Students' learning outcomes in Massive Open Online Courses (MOOCs): Some suggestions for course design

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Students' Learning Outcomes in Massive Open Online Courses (MOOCs): Some Suggestions for Course Design

Öğrencilerin kitlesel açık erişim çevrimiçi derslerdeki kazanımları: Ders tasarımına yönelik bazı öneriler

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Özet

Üçüncü nesil uzaktan eğitim kapsamında kitlesel açık erişim çevrimiçi dersler (*massive open online courses*, MOOC'lar) sayesinde yüksek öğrenimde herkes istediği yerden ücretsiz eğitim alabilmektedir. Son yıllarda, eğitimde MOOC'ların yeri üzerine birçok çalışma yapılmıştır, ancak öğrencilerin kazanımları üzerine olan çalışmalar sınırlıdır. Bu çalışmada, açık erişim çevrimiçi derslerin tasarlanmasına yönelik birtakım önerileri belirlemek amacıyla, öğrencilerin MOOC'lardaki kazanımlarına ilişkin literatürü gözden geçirildi. İnceleme, bilimsel literatür veritabanlarının sistematik olarak araştırılmasının ardından, 3P (*presage [öngörü], process [süreç] ve product [ürün]*) öğretim ve öğrenim modelinin temel bileşenlerine yönelik eleştirel bir analizle gerçekleştirildi (Biggs, 2003). 56 yayının bulguları sentezlenerek, öğrencilerin katılımını ve akademik başarıyı geliştirmek ve terk etme oranlarını düşürmek amacıyla 13 ders tasarımı önerisi geliştirildi. Gerek ileriki araştırmalarda incelenmek üzere gerek ise de MOOC'ların mevcut içeriğini geliştirerek ve zenginleştirerek öğrenim kazanımlarını en iyi hale getirmek için bazı uygulama önerileri sunuldu.

Anahtar sözcükler: 3P modeli, başarı, değerlendirme, katılım, öğrenim kazanımları.

Abstract

Massive open online courses (MOOCs) as a third generation distance education enable anyone anywhere to study for free in higher education. In recent years, various studies have been conducted on the position of MOOCs in education, but studies on students' learning outcomes are limited. In this study, literature concerning students' learning outcomes in MOOCs was explored with the aim of identifying a set of suggestions to design open online courses. The review was accomplished through a systematic search within scientific literature databases followed by a critical analysis with the main components of 3P (*presage-process-product*) model of teaching and learning (Biggs, 2003). Findings of the 56 publications were synthesized which resulted in the formulation of 13 course design suggestions in order to enhance students' engagement, academic achievement and lower attrition rate attrition. Some implications are proposed for further research and for providers to improve and enrich the current context of MOOCs to optimize students' learning outcomes.

Keywords: 3P model, achievement, assessment, engagement, learning outcomes.

Massive Open Online Courses (MOOC) are built on the impression that "information is everywhere" by extending access to education. A MOOC is a course, but it is open, distributed, participatory, and part of lifelong network learning. The underlying idea of a MOOC is accessibility, since anyone can participate by working collaboratively either to acquire new knowledge or to expand existing knowledge. This implies that MOOCs create a pathway for lifelong learning processes. MOOCs are online classes in which anyone can participate, regardless of location, in most cases for free. They are comprised of short video lectures, simulations, and online labs combined with computer-graded tests and online forums where participants can discuss the course content or get help (Hoy, 2014). Basically, MOOCs are a form of online learning that share some common features: open access using the Internet, free of charge, asynchronous, interactive user forums, and the opportunity to receive a certificate upon successful completion (EDUCAUSE, 2011). Student

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learning outcomes in a MOOC platform may not be the same as those in regular online or on-campus education, which makes a significant contribution to ensuring the quality of MOOCs. Understanding which factors account for students' learning outcomes in open online courses, including student characteristics, teaching context and learning activities, is an important step toward designing efficacious courses and improving open online learning. Recent attempts to use learning analytics and data mining to understand learners' behaviour provide ambiguous findings on learning outcomes in MOOCs. The similarity of behavioural patterns among students who fail and pass in the course context compels researchers to ask further questions and to conduct deeper analyses of students' learning behaviours and experiences (Wen and Rose, 2014). On the other hand, other research findings that evaluate the value of the MOOC phenomena indicate that students' learning experiences and study behaviours in MOOCs fluctuate (Yuan, Powell, & Olivier, 2014). Furthermore, although the low retention rate in MOOCs has been extensively debated and pointed out as a failure, research on the pedagogical aspects of MOOCs provides more insights about the deficiencies of the instructional model used in open learning environments (Fasihuddin, Skinner, & Athauda, 2013). That is to say, efforts to increase completion rates should be designed and implemented in light of learning and teaching theories, as well as learners' preferences and needs.

Despite the enthusiasm for and expectations of MOOCs as new learning platforms, many studies are based on personal observations and/or experiences of researchers either as instructors or participants in MOOCs (Fisher, 2014; Kop, 2011; Stefanic, 2014; Zutshi, O'Hare, & Rodafinos, 2013). There are also auto ethnographic studies in which the researcher acts as a participant observer (Wasson, 2013). Since 2013 several empirical studies have been published in peer-reviewed journals, which mainly focused on effectiveness, participation, reasons for low completion rates or high drop-out rates, and assessment. The small number of empirical studies is likely related to the difficulty of examining the huge amount of complex data generated by MOOCs (Fischer, 2014; Fournier, Kop, & Durand, 2014). At the same time, researchers have also began to point out the advantages of analysing huge digital data in the context of assessment, process of learning, and social interaction (Thille et al., 2014). In addition, although most research on MOOCs is quite recent, some review studies have already been published. The reviews are mainly oriented towards providing a general idea of the state-of-the-art in MOOC phenomenon from various perspectives (Ebben & Murphy, 2014; Gasevic, Kovanovic, Joksimovic, & Siemens, 2014; Hew & Cheung, 2014; Koutropoulos & Zaharias, 2015; Liyanagunawardena, Adams, & Williams, 2014). Nevertheless, these reviews provide limited practical implications for students' learning outcomes. Therefore, as Reich (2015) emphasized, additional research must be conducted to explore factors that promote students' learning. In addition to other research reviews, the current study adds a new perspective to the MOOC literature by drawing on findings of published MOOC studies to identify the course design principles that impact students' learning outcomes.

Purpose of the Study

Even though MOOCs are rooted in online learning, scholars suggest that pedagogical aspects of these massive courses may have a distinguishable nature in *laissez-faire* environments with rich data (Bayne & Ross, 2014; Redfield, 2015). Grounded on a diversity of students' backgrounds and intentions, outcomes of teaching and learning processes in MOOCs can be misleading if metrics from conventional in-class or online education are applied. As the traditional variables in higher education might play out quite differently in MOOCs, a systematic review of the MOOC literature could provide essential insights to understand new, diverse concepts including achievement, assessment, retention, and participation as crucial ingredients for students' learning outcomes (DeBoer, Ho, Stump, & Breslow, 2014). Understanding how these concepts are related to students' learning outcomes is important since these are crucial elements for MOOC course design, which helps enhance the pedagogical aspects of MOOCs as well as provide concrete perspective for MOOCs (Glance, Forsey, & Riley, 2013; Perna et al., 2014). For this purpose, the 3P Model (Fig. 1) of teaching and learning in universities by Biggs (2003) was used as a framework to provide an organized way of structuring findings identified in the literature that appear to explain students' learning outcomes.

According to Biggs (2003), teaching and learning in universities are considered an interacting system of four components: students, learning environment, learning processes, and learning outcomes. Previous studies effectively used this model as a framework to review the literature (Han, 2014; Noroozi, Weinberger, Biemans, Mulder, & Chizari, 2012; Spelt, Biemans, Tobi, Luning, & Mulder, 2009). In the current review, Biggs's 3P Model is used to structure the findings into each component, thereby presenting a comprehensive model for successful learning outcomes in MOOCs. This model might enable curriculum and course developers in open online learning platforms to gain a holistic understanding of factors influencing students' learning outcomes. Explicitly, this study aims to review existing MOOC research in order to answer the following research questions:

- "Which student characteristics are related to students' learning outcomes in MOOCs?"
- "Which teaching context is related to students' learning outcomes in MOOCs?"
- "Which learning activities are related to students' learning outcomes in MOOCs?"

Methods

This review covers literature published in or before the year this study started (2015). The digital catalogue search of Leiden University was used to conduct a research that spanned multiple databases related to educational and social sciences: Academic Search Premier (EBSCO), ProQuest, Annual Reviews, ScienceDirect, Cambridge Journals, DOAJ, SAGE, Web of Science, SSRN (Social Science Research Network), and Wiley Online Library.

Inclusion and Exclusion Criteria

The following criteria were formulated to determine if previous studies should be included in the literature review: (a) published in peer-reviewed journals, (b) reported empirical findings, (c) reported in English, and (d) related with learning outcomes in MOOCs. Online databases were searched using Boolean logic with the keywords; MOOC, MOOCs, massive open online course, and learning outcomes. This search generated 203 hits. The first author subsequently read all studies and identified whether each article matched the criteria mentioned above. After the first scan for appropriateness, 46 were not published in peer-reviewed journals, leaving 157 studies. Among them, 84 did not provide empirical findings, leaving 73 articles. Only 56 of these research studies were selected for this review since the others were not related to student learning outcomes (Liyanagunawardena et al., 2014, Noroozi et al., 2012). The Appendix I summarizes the 56 studies, showing the authors, publication date, purpose, research question(s), method, sample, results, and implications for research and practice.

Data Analysis

Initially the first author read all text segments of the Results and Discussion sections of the selected articles that related to students' learning outcomes to identify the factors influencing students' learning outcomes. Following careful reading of the Results and Discussion sections of each reviewed study, the critical analysis was executed guided by research questions based on Biggs' (2003) 3P Model. The factors identified as contributing to students' learning outcomes were refined in an iterative manner during which alternative classifications were considered. An outside researcher conducted the same analysis procedure in order to ensure the internal consistency of the research. This selection was then categorized into four interrelated components (i.e., student characteristics, learning environment, learning process, and learning outcomes) based on Biggs model (Fig. 2).

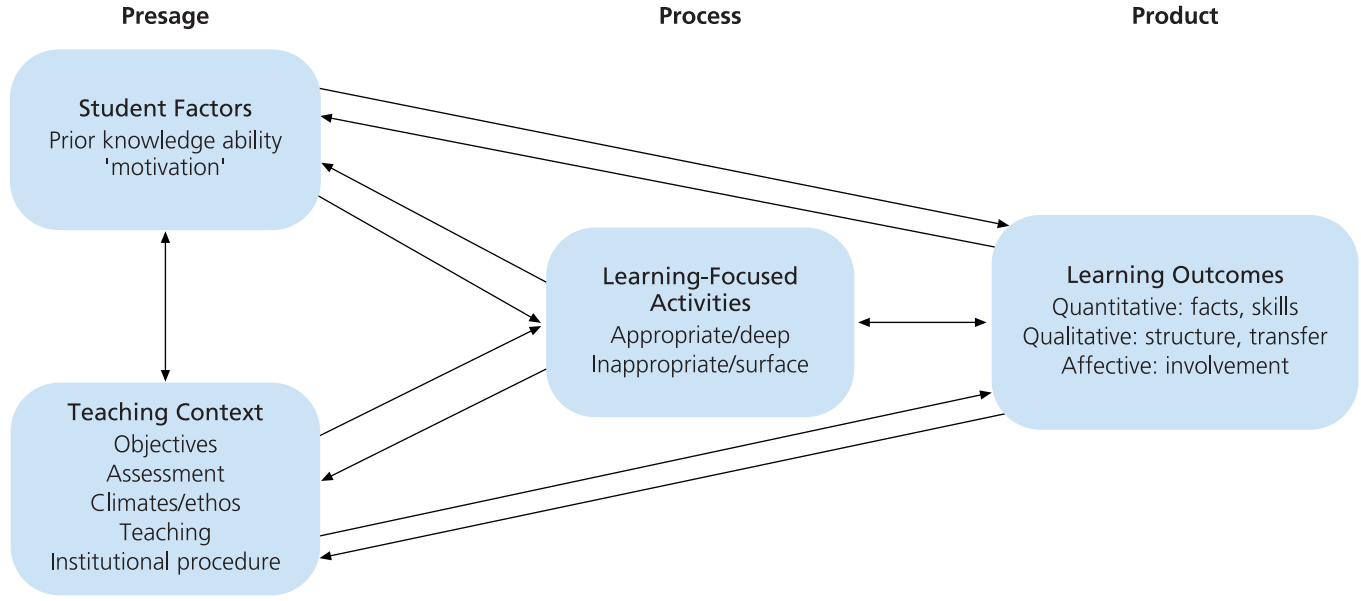

Fig. 1. The 3P model of teaching and learning (Biggs, 2003).

In the present study, the first factor that presaged learning outcomes was student characteristics, which includes academic (i.e., prior-knowledge, prior-experience, and expertise) and personal (i.e., self-motivation, self-confidence, and participation) student characteristics. The other factor that presaged learning outcomes was course features. These features are part of the learning environment in which MOOCs are set, which is established by instructors or providers in terms of pedagogy, tools, and assessment. In terms of factors that portend learning outcomes, some of the student characteristics and course features were related to each other. For example, course assessments were related to student characteristics and some student characteristics may have affected the efficiency of tools used in MOOCs. The learning process component consists of findings related to learning activities while. The final component (i.e., learning outcomes) includes students' engagement, achievement, and attrition. As Fig. 2 suggests, the adopted 3P model from Biggs (2003) identifies the relationship among and/or between these four components and provides a comprehensive framework of how factors that emerged from published studies interacted and related to students' learning outcomes.

Results

The factors related to learning outcomes extracted from the reviewed publications were clustered into four inter-related components from Biggs model (2003; Fig. 2):

- Students' characteristics
- Learning environment
- Learning process
- Learning outcomes

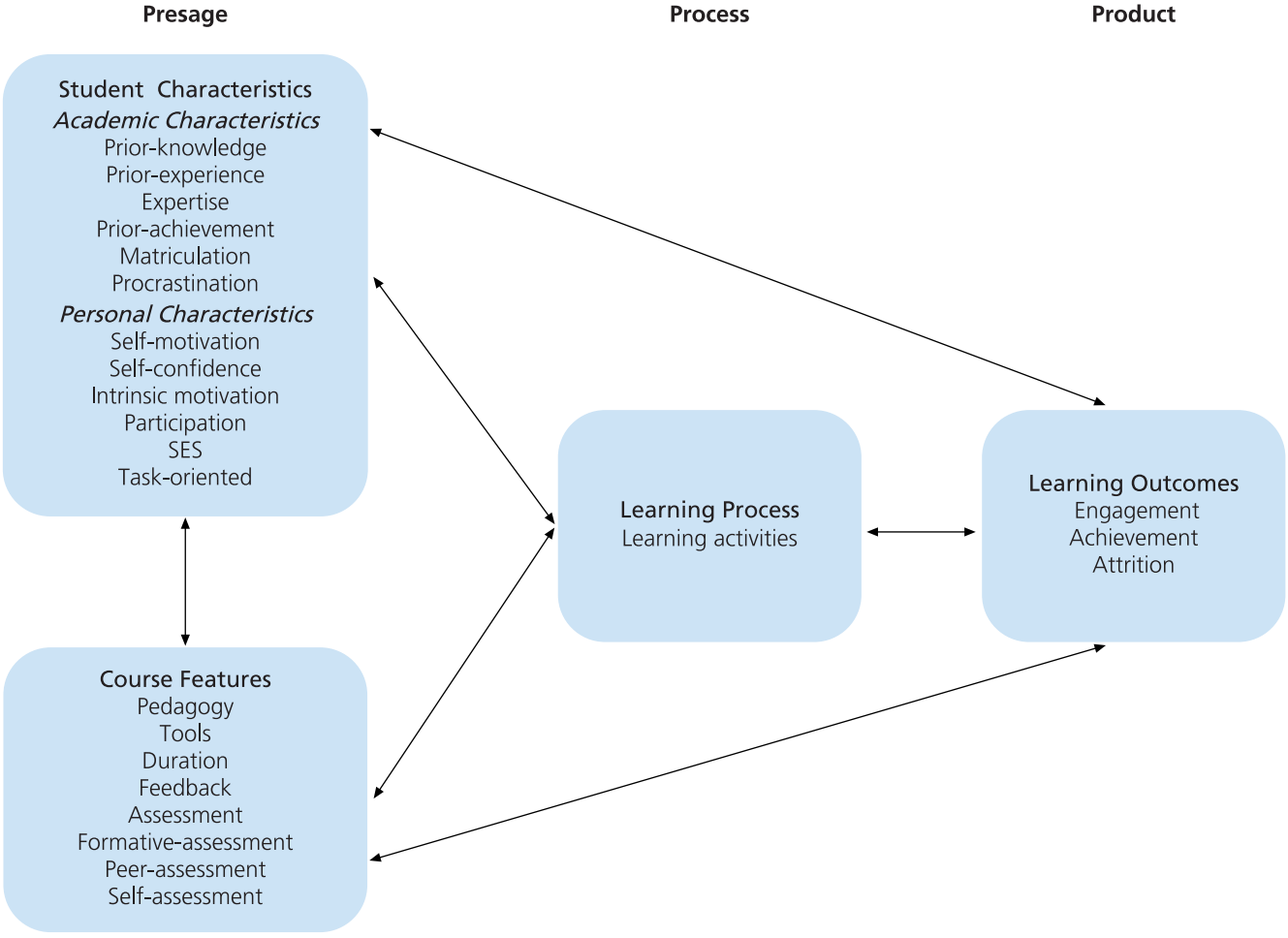

Fig. 2. Framework of the factors account for learning outcomes in MOOCs (adapted from the original 3P model of Biggs, 2003).

The component of students' characteristics was divided into academic (i.e., prior-knowledge, prior-experience, expertise, academic achievement, and matriculation) and personal (i.e., self-motivation, self-confidence, intrinsic motivation, participation, social economic statute, and task-oriented) student characteristics. The course features component addressed course design elements of MOOCs that characterize the learning environment including pedagogy, tools, tasks, duration, feedback, and assessment. The component process factors refered to students' learning activities in MOOCs and the component product factors included students' engagement, achievement, and attrition.

Presage Factors

Students' Academic Characteristics

Student' academic characteristics referred to learning goals (of an individual or a group of individuals), prior-experience, prior-knowledge, expertise, academic achievement, procrastination, matriculation, and task-orientation. Many of the reviewed studies highlighted that the students who participated in forums, discussion groups, and blogs were well-educated and taking the courses to gain professional skills (Gillani & Eynon, 2014). Moreover, students with task-oriented skills tended to be successful in MOOCs (Liu et al., 2014).

Students' prior experiences with e-learning were found to be positively related to their participation level. Experienced students in networked learning participated at a higher level in MOOCs (Greene, Oswald, & Pomerantz, 2015; Kop, Fournier, & Mak, 2011). The experienced students tended to participate and to contribute more than novice learners in discussion forums, blogs, and learning networks; new students tended to use the ready-made materials in MOOCs (Fournier et al., 2014; Milligan, Littlejohn, & Margaryan, 2013). Moreover, one recent study indicated the gap between novice and experienced MOOCers as a possible 'dark side' of MOOCs since the novice MOOC participants of Rhizo 14 cMOOC felt isolated, which limited their engagement (Mackness & Bell, 2015).

Although findings of the reviewed studies (Breslow et al., 2013; Greene et al., 2015; Konstan, Walker, Brooks, Brown, & Ekstrand, 2015) did not indicate any significant correlation between either age or gender with student learning outcomes, the authors found a relationship between student level of schooling and outcomes, as higher level of schooling is associated with higher participation and lower attrition.

For student retention in MOOCs students' prior achievement also seemed to be an influential factor (de Freitas, Morgan, & Gibson, 2015), although findings about this relationship were ambiguous. For example, Jiang, Williams, Warschauer, He, & O'Dowd (2014) found that students with a poor academic background were the ones who completed and received the certificate. On the other hand, other research indicated that matriculated students were more likely to complete a MOOC (Chen & Chen, 2015; Firmin et al., 2014) since they are more task-oriented (Jiang et al., 2014). Although students enrol in MOOCs for degree purposes (Chen & Chen, 2015), those who score high on procrastination on academic tasks (Diver & Martinez, 2015) tended to dropout of the course.

Student Personal Characteristics

The second category of student characteristics, personal characteristics, refer to non-academic characteristics including self-motivation, self-confidence, intrinsic motivation, intentions, self-commitment, and socioeconomic status. In general, these individual student characteristics were related to how students engaged with MOOC activities and their completion of the course. For example, Kizilcec & Schneider (2015) found that students' intentions and their level of intrinsic motivation were positively related to the extent to which students watched videos and their assessment completion in MOOCs. Similarly, students with high self-motivation were more engaged in cMOOCs (Castaño-Garrido, Maiz-Olazabalaga, & Garay-Ruiz, 2015; Dillahunt, Wang, & Teasley, 2014). This also was the case with students who reported a relatively high self-confidence (Milligan et al., 2013). Finally, students with a low socioeconomic status who self-identified as being unable to afford a formal education seemed to put more effort into being successful in the course compared to other students (Dillahunt et al., 2014).

Course features: Pedagogy

Many of the reviewed studies explicitly explained the design and implementation process of the MOOCs, but only a limited number of studies examined how the design of MOOCs was related to students' learning activities or outcomes. The pioneering empirical studies concentrated on only two philosophical MOOC designs: cMOOCs and xMOOCs (Rodriguez, 2012). After several years, however, the research shows that more varieties of xMOOC and cMOOC had emerged (Clark, 2013). It is what actually happens in these courses, however, rather than the specific pedagogical beliefs, that are essential for students' learning outcomes.

Students' learning mostly results from an interface between the provided content and pedagogical strategies when these engage the learner's interest (Khine &

Lourdusamy, 2003). Learners seem to feel more interactive, open, connected, and autonomous in small cMOOC [e.g., SPOCs (Small Private Open Courses) or SCOOCs (Small Connectivist Open Online Courses)] platforms (Mackness, Waite, Roberts, & Lovegrove, 2013). Some other factors, including 'flexibility to do and read,' 'course design,' and 'receiving feedback from a knowledgeable person,' are also identified as influential factors on students' learning in cMOOCs (Fournier et al., 2014). However, many MOOC students (i.e., achievers, non-achievers, live, and archive) follow the course content and watch videos in the sequential order specified by the instructor (Campbell, Gibbs, Najafi, & Severinski, 2014; Perna et al., 2014). Furthermore, most of the MOOCs follow the objectivist-individual teaching method, which actually contradicts basic features of MOOCs such as active learning and connectivisim (Toven-Lindsey, Rhoads, & Lozano, 2015). MOOC platforms can facilitate both online and offline communication, which is suitable for designing social learning experiences and many studies connect the pedagogy of a MOOC and the interaction and communication of students. The lack of student-student and student-instructor interaction in many MOOCs generally cannot provide engaged learning experiences (Hew & Cheung, 2014), whereas MOOCs that facilitate student-student interaction by asking students to collaborate with their peers positively influenced students' engagement (Trumbore, 2014) and their satisfaction with the course (Al-Atabi & DeBoer, 2014). These findings are confirmed by Kizilcec & Schneider (2015) who found that students show relatively more engagement when they are enrolled in MOOCs with their colleagues and/or friends.

Some authors claim that MOOCs lack a coherent instructional design process including learning objectives, instructional activities, and assessment (Margaryan, Bianco, & Littlejohn, 2015; Spector, 2014). In fact, there is a strong positive relationship between developing a curriculum that is consistent with learning objectives and assessments (Falchikov & Goldfinch, 2000). This means that in many cases, a lack of instructional objectives in MOOCs makes them insufficient to achieve the expected learning outcomes. If we compare xMOOCs and cMOOCs, connectivist oriented MOOCs seem to provide more quality in terms of instructional principles, such as students' activation, authentic resources, application and integration of learning activities, collaboration between peers, development of collective knowledge, and differentiation between various student groups (Margaryan et al., 2015). But this doesn't prove that xMOOCs are inappropriate for student learning. In MOOC environments, the flexibility of students to follow individualized learning pathways is sometimes incompatible with the course providers' or instructors' pre-determined course design structure. Therefore, researchers should think of new metric system to evaluate the design quality of MOOCs.

Course Features: Tools

Materials are the backbone of teaching-learning activities by supporting students with different learning styles in meaningful learning (Klimova & Poulova, 2013). MOOCs utilize commonly used teaching materials such as instruction videos, e-resources, e-books, and exercise sets. In addition, mostly in cMOOCs, social media tools such as discussion groups, blogs, web forums, social network sites (SNSs), Wikis, and podcasts encourage students to participate, contribute, and collaboratively construct knowledge (Veletsianos, Collier, & Schneider, 2015). Some authors found positive relationships between the use of social media tools in MOOCs and learning outcomes (e.g., the use of Google+) (Vivian, Falkner, & Falkner, 2014). In addition, some exclusive learning activities such as *challenge-lesson-resolution*, *the daily*, and *brain rewiring* facilitated students' participation and discussion, which resulted in students being more satisfied with the course (Al-Atabi & DeBoer, 2014; Kop et al., 2011). In addition to the potential beneficial results associated with integrating social media tools into the learning process, learners can empower themselves and contribute more autonomously to their own learning. Similar to open educational resources (OER) in education, availability and accessibility of learning tools and materials put MOOCs in an advantageous position, which means that the openness and flexibility of MOOCs are two major incentives for participation (Yousef, Chatti, Wosnitza, & Schroeder, 2015).

Whereas the pedagogical quality of instructional materials in online learning has been investigated by many researchers (Klimova & Poulova, 2013), only a few researchers have done so in MOOCs. Research on instructional materials in MOOCs indicates that readings (50%) and videos (40%) are the most used supportive materials; among other materials the discussion forums are cited by only 6% of the students as a useful learning resource (Giannakos, Jaccheri, & Krogstie, 2014; Liu et al., 2014). Pre-recorded videos are quite popular in open education platforms, and some authors show positive evaluations of pre-recorded video based on xMOOCs (Adams, Yin, Madriz, & Mullen, 2014; Firmin et al., 2014). However, students generally prefer to watch MOOC videos in a group and with individual control

over videos (Gasevic et al., 2014). This mode of watching videos increases student concentration and engagement, and balances synchronicity, video interactivity, and group discussion. Yet, simply incorporating interactive videos into an online learning environment may not always result in enhanced learning. Research shows that embedding topic related questions in a video-based online learning environment promotes meaningful student learning, improves the amount of student interaction, and increases the time students spend on the learning materials (Adams et al., 2014). Thus, MOOC platforms using question-embedded videos may help students be more active and consequently promote meaningful learning. Finally, including the instructor's face in the videos has no significant effect on students' recall and transfer learning, which would help students connect previous experiences to new learning contexts (Kizilcec et al., 2015).

Course Features: Duration

Generally, the popular standard for MOOC length changes between 6-8 week classes. Longer MOOCs can make both developers and students feel overwhelmed. This may be why the duration of the MOOC is negatively associated with the completion rate. As Jordan (2014, 2015) indicated, students tend to dropout of the course when the duration is extended.

Course Features: Assessment and Feedback

Assessment is one of the most criticized issues in MOOCs (Clarà & Barberà, 2014), with studies mainly focused on the credibility of e-assessment as well as self and peer-assessment. Self and peer-assessment are distinguishing features of MOOCs since they relieve instructors from grading huge number of assignments and quizzes, and support learners in enhancing their learning and understanding.

Use of self and peer-assessment as formative evaluation helps students see their progress throughout the course. Using self and peer-assessment as an assessment *for* learning can be useful if proper feedback or assessments with rubrics are provided to students during the formative assessment processes; otherwise students cannot become aware of their biases and/or misunderstanding (Admiraal, Huisman, & Pilli, 2015; Admiraal, Huisman, & Van de Ven, 2014). Peer and self-assessment is eventually needed and will be an enduring quality of MOOCs since it is one of the most beneficial ways to cope with disadvantages of having so many students enrolled in the same course simultaneously. Thus, it would be useful to increase the effectiveness, credibility, and usability of self and peer-assessment (Vista, Care, & Griffin, 2015).

Moreover, providing feedback and guidance (i.e., a rubric) on peer and self-assessment rating biases can help enhance students' learning. Using predetermined rubrics enable students to recognize their mistakes and misunderstandings, which provides a more accurate learning experience and better serves the purpose of assessment (Balfour, 2013; Kulkarni et al., 2013). Students learn in meaningful ways when they receive feedback from peers in discussion forums since they feel more comfortable and open when interacting with each other (Comer, Clark, & Canelas, 2014; Liu et al., 2014).

To improve assessment accuracy in MOOCs, machine-based assessment would be an alternative method to peer and self-assessment. Thus, some research studies have investigated the usability of machine assessment to evaluate students' learning outcomes. However, MOOC instructors have criticized Automated Essay Scoring (AES) tools because the way in which they score writing assignments in MOOCs is unsatisfactory. The reason is that AESs can be less accurate and reliable for evaluating students' writing assignments when they include complex metaphors and humour when compared to instructor grading (Reilly, Stafford, Williams, & Corliss, 2014). Finally, not the types of assessment, but the design and clarity of assessment, are important. For instance, poorly designed assessments decrease students' attention to the topic (Zutshi et al., 2013).

Process Factors

Learning Activities

In MOOC environments, understanding the learners' activities is mostly limited by log and clickstream analysis. For instance, Liang et al. (2014) analysed students' learning records using data mining technology to discover students' learning outcomes. Other researchers, however, have attempted to use qualitative data in order to reach the answer the question of how learners approach their tasks in MOOC environments. Veletsianos et al. (2015) distinguished four categories of students' activities in MOOCs: (1) digital activities, which mostly occur in outside MOOC platforms such as social networking sites, (2) non-digital activities such as note taking, (3) social activities, and (4) individual activities such as locating a study space at home.

Based on the reviewed studies, it can be concluded that there are various learning activities. Firstly, there is a need for equilibrium between collaborative and individual work. For instance, in cMOOC environments, students' learning approaches are oriented towards collaborative learning such as sharing, creating, and making mutual ways for learning

instead of following individual paths (Bali, Crawford, Jessen, Signorelli, & Zamora, 2015). Findings also showed that, apart from collaborative learning, query- and game-based learning also are highly preferred learning approaches in MOOCs (Chang, Hung, & Lin, 2015). Some studies indicated that learning activities are mainly structured on principles of self-directed learning (Bonk, Lee, Kou, Xu, & Sheu 2015; Hew & Cheung, 2014). Learning routines can help students build confidence, which in turn fosters commitment to the course (Castaño-Garrido et al., 2015). Thus, the amount of collaborative and individual learning activities should be balanced since too many collaborative activities might make students feel frustrated and contribute to incomplete submissions that result in dropout (Saadatmand & Kumpulainen, 2014).

Secondly, both synchronous and asynchronous learning activities should be balanced since learners might have some difficulties following synchronous activities. Thirdly, a robust balance between active learning and reproductive learning activities should be created. For instance, Miller (2015) suggested that active learning activities help students engage with course content easily while other studies have indicated that the opportunity to work on practical examples provides meaningful learning by requiring learners to apply theoretical knowledge (Park, Jung, & Reeves, 2015; Stefanic, 2014).

Product Factors

Engagement

Coates (2006, p. 122) defines engagement as encompassing "the active and collaborative learning, participation in challenging academic activities, formative communication with academic staff, involvement in enriching educational experiences, and feeling legitimated and supported by university learning communities." In online education, active and authentic learning environments, interactive learning activities, and learner-centred communities provide the foundation for a high level of student cognitive engagement (Katuk & Kim, 2013).

In MOOCs, engagement refers to learner participation with peers, instructors, and materials on the network/web. Interaction, an active learning environment, as well as clear instructions and guidance are effective for increasing student engagement in MOOCs (Chang et al., 2015). Participation and engagement in MOOCs can have different forms as students' interaction with MOOC resources happens at various times, in unique orders, and in different amounts (DeBoer et al., 2014). Thus, different forms of participation and engagement should be taken into consideration while developing MOOC curriculums, teaching-learning activities, organizing learning environments, and creating assignments to increase the quality of learning outcomes in MOOCs (Ahn, Butler, Alam, & Webster, 2013).

Achievement

Academic achievement can be defined as fulfilling course requirements and making satisfactory progress on the way to receiving a diploma. However, this might manifest quite differently in MOOCs since there is still disagreement on appropriate measures of academic achievement between MOOC researchers and providers (Hew & Cheung, 2014). When MOOCs are considered as an open and large-scale course context, course certification rates can be misleading and counterproductive indicators of their real impact and potential.

Likewise, it may not be useful to evaluate students' achievement with traditional metrics and methods. The definition of student success might be reformulated in terms of if students are able to reach their own goals or realize their own intentions (DeBoer et al., 2014; Ho et al., 2014). Furthermore, Ho et al. (2014, p. 2) specifically stated that "*Pressure to increase certification rates may decrease the impact of open online courses, by encouraging instructors and administrators to suppress or restrict registration, lower certification standards, deemphasize recruitment of target subpopulations, or disregard interventions that may disproportionately increase numbers of non-certified registrants over certified registrants*".

The current review showed that being assignment-oriented and well-structured, having sequential course structure and well-designed assessments, task-oriented MOOCs, small cMOOCs, as well as the quality of materials (e.g., videos) are important portents of student success (Forsey, Low, & Glance, 2013). Mainly, assignments play a significant role in students' achievement. For instance, Daza, Makriyannis, and Rovira Riera (2014) revealed that learning tasks *called challenge–lesson–resolution*, which introduce simple real-life problems to students that are then explained and solved during the lesson, can help students comprehend course content.

Apart from the underlying course design, some key features of courses positively affect students' achievement. For instance, group projects, e-learning activities, tutorials and online quizzes, discussion sessions such as *brain rewiring*, which require students to post daily positive experiences, result in increased student success (Al-Atabi & DeBoer, 2014). In addition, integrating other social media tools (e.g., Skype, Facebook, Google+) that enable students to work col-

laboratively with discussion boards and blogs are also effective for ameliorating students' understanding and success (Comer et al., 2014; Firmin et al., 2014; Zutshi et al., 2013).

Moreover, instructor support (e.g., providing feedback) of student effort, which increases course engagement, may have a substantial positive impact on achievement in MOOCs (Hernández-Carranza, Romero-Corella, & Ramírez-Montoya, 2015). Some studies pointed that participation, motivation, intention to complete the course, and level of course satisfaction are all related to students' achievement (Castaño-Garrido et al., 2015; Liyanagunawardena, Lundqvist, & Williams, 2015; Milligan et al., 2013).

Attrition

The dropout rate is a critical issue in the MOOC literature. Thousands sign up for courses, but a very small percentage finish with a passing grade. The literature showed that notwithstanding the huge enrolment rate of MOOCs, the retention rate is generally quite low (Jordan, 2014). The vast gap between enrolment and completion is caused by several factors such as 'lack of time,' 'bad time management,' and 'limited time-on-task' (Fini, 2009; Liu et al., 2014).

Some course design features are understood as strong predictors of student retention in MOOCs (Castaño-Garrido et al., 2015; Macleod, Haywood, Woodgate, & Alkhatnai, 2015). For instance, courses with flexible structure, support from and monitoring by the instructor, high student cognitive engagement, and high quality course materials positively influence student retention (Campbell et al., 2014; Hernández-Carranza et al., 2015; Liu et al., 2014; Yang, Wen, Kumar, Xing, & Rose, 2014). Finally, Perna et al. (2014) suggested that attending the first lecture and the first quiz are two significant predictors of course completion.

Discussion and Conclusion

It is clear that research on MOOCs is undergoing rapid development. As this review underlines, there is a new growing body of empirical research that supports the notion that instructional quality and learning analytics play a significant role in the MOOC phenomenon. Criticisms of MOOCs regarding their low completion rates, lack of pedagogical infrastructure, and unreliable assessment methods have led recent research to focus on students' learning outcomes in MOOCs (Mackness & Bell, 2015). Thus, knowing more about what and how students learn would provide data for designing ways to address the challenges faced in MOOCs. As called for by many researchers, the current study aimed to explore MOOCs by examining factors involved in students' learning outcomes (Castaño-Garrido et al., 2015; Reich, 2015). Thus, literature on MOOCs was reviewed to identify students' characteristics, course features, and learning processes related to significant learning outcomes. The selected studies were systematically analysed with respect to the components of Biggs (2003) 3P model. The students' characteristics, teaching context, and learning activities related to students' learning outcomes (*see* Fig. 2.) were synthesized in order to formulate a set of suggestions for designing significant learning outcomes in MOOCs. Applying the following suggestions for the design of MOOCs might be beneficial to both MOOC providers and instructors:

- Ensure that all students with different personal and academic characteristics are able to follow the course information. Conducting need assessment could be helpful to identify the students' needs, preferences, and expectations as a basis for organizing course design. For instance, students who have prior experience with online learning might be more active and ready to participate in open online courses compared to those who have no or limited experience.
- Course resources and tools should encourage students to participate. These may include social networking tools, authentic tasks, project-based assignments, and collaborative projects.
- Providing unique features (e.g., authentic e-learning activities) within the courses increases students' commitment and participation.
- Use peer and self-assessment for formative evaluation in conjunction with rubrics or other form of guidance to improve both students' learning and the accuracy of their assessments.
- Provide clear and structured assessments, and design the assessments by taking into account the students' profile and preferences in order to capture the students' attention.
- Ensure that feedback is personalized and contextualized to stimulate students' participation and engagement.
- Facilitate learner-centred communities using group projects or collaborative study groups to encourage students' participation and engagement.
- Provide opportunities for students to contribute in discussion forums and blogs in order to sustain their motivation to participate and complete the course.
- Ensure that MOOCs are prepared based on a well-structured instructional design models that include learning

tasks, quality materials (e.g., videos) and tools, SNSs, aligned assessments, and personalized learning environments.

- Provide opportunities for students to manage their own time in order to develop their intrinsic motivation and commitment to the course.
- Ensure that the duration of the course is no longer than 8 weeks; students tend to remain in and complete shorter MOOCs.
- Provide alternatives for students to accredit MOOCs to increase the retention. There should be an option to transfer credits from MOOCs into institutional degree programs.
- Foster self-directed learning environments to expand students' autonomy, encourage them to complete their weekly assignments, and provide opportunities for students with limited computer and language skills.

Based on the current review study several conclusions can be highlighted. Firstly, the MOOC studies reviewed reinforce the message that proper course design, which considers students' individual differences and intentions, may provide a solution to current problematic issues that make the higher education committee sceptical of MOOCs. No one denies the reality that the mounting MOOC phenomenon brings vital change and development to higher education, but this innovation must not change the real purpose of providing effective learning environments. Therefore, the needs and requirements of those who follow and lead MOOCs should be fulfilled by MOOC providers to continue their existence and enhance efficiency. It is further important to note that these needs and requirements are evolving and changing in very different patterns compared to traditional education (DeBoer et al., 2014; Liyanagunawardena et al., 2015).

Secondly, there is widespread agreement that students' learning outcomes are more difficult to explore and analyse in open online learning environments than in campus environments because of the difficulty, discrepancies, and fertility of data in open online learning environments. More research is needed to fully comprehend factors related to significant learning outcomes in MOOCs by conducting research that goes beyond counting 'clicks.'

Thirdly, this review study revealed that there are many MOOCs without sufficient pedagogical infrastructure. Although teaching and learning practices including instructional design, teaching materials, and assessment might be problematic, many students who participated in MOOCs especially in miniMOOCs expressed a high level of satisfaction (Khalil & Ebner, 2013). Even more surprisingly, this positive attitude towards MOOCs is not related to course completion (Mackness & Bell, 2015). Some distance education researchers claim that the MOOC phenomenon is just a fad that will never challenge or alter in-class higher education and that they are going to lose their popularity in the near future. Other researchers, however, claim that MOOCs will continue to provide new insights and opportunities for higher education.

MOOCs promote a great opportunity for lifelong learning (Liyanagunawardena, 2015; Macleod et al., 2015; Milligan & Littlejohn, 2014; Steffens, 2015). Albeit that students differ in reasons why they attend a MOOC (e.g., lifelong learning, personal development or credits), MOOCs should be developed on the basis of instructional design models. To this end, the set of implications mentioned above which were based on empirical findings from the literature, offers an opportunity to develop open online courses for significant students' learning outcomes.

Implications for Future Work

Although the research literature defines general issues that could be addressed in research on MOOCs, only a few studies focused on teaching and learning aspects. More research is needed on how MOOCS impact students' learning outcomes and performance, and their connection with aspects of instruction and teaching. Finding ways to increase student' completion rates would not automatically translate to definitely establishing the quality of MOOCs. Like in face-to-face education, passing rates are not always good indicators of students' meaningful learning. This means that MOOC stakeholders must develop additional indicators of MOOC quality.

Firstly, we suggest investigating issues related to pedagogical aspects of MOOCs, such as how to align with students' needs and how various course designs (e.g., personalized learning, e-activity-based learning, game-based learning, and project-based learning) impact students' engagement, satisfaction, achievement, and retention rates in MOOCs. One of these pedagogical aspects is feedback. Timely feedback that is formulated to be "to the point" is positively related to students' meaningful learning and future research could investigate how to incorporate this kind of feedback into MOOCs.

Secondly, we suggest examining alternative assessment methods that are aligned with learners' needs and motivations, and to also assess aspects of performance that are more relevant for MOOC platforms (e.g., collaboration, openness, active involvement) compared to traditional learning environments.

Thirdly, it might be useful to examine the differences in learning outcomes of experienced and novice MOOCers, and how these differences are related to the learning behaviors they exhibit during a MOOC. Experience could also be a research topic in terms of the instructors to examine differences between experienced and novice MOOC instructors.

Fourthly, further research could focus on testing hypothetical relationships between students' characteristics, course features, learning and teaching activities, and students' learning outcomes in MOOCs. This kind of research can support teachers and designers in decisions regarding how to plan MOOC components.

References

Adams, C., Yin, Y., Madriz, L. F. V., & Mullen, C. S. (2014). A phenomenology of learning large: The tutorial sphere of xMOOC video lectures. *Distance Education*, *35*(2), 202–216.

Admiraal, W., Husiman, B., & Pilli, O. (2015). Assessment in massive open online courses. *Electronic Journal of e-Learning*, *13*(4): 207–216.

Admiraal, W., Huisman, B., & Van de Ven, M. (2014). Self- and peer assessment in massive open online courses. *International Journal of Higher Education*, *3*(3), 119–128.

Ahn, J., Butler, B. S., Alam, A., & Webster, S. A. (2013). Learner participation and engagement in open online courses: Insights from the Peer 2 Peer University. *MERLOT Journal of Online Learning and Teaching*, *9*(2), 160–171.

Al-Atabi, M., & DeBoer, J. (2014). Teaching entrepreneurship using massive open online course (MOOC). *Technovation*, *34*(4), 261–264.

Balfour, S. P. (2013). Assessing writing in MOOCs: Automated essay scoring and calibrated peer review. *Research & Practice in Assessment*, *8*, 40–48.

Bali, M., Crawford, M., Jessen, R. L., Signorelli, P., & Zamora, M. (2015). What makes a cMOOC community endure? Multiple participant perspectives from diverse MOOCs. *Educational Media International*, doi:10.1080/09523987.2015.1053290

Bayne, S., & Ross, J. (2014). *The pedagogy of the Massive Open Online Course: the UK view*. York, UK: The Higher Education Academy.

Biggs, J. (2003). *Teaching for quality learning at university* (2 ed.). Berkshire, UK: Open University Press.

Bonk, C. J., Lee, M. M., Kou, X., Xu, S., & Sheu, F.-R. (2015). Understanding the self-directed online learning preferences, goals, achievements, and challenges of MIT OpenCourseWare subscribers. *Educational Technology & Society*, *18*(2), 349–368.

Breslow, L., Pritchard, D. E., DeBoer, J., Stump, G. S., Ho, A. D., & Seaton, D. T. (2013). Studying learning in the worldwide classroom research into edX's First MOOC. *Research & Practice in Assessment*, *8*, 13–25.

Campbell, J., Gibbs, A. L., Najafi, H., & Severinski, C. (2014). A comparison of learner intent and behaviour in live and archived MOOCs. *The International Review of Research in Open and Distance Learning*, *15*(5), 235–262.

Castaño-Garrido, C., Maiz-Olazabalaga, I., & Garay-Ruiz, U. (2015). Design, motivation and performance in a cooperative MOOC course. *Comunicar*, *22*(44), 19–26.

Chang, R. I., Hung, Y. H., & Lin, C. F. (2015). Survey of learning experiences and influence of learning style preferences on user intentions regarding MOOCs. *British Journal of Educational Technology*, *46*(3), 52819–26541.

Chen, Y.-H., & Chen, P.-J. (2015). MOOC study group: Facilitation strategies, influential factors, and student perceived gains. *Computers & Education*, *86*, 55–70.

Clarà, M., & Barberà, E. (2014). Three problems with the connectivist conception of learning. *Journal of Computer Assisted Learning*, *30*(3), 197–206.

Clark, D. (2013). *MOOCs: Taxonomy of 8 types of MOOC*. Accessed through <http://donaldclarkplanb.blogspot.co.uk/search?q=MOOCs: +taxonomy> on March 24th, 2015.

Comer, D. K., Clark, C. R., & Canelas, D. A. (2014). Writing to learn and learning to write across the disciplines: Peer-to-peer writing in introductory-level MOOCs. *The International Review of Research in Open and Distance Learning*, *15*(5), 26–82.

Daza, V., Makriyannis, N., & Rovira Riera, C. (2014). MOOC attack: Closing the gap between pre-university and university mathematics. *Open Learning: The Journal of Open, Distance and e-Learning*, *28*(3), 227–238.

de Freitas, S. I., Morgan, J., & Gibson, D. (2015). Will MOOCs transform learning and teaching in higher education? Engagement and course retention in online learning provision. *British Journal of Educational Technology*, *46*(3), 455–471.

DeBoer, J., Ho, A. D., Stump, G. S., & Breslow, L. (2014). Changing "Course": Reconceptualizing educational variables for massive open online courses. *Educational Researcher*, *43*(2), 74–84.

Dillahunt, T. R., Wang, B. Z., & Teasley, S. (2014). Democratizing higher education: Exploring MOOC use among those who cannot afford a formal education. *The International Review of Research in Open and Distance Learning*, *15*(5), 177–196.

Diver, P., & Martinez, I. (2015). MOOCs as a massive research laboratory: Opportunities and challenges. *Distance Education*, 1-21.

Ebben, M., & Murphy, J. S. (2014). Unpacking MOOC scholarly discourse: a review of nascent MOOC scholarship. *Learning Media and Technology*, *39*(3), 328–345.

EDUCAUSE. *7 things you should know about MOOCs. (2011)*. Accessed through <http://net.educause.edu/ir/library/pdf/ ELI7078.pdf/> on February 13th, 2015.

Falchikov, N., & Goldfinch, J. (2000). Student peer assessment in higher education: A meta-analysis comparing peer and teacher marks. *Review of Educational Research*, *70*(3), 287–322.

Fasihuddin, H. A., Skinner, G. D., & Athauda, R. I. (2013). Boosting the opportunities of open learning (MOOCs) through learning theories. *GSTF Journal on Computing*, *3*(3), 112–117.

Firmin, R., Schiorring, E., Whitmer, J., Willett, T., Collins, E. D., & Sujitparapitaya, S. (2014). Case study: Using MOOCs for conventional college coursework. *Distance Education*, *35*(2), 178–201.

Fini, A. (2009). The technological dimension of a massive open online course: The case of the CCK08 course tools. *The International Review of Research in Open and Distance Learning*, *10*(5).

Fischer, G. (2014). Beyond hype and underestimation: Identifying research challenges for the future of MOOCs. *Distance Education*, *35*(2), 149–158.

Fisher, D. H. (2014). Educational advances in artificial intelligence leveraging AI teaching in the cloud for AI teaching on campus. *Ai Magazine*, *35*, 98–100.

Forsey, M., Low, M., & Glance, D. (2013). Flipping the sociology classroom: Towards a practice of online pedagogy. *Journal of Sociology*, *49* (4), 471–485.

Fournier, H., Kop, R., & Durand, G. (2014). Challenges to research in MOOCs. *MERLOT Journal of Online Learning and Teaching*, *10*(1), 1–15.

Gasevic, D., Kovanovic, V., Joksimovic, S., & Siemens, G. (2014). Where is research on massive open online courses headed? A data analysis of the MOOC research initiative. *The International Review of Research in Open and Distance Learning*, *15*(5), 134–176.

Giannakos, M., Jaccheri, L., & Krogstie, J. (2014). Looking at MOOCs rapid growth through the lens of video-based learning research. *International Journal of Emerging Technologies in Learning (IJET)*, *9*(1), 35–38.

Gillani, N., & Eynon, R. (2014). Communication patterns in massively open online courses. *The Internet and Higher Education*, *23*, 18–26.

Glance, D. G., Forsey, M., & Riley, M. (2013). The pedagogical foundations of massive open online courses. *First Monday*, *18*(5).

Greene, J. A., Oswald, C. A., & Pomerantz, J. (2015). Predictors of retention and achievement in a Massive Open Online Course. *American Educational Research Journal*, *52*(5), 925–955.

Han, J. H. (2014). Closing the missing links and opening the relationships among the factors: A literature review on the use of clicker technology using the 3P model. *Educational Technology & Society*, *17*(4), 150–168.

Hernández-Carranza, E. E., Romero-Corella, S. I., & Ramírez-Montoya, M. S. (2015). Evaluation of digital didactic skills in massive open online courses: A contribution to the latin american movement. *Comunicar*, *XXII*(44), 81–89.

Hew, K. F., & Cheung, W. S. (2014). Students' and instructors' use of massive open online courses (MOOCs): Motivations and challenges. *Educational Research Review*, *12*, 45–58.

Ho, A. D., Reich, B. J. F., Nesterko, S. O., Seaton, D. T., Mullaney, T. P., Waldo, J. H., & Chuang, I. (2014). HarvardX and MITx: The first year of open online courses, Fall 2012-Summer 2013. *Working Paper*, *1*, 1–33.

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

Jiang, S., Williams, A. E., Warschauer, M., He, W., & O'Dowd, D. K. (2014). Influence of incentives on performance in a pre-college biology MOOC. *The International Review of Research in Open and Distance Learning*, *15*(5), 99–112.

Jordan, K. (2014). Initial trends in enrolment and completion of massive open online courses. *The International Review of Research in Open and Distance Learning*, *15*(1), 133–160.

Jordan, K. (2015). Massive open online course completion rates revisited: Assessment, length and attrition. *The International Review of Research in Open and Distributed Learning*, *16*(3), 341–358.

Katuk, N., & Kim, J.H. (2013). Experience beyond knowledge: Pragmatic e-learning systems design with learning experience. *Computer Human Behaviour*, *29*, 747–758.

Khine, M. S., & Lourdusamy, A. (2003). Blended learning approach in teacher education: Combining face-to-face instruction, multimedia viewing and on-line discussion. *British Journal of Educational Technology*, *34*(5), 671–675.

Khalil, H., & Ebner, M. (2013). *"How satisfied are you with your MOOC?" - A research study on interaction in huge online courses.* Paper presented at the Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2013, Chesapeake, VA, USA.

Kizilcec, R. F., & Schneider, E. (2015). Motivation as a lens to understand online learners: Towards data-driven design with the OLEI scale. *ACM Transactions on Computer-Human Interaction*, *22*(2), doi:10.1145/2699735

Kizilcec, R. F., Bailenson, J. N., & Gomez, C. J. (2015). The instructor's face in video instruction: Evidence from two large-scale field studies. *Journal of Educational Psychology*, *107*(3), 724–739.

Klimova, B. F., & Poulova, P. (2013). Impact of a form of online materials on the quality of education: A case study. *International Journal of Digital Information and Wireless Communications (IJDIWC)*, *3*(1), 43–49.

Konstan, J. A., Walker, J. D., Brooks, D. C., Brown, K., & Ekstrand, M. D. (2015). Teaching recommender systems at large scale: Evaluation and lessons learned from a Hybrid MOOC. *ACM Transactions on Computer-Human Interaction*, *22*(2), doi:10.1145/2728171

Kop, R. (2011). The challenges to connectivist learning on open online networks: learning experiences during a massive open online course. *The International Review of Research in Open and Distance Learning and Instruction*, *12*(3), 19–38.

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. *The International Review of Research in Open and Distance Learning*, *12*(7), 74–93.

Koutropoulos, A., & Zaharias, P. (2015). Down the rabbit hole: An initial typology of issues around the development of MOOCs. *Current Issues in Emerging eLearning*, *2*(1), Article 4.

Kulkarni, C., Wei, K. P., Le, H., Chia, D., Papadopoulos, K., Cheng, J., Koller, D., & Klemmer, S. R. (2013). Peer and self assessment in massive online classes. *ACM Transactions on Computer-Human Interaction*, *20*(6), 1–31.

Li, N., Himanshu, V., Skevi, A., Zufferey, G., Blom, J., & Dillenbourg, P. (2014). Watching MOOCs together: Investigating co-located MOOC study groups. *Distance Education*, *35*(2014), 217–233.

Liang, D., Jia, J., Wu, X., Miao, J., & Wang, A. (2014). Analysis of learners' behaviors and learning outcomes in a massive open online course. *Knowledge Management & E-Learning*, *6*(3), 281–291.

Liu, M., Kang, J., Cao, M., Lim, M., Ko, Y., Myers, R., & Schmitz Weiss, A. (2014). Understanding MOOCs as an emerging online learning tool: perspectives from the students. *American Journal of Distance Education*, *28*(3), 147–159.

Liyanagunawardena, T. R. (2015). Massive open online courses. *Humanities*, *4*(1), 35–41.

Liyanagunawardena, T. R., Adams, A. A., & Williams, S. A. (2014). MOOCs: A systematic study of the published literature 2008–2012. *The*

International Review of Research in Open and Distance Learning, *14*(3), 202–227.

Liyanagunawardena, T. R., Lundqvist, K. Ø., & Williams, S. A. (2015). Who are with us: MOOC learners on a FutureLearn course. *British Journal of Educational Technology*, *46*(3), 557–569.

Mackness, J., Waite, M., Roberts, G. & Lovegrove, E. (2013). Learning in a small, task-oriented, connectivist MOOC: Pedagogical issues and implications for higher education. *The International Review of Research in Open and Distributed Learning*, *14*(4), 140–159.

Mackness, J., & Bell, F. (2015). Rhizo14: A rhizomatic learning cMOOC in sunlight and in shade. *Open Praxis*, *7*(1), 25–38.

Macleod, H., Haywood, J., Woodgate, A., & Alkhatnai, M. (2015). Emerging patterns in MOOCs: Learners, course designs and directions. *TechTrends: Linking Research & Practice to Improve Learning*, *59*(1), 56–63.

Margaryan, A., Bianco, M., & Littlejohn, A. (2015). Instructional quality of massive open online courses (MOOCs). *Computers & Education*, *80*, 77–83.

Miller, S. L. (2015). Teaching an online pedagogy MOOC. *MERLOT Journal of Online Learning and Teaching*, *11*(1), 104–119.

Milligan, C., & Littlejohn, A. (2014). Supporting professional learning in a massive open online course. *The International Review of Research in Open and Distance Learning*, *15*(5), 197–213.

Milligan, C., Littlejohn, A., & Margaryan, A. (2013). Patterns of engagement in connectivist MOOCs. *MERLOT Journal of Online Learning and Teaching*, *9*(2), 149–159.

Noroozi, O., Weinberger, A., Biemans, H. J. A., Mulder, M., & Chizari, M. (2012). Argumentation-based computer supported collaborative learning (ABCSCL): A synthesis of 15 years of research. *Educational Research Review*, *7*(2), 79–106.

Perna, L. W., Ruby, A., Boruch, R. F., Wang, N., Scull, J., Ahmad, S., & Evans, C. (2014). Moving through MOOCs: Understanding the progression of users in massive open online courses. *Educational Researcher*, *43*(9), 421–432.

Redfield, R. J. (2015). Putting my money where my mouth is: The useful genetics project. *Trends in Genetics*, *31*(4), 195–200.

Reich, J. (2015). Rebooting MOOC research. *Science*, *347*(6217), 34–35.

Reilly, E. D., Stafford, R. E., Williams, K. M., & Corliss, S. B. (2014). Evaluating the validity and applicability of automated essay scoring in two massive open online courses. *The International Review of Research in Open and Distance Learning*, *15*(5), 83–98.

Rodriguez, C. O. (2012). MOOCs and the AI-Stanford like courses: two successful and distinct course formats for massive open online courses. *The European Journal of Open, Distance and E-Learning, 2012/II.* Accessed through <http://www.eurodl.org/?p=archives&year=2012&halfyear=2&abstract=516> on November 12th, 2014.

Saadatmand, M., & Kumpulainen, K. (2014). Participants' perceptions of learning and networking in connectivist MOOCs. *MERLOT Journal of Online Learning and Teaching*, *10*(1), 16–30.

Seaton, D. T., Bergner, Y., Chuang, I., Mitros, P., & Pritchard, D. E. (2014). Who does what in a massive open online course? *Communications of the ACM*, *57*(4), 58–65.

Spector, J. M. (2014). Remarks on MOOCS and Mini-MOOCS. *Educational Technology Research and Development*, *62*(3), 385–392.

Spelt, E. H., Biemans, H. A., Tobi, H., Luning, P., & Mulder, M. (2009). Teaching and learning in interdisciplinary higher education: A systematic review. *Educational Psychology Review*, *21*(4), 365–378.

Stefanic, N. M. (2014). *Creativity-based music learning: Modeling the process and learning outcomes in a massive open online course.* Unpublished PhD thesis, (3631459 PhD), University of South Florida, Ann Arbor, MI, USA. Accessed through <http://search.proquest.com/docview/1564785347?accountid=12045> on April 16th, 2015.

Steffens, K. (2015). Competences, learning theories and MOOCs: Recent developments in lifelong learning. *European Journal of Education*, *50*(1), 41–59.

Thille, C., Schneider, E., Kizilcec, R. F., Piech, C., Halawa, S. A., & Greene, D. K. (2014). The future of data-enriched assessment. *Research & Practice in Assessment*, *9*(2), 5–12.

Toven-Lindsey, B., Rhoads, R. A., & Lozano, J. B. (2015). Virtually unlimited classrooms: Pedagogical practices in massive open online courses. *The Internet and Higher Education*, *24*, 1–12.

Trumbore, A. (2014). Rules of engagement: Strategies to increase online engagement at scale. *Change: The Magazine of Higher Learning*, *46*(4), 38–45.

Veletsianos, G., Collier, A., & Schneider, E. (2015). Digging deeper into learners' experiences in MOOCs: Participation in social networks outside of MOOCs, notetaking and contexts surrounding content consumption. *British Journal of Educational Technology*, *46*(3), 570–587.

Vista, A., Care, E., & Griffin, P. (2015). A new approach towards marking large-scale complex assessments: Developing a distributed marking system that uses an automatically scaffolding and rubric-targeted interface for guided peer-review. *Assessing Writing*, *24*, 1–15.

Vivian, R., Falkner, K., & Falkner, N. (2014). Addressing the challenges of a new digital technologies curriculum: MOOCs as a scalable solution for teacher professional development. *Research in Learning Technology*, *22*, 24691.

Wasson, C. (2013). "It was like a little community": An ethnographic study of online learning and its implications for MOOCs. *Ethnographic Praxis in Industry Conference Proceedings*, *2013*(1), 186–199.

Wen, M., & Rose, C. P. (2014). *Identifying latent study habits by mining learner behavior patterns in massive open online courses.* Paper presented at the 23rd ACM Conference on Information and Knowledge Management (CIKM'14), November 3–7, 2014, Shanghai, China.

Yousef, A. M. F., Chatti, M. A., Wosnitza, M., & Schroeder, U. (2015). A cluster analysis of MOOC stakeholder perspectives. *RUSC, Universities and Knowledge Society Journal*, *12*(1), 74–90.

Yang, D., Wen, M., Kumar, A., Xing, E. P., & Rose, C. P. (2014). Towards an integration of text and graph clustering methods as a lens for studying social interaction in MOOCs. *The International Review of Research in Open and Distance Learning*, *15*(5), 214–234.

Yuan, L., Powell, S., & Olivier, B. (2014). *Beyond MOOCs: Sustainable online learning in institutions.* Lancaster, UK: Centre for Educational Technology, Interoperability and Standards (CETIS LLP). Accessed through <http://publications.cetis.ac.uk/2014/898> on June 6th, 2015.

Zutshi, S., O'Hare, S., & Rodafinos, A. (2013). Experiences in MOOCs: The perspective of students. *American Journal of Distance Education*, *27*(4), 218–227.

Appendix I. Summary of reviewed studies.

No	Author/Date	Purpose	Research question(s)	Methodology	Sample	Results	Implications for future research	Implications for practice
1	Adams, Yin, Madriz, & Mullen (2014)	Examine the students' accounts of their everyday experiences of learning in MOOCs.	What are completers' experiences of learning in an xMOOC?	Qualitative research methodology, phenomenology of practice	4 current participants in MOOC and 6 MOOC completers	Intimacy developed for xMOOC instructor, most especially in the context of the pre-recorded instructional videos	Need to explore the everyday activities of xMOOC students	Using video in xMOOC can be helpful to develop engagement both to the course and instructor.
2	Admiraal, Huisman, & Van de Ven (2014)	Examine the quality of self- and peer assessments in three MOOCs.	1. What is the reliability of self- and peer assessment implemented in MOOCs? 2. What is the relationship between self- and peer assessment and quizzes? 3. To what extent do self- and peer assessment and quizzes explain differences in students' final exams scores?	Case study	Students from three MOOCs from Leiden University: The Law of the European Union: An Introduction and Terrorism and Counterterrorism: Comparing theory and practice	No significant correlation between the students' peer and self- assessment, self-assessments might not be a valid way to assess students' performance in MOOCs	The reliability of self- and peer-assessment should be conducted in more learner-centred MOOCSs pedagogy. Need to have new metric to consider the relationship between self- and peer assessment.	Self-assessments and peer assessments should be improved if they are used as summative indicators of one's achievements (assessment of learning).
3	Ahn, Butler, Alam, & Webster (2013)	Understand the notions of learner participation and engagement in open online courses.	How have learners participated and engaged with open online learning in P2PU?	Case study	Dataset from entire history of P2PU	Participation and engagement take on varied forms in cMOOCs	Examine longitudinal patterns of the learning tasks of P2PU members, the relationship between factors such as course design, social interaction, dropout and retention	Course, assessment, and learning environment must be developed considering the engagement and participation patterns.
4	Al-Atabi & DeBoer (2014)	Explore the students' learning achievement outcomes in entrepreneurship course as a MOOC.	What is the effectiveness of using the MOOC to teach entrepreneurship?	Case study/ Survey	80 students	MOOC is a suitable platform to students' collaborative learning, opportunity recognition and resource acquisition.	Not provided	Brain rewiring exercises is a good way to initiate discussions among students.
5	Bali et al. (2015)	To provide insight into the thrill and depth of learning and connection possible through participation in cMOOCs.	Not provided	Collaborative autoethnography	Five cMOOCers	MOOCs are the mentalequivalent of working on a 3D puzzle that is in constant motion rather than a static workbook.	Not provided	MOOCs are a good way to develop or hone digital literacies.

Appendix I. [*Continued*] Summary of reviewed studies.

No	Author/Date	Purpose	Research question(s)	Methodology	Sample	Results	Implications for future research	Implications for practice
6	Bonk et al. (2015)	To explore the self-directed and informal learning experiences of subscribers to the monthly MIT OpenCourseWare (OCW) online newsletter.	Not provided	Survey	1429 people	Motivational factors are curiosity, interest, and internal need for self-improvement. Success or personal change factors included freedom to learn, resource abundance, choice, control, and fun. In terms of achievements, respondents were learning both specific skills as well as more general skills that help them advance in their careers.	Not provided	Educators, instructional designers, and online learning tool and resource designers need to embed a sense of choice and control when creating or enhancing OCW, OER, and MOOCs.
7	Breslow et al. (2013)	Understand the modes of learning which work well under the specific situations of 6,002x MOOC?	Who the students were in 6.002x?, how they utilized course resources?, what contributed to their persistence?, and what advanced or hindered their achievement?	Case study	Data set of 155,000 people who enrolled 6.002x	The certificate earners used the forum at a much higher rate than other students. High achievers are studying offline with another person. Positive relationship between highest degree earned and achievement	How different representations of complex concepts and phenomena (textual, graphical, mathematical) can best be used to help students master them?	Collaborating with another person, whether novice or expert, strengthens learning
8	Campbell, Gibbs, Najafi, & Severinski (2014)	Explore and compare the demographics, intent, and behavior differences of live-and archived-learners.	Are there any potential and purpose for archived MOOCs to be used as learning resources beyond and between instructor-led live-sessions?	Survey, activities and clickstream of all learner actions	Learners in the live- and archived-sessions of "Statistics: Making Sense of Data" (STATS) and "Learn to Program: The Fundamentals" (LPT1)	The archived-learners interact with the course in much the same way as live-learners. Learners follow the course sequentially who intended to complete all required work.	Exploration of the pace at which archived-learners access videos and complete assessments may have valuable implications for course design.	MOOCs to be beneficial as self-study courses, students in archived-MOOCs have potentials to fulfill students' needs.
9	Castaño-Garrido, Maiz-Olazabalaga, & Garay-Ruiz (2015)	Focus on the pedagogical design of a cooperative MOOC and its influence on motivation and academic results	1. Is there a relationship between academic performance and the pedagogical design of the course? 2. Is there a relationship between student motivation and the pedagogical design of the course? 3. Is there a relationship between academic performance and student motivation?	Survey, analyzing of e-activities	186 participants of 744 students who enrolled on the MOOC	Course design (cooperative and social network learning) influences students' performance. No global significance between motivation and performance, but positive relationship between satisfaction and performance	How is the relationship between academic performance and students' learning experiences?	Increase the level of student satisfaction can help to cut dropout rates. Course design should be integrated with students' motivational factors.

Appendix I. [*Continued*] Summary of reviewed studies.

No	Author/Date	Purpose	Research question(s)	Methodology	Sample	Results	Implications for future research	Implications for practice
10	Chen & Chen (2015)	Investigate the effectiveness and sustainability of face-to-face study groups for MOOCs.	RQ1: What are MOOC students' perceived gains from the face-to-face study group? RQ2: What are the key factors that influence the dynamic/ effectiveness of the MOOC study group? RQ3: What are MOOC students' suggestions to improve the face-to-face study group?	Interpretive case study approach	Four audiences who attended a 2-h guest speech entitled "From OCW to MOOCS: Implication for college students"	Cognitively, participants broadened their perspective of thinking, raised cultural awareness, and shared many learning strategies	To explore study group dynamics, perceived gains and challenges, and key influential factors across culture.	Study group may serve as an ideal approach to help MOOC learners develop requisite skills, share feelings and thoughts, and strengthen their self-determination to continue.
11	Chang et al. (2015)	Explore whether learning styles can influence the use of MOOCs and determine the learning style related to use intentions.	Not provided	Survey	184 undergraduate students	Innovative learning styles influence the learning experience in MOOCs.	Increase the sample size and include more important personal traits to enhance the effect of personalized learning in MOOCs.	Collaborative, game-based and query-based learning should be taken into account for increasing the quality and enrolment of MOOCs.
12	Comer, Clark, & Canelas (2014)	Evaluate how peer-to-peer interactions through writing impact student learning in introductory-level MOOCS.	1. How do peer-to-peer interactions through writing impact student learning in introductory-level writing and chemistry MOOCs? 2. What is the impact of peer-to-peer writing on engaging students in MOOC coursework who identify as less academically-prepared and less self-motivated? 3. How can peer-to-peer writing function as a metric to assess student success in MOOC delivered introductory writing and science coursework?	Qualitative coding analysis	English Composition I: Achieving Expertise and Introduction to Chemistry	Peer-to-peer interactions in writing through the forums and through peer assessment enhance learner understanding, link to course learning objectives, and generally contribute positively to the learning environment.	Not provided	The peer-feedback process, discussion forums, and writing through the forums contribute to students' learning, especially in understanding.
13	Daza, Makriyannis, & Rovira Riera (2014)	Create a useful tool for students that enter university.	Not provided	Survey	194 students	Not provided	To collect more data at the end of the academic year. We would like to know whether this year's students will be more successful with linear algebra compared with previous years.	

Appendix I. [*Continued*] Summary of reviewed studies.

No	Author/Date	Purpose	Research question(s)	Methodology	Sample	Results	Implications for future research	Implications for practice
14	DeBoer et al. (2014)	Propose the redefine the some conventional variables: enrollment, participation, curriculum, and achievement to be useful for description and evaluation of the educational experience in MOOCs.	Not provided	Data analyzing	Data from the first MOOC offered by MIT, "Circuits and Electronics"	Reconceptualization of conventional variables in terms of individualized and informed user intentions	Analysis and mining of log files to identify the actions users are taking, may also surface the intentions of the students.	Not provided
15	de Freitas et al. (2015)	Explore how course retention can be improved in online provision.	1. How did students view the course after completing it? 2. What were the main retention patterns of students? 3. How did student activity relate to final grade? 4. Did the quality of the MOOC and its links to Astronomy degree level education have an impact upon retention? 5. Did the role of "gamified" elements have an impact upon engagement and retention?	Case study	Students in Astronomy MOOC	Higher levels of engagement, creativity and experimentation can be used to decrease the of high dropout rates.	Not provided	Experience presenting video and audio materials, activities including interactive media, quizzes and assignments, and for social interactions should be in MOOCs.
16	Dillahunt, Wang, & Teasley (2014)	Compare the MOOC learners who self-identified as being unable to afford to pursue a formal education (the target group) with other learners (the comparison group) in terms of demographic data and motivation.	How MOOCs might better serve those who feel financially unable to pursue a more traditional path to post-secondary education studies?	Survey	Six Coursera MOOCs related with Humanities, Economics and Finance, and Technology, N=3812	There were no significant differences between the two groups' engagement in terms of watching videos, accessing course materials and/or conducting assessments. The comparison group had a higher percentage of course completion but the achievement level is significantly high in target group.	Whether and how MOOC platforms can capture more detailed information about learners during their activity and engagement in the courses	Students who have educational affordability are more likely to earn a certificate with distinction than those who enrolled in the MOOC for reasons other reasons.
17	Diver & Martinez (2015)	Investigate dropout rates and how students who decide to drop out differ from those who continue courses.	Not provided	Data analysis	MOOC data from two Coursera	Procrastination, as measured by delays in taking quizzes is negatively correlated with achievement on quizzes.	Determine how students change behavior when they are offered certificates of different values.	Establishing or altering deadlines or sending students almost costless emails to reduce procrastination

Appendix I. [*Continued*] Summary of reviewed studies.

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18	Fini (2009)	Investigate lifelong learners attitudes towards learning network technologies.	What are the learners' views about the multi-tool environments in CCK08 cMOOC?	Survey	Eighty-three students in cMOOC (49 males, 34 females)	Various opinions about the tools related with needs, purposes and self-organization skills. Social networks that were external to the course was perceived as unnecessary.	Issues related to sustainability and the workload of instructors should be studied.	Use of unique tools and/or activities such as The Daily can be a useful tool for learning.
19	Firmin et al. (2014)	Identify reasons for students' achievement and to discover patterns to inform future online course planning.	1. Who engaged and who did not engage in a sustained way and who passed or failed in the remedial and introductory AOLE courses? 2. What student characteristics and use of online material and support services are associated with success? 3. What do key stakeholders (students, faculty, online support services, coordinators, and leaders) tell us they have learned from the AOLE experiment?	Case study	213 students in SJSU Plus by Udacity	Student effort was the strongest success indicator, suggesting criticality of early and consistent student engagement. No statistically significant relationships with student characteristics (age and gender) were found. AOLE support effectiveness was compromised with staff time consumed by the least prepared students.	How some factors (e.g. early support, high degree of structure and use of learning analytics) are related with students' engagement and persistence in MOOCs.	Matriculation of students and software development for early warning to students can increase the achievement, contextualization of MOOCs provides more advantage for both engagement and authentic learning.
20	Forsey, Low, & Glance (2013)	Critically re-examine pedagogy and practice in the sociology classroom	How is the pedagogy and practice in sociology flipped classroom with MOOC?	Survey and focus group interviews	74 completed surveys	Students were experienced an increase in the amount of learning time, materials were clear and well-structured in MOOC platform.	Not provided	MOOC can be an good alternative for blended learning.
21	Fournier, Kop, & Durand (2014)	Explore the cPLENK MOOC, and to highlight the challenges in the research and analyze process.	What are the learning and activity levels in an open learning environment ?	Qualitative and quantitative-survey method	PLENK participants	Motivation, past experienced and reflective are three factors to self-directed learning. "Freedom to do and read as I felt like" and "how the course organized" are the two main factors on learning.	Usefulness of the tools that help students to develop self-directed learning	The importance of human factors such as motivation, incentives, support in creating high-quality learning experiences in MOOC
22	Gillani & Eynon (2014)	Understand the ways that learners from around the world interact in MOOCs.	1. What are the demographic characteristics of students that participate in MOOC discussion forums? 2. What are the discussion patterns that characterize their interactions? 3. How does participation in discussion forums relate to students' final scores?	Case study, survey	87,000 individuals from one MOOC	Forum participants tend to be well-educated adults from the Western world. Engaged students in the discussion forums are often higher-performing than those that do not, although the huge majority of forum participants receive "failing" marks.	How MOOC participants use the discussion forums? How learning occurs in MOOC using both qualitative and quantitative methods?	Higher-performing students use the discussion forums, but they do not only interact with other higher-performing students.

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23	Greene, Oswald, & Pomerantz (2015)	Examine which student characteristics, relevance, prior experience with MOOCs, self-reported commitment, and learners' implicit theory of intelligence predicted retention and achievement.	Not provided	Survey	'Metadata: Organization and Discovering Information' MOOC	Learners' expected investment, including level of commitment, expected number of hours devoted to the MOOC, and intention to obtain a certificate, related to retention. Prior level of schooling and expected hours devoted to the MOOC predicted achievement	Finding out why MOOC droppers did not persist, how learners do and do not interact in discussion forums and synchronous meetings	Provide specific intervention for students with low commitment or intentions to ensure the retention and success
24	Hernández-Carranza, Romero-Corella, & Ramírez-Montoya (2015)	Present an evaluation of digital teaching skills in a project funded by the National Distance Education System (SINED) in Mexico conducted on a Massive Open Online Course (MOOC) which was designed to develop competences in teachers in the distance learning or classroom setting for the integration of open educational resources (OER).	Not provided	Qualitative and quantitative approaches	1126 students from 11 Latin American countries, Spain and Portugal and 58 MOOC teachers officially enrolled on the course	MOOC participants were able to develop digital teaching skills, identify how to use OER and how the training process occurs in the open education movement.	Analysing the contributions of MOOCs, the open education movement and the development of digital competences for education	MOOC virtual learning scenarios are highly suitable for the design and use of OER to develop digital didactic competences.
25	Hew & Cheung (2015)	Propose a model of engaging students in online learning courses, based on six major instructional design elements.	1. What are the main recommendations offered by professional councils for designing an online course? 2. What specific instructional design factors related to highly rated MOOC may have engaged students to complete an online course?	Content analysis	910 participants' comments on two most highly-rated MOOCs	Instructional design elements can play major role in engaging online students.	Analyzing the viewpoints of other silent participants and investigate what factors may predict student learning outcomes.	Not provided
26	Ho et al. (2014)	Describe the registrant and course data provided by edX in the context of the diverse efforts and intentions of HarvardX and MITx instructor teams.	Not provided	Data analysis	17 courses from the first year of HarvardX and MITx	Course certification rates are misleading. New metrics, far beyond grades and course certification, are necessary to capture the diverse usage patterns in the data.	Future research designs including pretesting and experiments should focus on what and how registrants are learning.	High-quality and scalable assessments to understand what and how registrants are learning

Appendix I. [*Continued*] Summary of reviewed studies.

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27	Jiang, Williams, Warschauer, He, & O'Dowd (2014)	Explore the factors influencing enrollment and completion in a pre-college preparatory MOOC.	1. How did UC Irvine (UCI) Bio 93 students perform in the MOOC compared to the general population students? 2. Among UCI Bio 93 students, were underprepared students more likely to enroll in the MOOC given an explicit incentive? 3. Among UCI Bio 93 students, were underprepared students more likely to complete the course?	Descriptive assessment and logistic regression model	382 students from Pre-College Biology MOOC	Two groups of UCI students had a much higher percentage of completion and Distinction compared to non-UCI group. Weak math UCI students (n=156) more earned a Distinction certification (39%) than a Normal certificate (30%).	Impact of the MOOC for students' academic performance in the onsite Bio 93 course	MOOC can provide alternative learning environment for students who have disadvantages such as weak math background.
28	Jordan (2014)	Explore factors affecting enrolment and completion.	Can we learn anything about factors which might affect enrolment numbers and completion rates?	Linear regression of the data from internet searches and crowdsourcing information	279 MOOCs	Enrolment numbers are decreasing over time and are positively correlated with course length. Completion rates are consistent across time, university rank, and total enrolment, but negatively correlated with course length.	Whether the underlying pedagogy of MOOCs (transmissive or connectivist) influential on the enrolment and completion rates or not.	The relationship between completion rate and course length is critical issue for course designers.
29	Jordan (2015)	Extend a previous study on initial trends in MOOC completion rate (Jordan, 2014).	Not provided	Multiple regression analysis of factors that affects completion rates	221 MOOCs	Factors that significantly predicted completion rate included start date, course length and assessment type	Educator should carefully consider whether to use this as an assessment mechanism, or whether automated assessments would meet their educational goals.	To examine the effects in practice
30	Kizilcec, Bailenson, & Gomez (2015)	Examine the behavior and attitudes of adult learners in MOOC under the different presentation styles (Video watching with instructor face or w/o instructor face).	1. Is cognitive load higher in the strategic or the constant condition? 2.Is there a learning period in the strategic condition? 3. Is social presence higher in the strategic or the constant condition? 4. Are learning outcomes higher in the strategic or the constant condition? 5. Is attrition lower in the strategic or the constant condition? 6. Do individual differences in learning preference moderate the effect of the strategic presentation relative to the constant presentation of the face on (a) cognitive load and (b) attrition	Longitudinal field experiment	11% response rate out of 44,432 learners	No significant main effects of the strategic relative to the constant presentation were found on attrition, social presence, and recall and transfer learning.	The potential benefits and costs of showing the instructor's face in multimedia learning in a more controlled setting	Learners' verbal or nonverbal preferences are important factor to consider before utilizing instructor face on videos.

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31	Kizilcec & Schneider (2015)	Examine the how learners' initial motivations shape sub-sequent actions in MOOCs.	1. What motivates learners in MOOCs? 2. How pronounced are individual differences in motivations between demo-graphics or across courses? 3. Which motivations are predictive of behaviors in MOOCs and how predictive are they?	Survey	71,475 from 14 MOOCs.	Earn a certificate, to improve English skills, and a variety of social, academic, vocational, and interest-driven.	Report enrollment intentions using the OLEI scale as a standardized metric	Design of MOOCs should be based on learner motivations.
32	Konstan et al. (2015)	Experiment with MOOC based hybrid instruction	1. Do students learn in this MOOC? 2. Do students in a face-to-face recommender systems course, who have access to MOOC resources, learn more than a comparable group of MOOC students who have access to recorded face-to-face instructional sessions?	Single-group cross-sectional and pretest-posttest nonequivalent groups design	39 students in the face-to-face section and 4844 online-section of CSci 5980: Recommender Systems hybrid MOOC	Significant knowledge gains and retention, and the MOOC was successful in reaching across age, sex, and other demographic categories.	The effects of changes of comparative assessment and better ways of integrating a live class with the MOOC	Generation of a class-specific dataset for the assignments is a successful and motivating activity.
33	Kop (2011)	Examine the levels of learner autonomy, presence, and critical literacies required in active connectivist learning.	Whether the four activities highlighted as being crucial to learning (aggregating, relating, creating, and sharing) were actually as important as envisaged by the course planners	Mixed-method approach: Surveys, observations, discourse analysis, and learning analytics	PLENK and CritLit participants	The four activities mentioned in the introduction—aggregation, relation, creation, and sharing—were not achieved by the majority of participants.	To find out if this "creation" stage is really necessary to enhance learning in a connectivist learning environment	That people needs time to feel comfortable and confident to get involved in activities, while it also seems that people needs some time to digest readings and resources.
34	Kop, Fournier, & Mak (2011)	Examine how emergent technologies might influence the design of the learning environment.	What are the roles of educators and learners in creating learning experiences on online networked learning environments?	Survey and virtual ethnography	Personal Learning Environments Networks and Knowledge course (PLENK2010) and the Connectivism and Connective Knowledge course (CCK11)	The more experience in networked learning and through MOOCs, the higher the level of participation.	Explore the role educators and learners should play in adding value to the learning experience in MOOC. Support from facilitator or knowledgeable students play critical role on learning in cMOOCs.	Novice MOOCers can be supported through a series of activities that are structured on connectivist learning principles.
35	Kulkarni et al. (2013)	Use peer assessment over two iterations in the first large-scale class and to improve assessment accuracy and encourage qualitative feedback.	How to improve the assessment accuracy with peer-assessment?	Case study	5,876 students-online HCI class	Providing feedback to students about their grading bias increased subsequent accuracy. "Fortune cookie" is a method for peers to provide each other personalized feedback.	To explore if fortune cookies confer differential benefits to different students	Feedback is an effective way to decrease the students rating bias in peer-assessment.

Appendix I. [*Continued*] Summary of reviewed studies.

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36	Li et al. (2014)	Investigate how co-located study groups watch and study MOOC videos together.	1. Do study groups tend to watch videos asynchronously (independent watching within the time frame when the students meet to study) or is synchronicity a desirable attribute of group video watching? 2. Are there discussions while watching a video or after finishing a video- lecture? Does the video watching configuration influence the discussion patterns of the group members? 3. Do video watching styles lead to a difference in the amount of interactivity with the video lectures?	Longitudinal study	54 engineering students	Students like to stay synchronized in the group while watching MOOC videos. Overall high satisfaction with the study group style.	Measuring the learning outcomes of the study group participants under different video watching style	Video watching style that has shared display and distributed individual controls might enable study groups to find a fine balance between synchronicity, video interactivity, and discussions.
37	Liang et al. (2014)	Explore the relationship among learners' perceived learning experience, learning behaviors, and learning outcomes with MOOC.	Not provided	Survey and data mining	312 participants	Learners'perceived usefulness rather than perceived ease of use of the MOOC, positively influences learners'use of the system, and consequentially, the learning outcome.	To discover more learning mechanism of MOOC users with bigger data and more reliable survey	It essential to attach more importance to the dissemination of the course, not merely for increasing the registrants
38	Liu et al. (2014)	Examine participants' learning experiences in the context of a six-week massive open online course (MOOC) in journalism.	1. Who are the students and why are they enrolled in this MOOC?, 2. How much time have the students spent in taking this MOOC and have they completed all the assignments?, and, 3. What have they learned and what aspects of this MOOC do the students find most helpful?	Both quantitative and qualitative: survey, interview and course activity data	Five thousand students from 137 countries	Most participants reported a positive learning experience, but lack of feedback and/or poor quality were reported as negative experiences.	Not provided	MOOC environment requires learners to be more self-directed, self-disciplined, and intrinsically motivated than in a typical face-to-face course.
39	Liyanagunawardena et al. (2015)	To identify the learner groups and their perception of the MOOC	Not provided	Pre-course and post-course survey	Students of the *Begin programming: build your first mobile game* MOOC with two iterations	Games can be used to teach introductory programming over MOOC when sufficient support is provided to the participants.	Further investigations should focus on insight about learner participation.	Concentrate on the target learner group while designing a course with providing possible pathways for other learners

Appendix I. [*Continued*] Summary of reviewed studies.

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40	Mackness, Waite, Roberts, & Lovegrove (2013)	Provide evidence about how people learned in FSLT12 MOOC and consider wider implications for teaching and learning in higher education.	1. How did cMOOC design principles and activities in FSLT12 enable participant learning? 2. What are the deeper implications for learning of the principles and activities used in the design of FSLT12? 3. What are the possible implications of small task-oriented cMOOCs for higher education?	Case study	21 participants out of 206 students	Learning is happening in distributed platforms in cMOOCs. Social construction of knowledge is key component of cMOOCs for active learners. Technical skills are also important to participate and be in MOOCs.	Not provided	Learner autonomy play critical role in cMOOC environment especially for the design of tasks and completion rates. Small task-oriented cMOOCs can be better option in higher education.
41	Mackness & Bell (2015)	Focus on the participant experiences in Rhizo 14 MOOC	Not Provided	Survey	47 survey participants and 35 follow up survey participants	Light side; some highlighted positive experience i.e. learner-autonomy, self-organization. Dark side; some felt not connected, less experienced MOOCers were felt isolated.	Interrelated processes of community and curriculum formation in Rhizo14. The positive and negative effects of emotion and alienation	Rhizomatic learning, can benefited adult learner by forming community, and creating curriculum in a community setting
42	Macleod, Haywood, Woodgate, & Alkhatnai (2015)	Understanding who Edinburgh MOOC learners are, who elects to participate and the aspirations of that population, and the place that the MOOC will occupy in the University's online learning ecology.	1. Who are the tens of thousands of individuals who sign up to learn on short, free, online courses that offer no qualification or credits, and what are they hoping to achieve? 2. Are they attracting an 'unusual audience', and if so, will a stable audience arise and if so, when?	Survey	150k participants	Providing educational opportunities to the disadvantaged; global uptake of online learning; growth of an 'educational imperialism'; and the claim that 'MOOCs are for male geeks'	Not provided	Not provided
43	Margaryan, Bianco, & Littlejohn (2015)	Assess and compare the instructional design quality of MOOCs (xMOOC and cMOOC).	Whether or not and to what extend the design of MOOCs reflects the fundamental principles of instruction?	Course scan questionnaire	76 MOOCs	The majority of MOOCs scored poorly on most instructional design principles.	Investigation of institutions' and individual academics' and instructional designers' rationale, goals and motivations underpinning their involvement.	Ten-principles and course scan instrument serve as an evaluation framework for quality control and improvement of the implementation.
44	Miller (2015)	Understanding the differences in quality online pedagogy between MOOCs and quality online learning as currently defined	1. Do MOOCs represent quality online pedagogy? 2. Are students able to stay and learn effectively in MOOCs?	Survey	500 participants	MOOCs can conflict with certain established best practices in online learning.	Not provided	Not provided

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45	Milligan & Littlejohn (2014)	Investigate the learning behaviours of health professionals within Fundamentals of Clinical Trials, a MOOC offered by edX.	How do professionals prepare for learning in a MOOC? This question explores the motivations and expectations of professional learners as well as their goal setting and strategic planning during the forethought phase.	Survey	MOOC participants	A professional learning MOOC could support professional learners to reflect on the knowledge gained from the course.	Explore the same research questions in a different MOOC context.	Not provided
46	Milligan, Littlejohn, & Margaryan (2013)	Determine patterns of engagement and to find out factors influencing engagement in MOOC environment.	1. What patterns of engagement exist within the Change11 cMOOC course? 2. What principal factors mediate this engagement?	Qualitative study/Interview sessions	29 participants from out of 2300	Three levels of engagement: active participants, lurkers, and passive participants. Confidence, prior experience and motivation are key factors for engagement.	Compare the learning experience offered by different cMOOCs, target specific types of learners, to gain a better understanding of how critical literacies for learning in cMOOCs develop.	Course organizers can accommodate students' diverse learner profiles when design a learning experience. Support can be provided those students who has no prior experiences on online learning.
47	Perna et al. (2015)	Report the progress of users through 16 Coursera courses taught by University of Pennsylvania.	1. Do MOOC users progress through a course sequentially in the order identified by the course instructor, or do users determine their own approach to accessing content? 2. What are the milestones that predict course completion?	Descriptive analysis	16 first-generation MOOCs	Users accessed course content in the sequential order identified by the instructor. Accessing the first lecture and the fourth quiz are strong predictors for retention to the course.	Examination of users' course experiences with 'better data'. Understanding how design elements and pedagogical practices effect user products.	Not provided
48	Reilly, Stafford, Williams, & Corliss (2014)	Examine the effectiveness of an (automated essay scoring) AES tool to score writing assignments in two MOOCs.	To what extent is the current edX machine-graded assessment system (both holistic and rubric-total) valid, reliable and comparable to instructor grading? Do the AES-graded assignments (AES-Holistic and AES-Rubric total) correlate with non-essay assignment grades in the course?	Causal-comparative, a non-experimental research design	Randomly selected 206 of the AES-scored essays	AES and instructor's scores are significantly related, but that the instructor assigned significantly higher grades than either AES-scoring system. AES-Holistic Total and AES-Rubric Total were most highly correlated	To determine the types of assignments that are most relevant for this scoring tool (length, topic, number of rubri categories, range of rubric scores, etc.)	MOOC providers and faculty members can use AES systems in MOOCs.
49	Saadatmand & Kumpulainen (2014)	Examined participants' experiences and perceptions of learning in cMOOCs	1. How do participants in cMOOCs use tools and resources for their learning? 2. What networking activities take place in cMOOCs? 3. What is the nature of participation and learning in MOOCs, and how is it perceived by MOOC learners?	Online ethnography design; survey, interview and autoethno-graphic insight	PLENK10, CCK11 and EC&I 831 participants	Participation in MOOCs challenges learners to develop self-organization, selfmotivation, and a reasonable amount of technological proficiency to manage the abundance of resources and the more open format.	Results of the study should be further exploration in different MOOCs.	cMOOCs are learner-controlled environments in which learners participate in the flow and generation of knowledge.

Appendix I. [*Continued*] Summary of reviewed studies.

No	Author/Date	Purpose	Research question(s)	Methodology	Sample	Results	Implications for future research	Implications for practice
50	Seaton, Bergner, Chuang, Mitros, & Pritchard (2014)	Overview of how the 108,000 participants behaved in 6.002x - Circuits and Electronics, the first course in MITx	How various course components, and transitions among them, influence learning in MOOCs?	Case study	230 million interactions were logged in 38,000 log files	Students spent the most time per week interacting with lecture videos and homework, followed by discussion forums and online laboratories.	The correlation studies between resource use and learning	Course component can improve students' learning both in MOOC and traditional on-campus environment.
51	Toven-Lindsey, Rhoades, & Lozano (2015)	Explore the range of pedagogical tools used in MOOCs, to consider the extent to which these courses provide students with high-quality, collaborative learning experiences.	1. What instructional tools and pedagogical practices are using 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?	Qualitative multi-case study analysis	24 university-level MOOCs	The range of pedagogical practices currently used in MOOCs tends toward an objectivist-individual approach, a few number of MOOCs are oriented by constructivist-group approaches.	Not provided	For better benefit MOOC should be design in a creative and empowering structure.
52	Trumbore (2014)	Determine what course design elements were successful in increasing their engagement.	What course design elements are successful in increasing their engagement?	Survey and datasets of MOOCs	8 MOOCs hosted in the NovoEd social	MOOCs hosted on the NovoEd social learning site produce sustained student engagement, leading to increased persistence and completion rates. Three critical conditions for engagement are student collaboration; cohesive, open-ended assignments; and learning communities.	How can we better define learning outcomes for complex open-ended assignments?, How can we measure learning outcomes so that we can improve students' learning while they are in the course?	Engagement is necessary for learning, course designer should use strategies for better student engagement both in online and on-campus education.
53	Veletsianos et al. (2015)	Describes MOOC learner activities around notetaking and interactions in social networks outside of the MOOC platform.	Not provided.	Qualitative study	41 students surveyed and 13 students interviewed	Interactions in social networks outside of the MOOC platform, notetaking and consuming are most common experiences and activities.	Use diverse methodologies to generate a greater understanding of learner experiences and activities in MOOCs.	Design digital notebooks live outside of a particular course so that learners can use them for multiple related courses.

Appendix I. [*Continued*] Summary of reviewed studies.

No	Author/Date	Purpose	Research question(s)	Methodology	Sample	Results	Implications for future research	Implications for practice
54	Yang, Wen, Kumar, Xing, & Rose (2014)	Analyze the emergent social structure in massive open online courses (MOOCs).	How the novel exploratory machine learning modeling approach is able to identify emerging social structure in threaded discussions?	Social network structure and thematic structure of text	1146 active users and 5107 forum posts; 771 active users and 6250 posts; 3590 active users and 24,963 forum posts.	Higher attrition demonstrate lower comfort with course procedures and lower expressed motivation and cognitive engagement with the course materials.	Integration of other networks in addition to text would be another approach for further research	More dropout when students have not yet found a personal connection between their interests and goals and the specific content provided by the course
55	Yousef, Chatti, Wosnitza, & Schroeder (2015)	Cluster and analyze the different objectives of MOOC stakeholders to build a deeper and better understanding of their behaviors.	Not provided	Action research/Survey	76 professors and 82 learners	Blended learning, flexibility, high quality content, instructional design and learning methodologies, life-long learning, network learning, openness, and student-centered learning	Investigate a set of specific criteria related to each emerged cluster.	Put more emphasis on the hybrid MOOCs which combine both xMOOCs and cMOOCs to meet the goals of a wide range of participants.
56	Zutshi, O'Hare, & Rodafinos (2013)	Examine the experiences of students who have participated in massive open online courses (MOOCs).		Google blog search				