Finally, time constraints were a major barrier particularly for adult lifelong learners in established professions (Fini, 2009). Although able to reach thousands of learners, xMOOCs had significantly higher dropout rates compared to cMOOCs, 85% compared to 40% respectively (Rodriguez, 2012). This may suggest a connection between the pedagogical grounding of an online learning environment and characteristics influencing a learner's experience.

Models. MOOCs began with a connectivist model targeting an adult lifelong learning audience. The MOOC concept was then applied to postsecondary online education using the xMOOC model, which was designed as a traditional teacher-directed course, yet automated, massive, and online. These two models differ in multiple ways, including but not limited to: the extent of learner autonomy versus course structure, the role of assessments, the pedagogical approach (xMOOCs are grounded in cognitive-behaviorism while cMOOCs are grounded in connectivism), and the platform (xMOOCs are centralized whereas cMOOCs are distributed).

Discussion

The results show that multiple perspectives have been exposed about MOOCs, from the divergent models to the diverse definitions of openness. MOOCs continue to fascinate the learning world, with ardent proponents and opponents. The massive openness of MOOCs

disrupts conventional thinking about the role, value, and cost of higher education. While many universities are ramping up their information technology divisions, opponents who are skeptical of the methods and results temper the fervor.

This research synthesis is not intended to expound an exhaustive interpretation of the controversy surrounding MOOCs; rather, it is focused solely on scholarly research in hopes of improving understanding and communication about the characteristics associated with MOOCs. From a historical context, there are lessons to be learned from the challenges of past instructional mass media experiments such as radio and television. In particular, that the expository nature of mass teaching methods are limited by one-way communication (Saba, 2013). The changing paradigms and growth of MOOCs continue to make headlines in mainstream media due to immense growth within and beyond postsecondary online learning and informal professional development into corporate e-learning. As conceptualizations of MOOCs begin to morph, variations will be adapted for unique contexts focused on learner needs and human connections.

Conclusion

Worthy goals of any literature review are to disrupt conventional thinking, expose multiple perspectives, and improve understanding and communication (Eisenhart, 1998). This analysis and synthesis has identified limitations and gaps in the research. The limitations examined in this review stem from the limited MOOC courses represented in the research, the limited number of authors represented, and the limited number of peer-reviewed journals. There is a need for more scholarly research given that MOOCs are a new phenomenon with important implications for online learning in postsecondary institutions, professional development, and corporate e-learning. Overlap in future research recommendations focus on better understanding the learners, types of behaviors, and the social nature of learning (deWaard et al., 2011; Fini, 2009; Kop, 2011; Kop et al., 2011; and Koutropoulus et al., 2012). Rodriguez (2012) points out the few similarities and vast differences in the two distinct MOOC models, particularly around pedagogical approaches. As Kop et al. (2011) explain, "A change in the thinking, philosophy, design, and pedagogies of institution-based online courses may be necessary if the affordances of emerging technologies are embraced and adopted within formal educational institutions" (p. 89). Table 4 displays a list of future research recommendations.

Table 4
Future research areas

Author(s)	Suggestions for Future Research
deWaard et al.	• New educational frameworks such as chaos theory • Profiles and characteristics of MOOC learners that include motivational factors, ethnicity, and socioeconomic status rather than simple demographics of age and gender alone • Retention rates of learners and the strength of the learning network beyond the end of the course • Design principles to maximize connectivist attributes such as self-organization, self-referencing, and knowledge-production • Affordances of mLearning and social media for learning
Fini	• Use of internal versus external social networks • Profiles of participants related to outcomes and retention • Cost and effectiveness related to sustainability and instructor workload
Kop	• The necessity of the creation stage for learning using the connectivist model (aggregate, relate, create, and share) • Overcoming challenges in connectivist learning
Kop et al.	• Future MOOC designs based on the learner-in-dialogue model and co-creation of the learning environment • The role that educators and learners should play in adding value to the learning experience • Blending informal and formal learning • Learning through a social learning community and collaboration in online networks
Koutropoulos et al.	• Comparison of data analytics between the central hub and other social learning venues for participation patterns, content shared, and emotive vocabulary • Social vocabulary based on France Henri's framework and analytical model of five dimensions of the learning process in computer-mediated communication messages: participation, interaction, social, cognitive, and metacognitive • Social interaction based on the social presence model • Learning designs that employ a starter-wrapper-moderator discussion architecture • Learner motivation, engagement, social presence, and instructor presence • Improved learning analytics for understanding "window shopping," lurking, active participating, and dropping out
Rodriguez	• Questions related to the two distinct course formats (cMOOC and xMOOC) • Issues related to the fundamental aspects of the two distinct formats, particularly pedagogy

MOOCs represent a promising area for learning technology growth. Like cMOOC researchers, early pioneers of the xMOOC model realize the importance to design for a human connection and are beginning to adapt the model accordingly (Westervelt, 2013). Not yet evident in the scholarly research on MOOCs, are issues related to increased access, intellectual property, economic models, and personalized learning (Saba, 2013). As a new innovation, there are significant opportunities for pedagogical research, philosophical and theoretical development, design and facilitation adaptations, and implementations in varied contexts.

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Appendix
Word Cloud Visualizations of Selected Articles

Figure A1. deWaard et al

Figure A2. Fini.

Figure A3. Kop.

Figure A4. Kop et al.

Figure A5. Koutropoulos et al.

Figure A6. Rodriguez.