MOOCs
A Review of the State-of-the-Art

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Abstract: Massive open online courses (MOOCs) have drastically changed the way we learn as well as how we teach. The main aim of MOOCs is to provide new opportunities to a massive number of learners to attend free online courses from anywhere all over the world. MOOCs have unique features that make it an effective technology-enhanced learning (TEL) model in higher education and beyond. The number of academic publications around MOOCs has grown rapidly in the last few years. The purpose of this paper is to compile and analyze the state-of-the-art in MOOC research that has been conducted in the past five years. A template analysis was used to map the conducted research on MOOCs into seven dimensions, namely concept, design, learning theories, case studies, business model, targets groups, and assessment. This classification schema aims at providing a comprehensive overview for readers who are interested in MOOCs to foster a common understanding of key concepts in this emerging field. The paper further suggests new challenges and opportunities for future work in the area of MOOCs that will support communication between researchers as they seek to address these challenges.

1 INTRODUCTION

Massive open online courses (MOOCs) have attracted a great deal of interest in educational institutions. MOOCs anticipate leading the new revolution of technology-enhanced learning (TEL), by providing new opportunities to a massive number of learners to attend free online courses from anywhere all over the world (Liyanagunawardena et al., 2013a). Over the last few years, the MOOCs phenomenon has become widely acknowledged as crucial for freely accessible high quality courses provided by international institutes for informal as well as formal education (Brown, 2013).

In recent years, topics around MOOCs are widely discussed across a range of academic publications from different theoretical and practical perspectives, including numerous implementations and design concepts of MOOCs. These publications are however still in an infancy stage and a systematic classification of the MOOC literature is still missing. This paper is one of the efforts to:

1. Compile and analyze the state-of-the-art that has been conducted on MOOCs between 2008 and 2013 to build a deep and better understanding of key concepts in this emerging field.
2. Identify some future research opportunities in the area of MOOCs that should be considered in the development of MOOCs environments.

In the light of these goals, this paper will discuss different angles of MOOCs and is structured as follows: Section 2 is a review of the related work. Section 3 describes the research methodology and how we collected the research data. In section 4, we review and discuss the state-of-the-art based on several dimensions. Finally, Section 5 gives a summary of the main findings of this paper and as a result highlights new opportunities for future work.

2 RELATED WORK

Since research in MOOCs is still an emerging field, we found only one systematic study of the published

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literature of MOOCs from 2008-2012, done by Liyanagunawardena et al. (2013b). The study provides a quantitative analysis of 45 peer reviewed studies and provides a general discussion based on a categorization into eight dimensions, namely introductory, concept, case studies, educational theory, technology, participant focused, provider focused, and other.

As compared to Liyanagunawardena et al.'s study, our study adds a wide range of peer-reviewed publications that have been conducted between 2008 and 2013 and provides a quantitative as well as qualitative analysis of the MOOC literature. Moreover, we apply a template analysis to categorize the MOOCs state-of-the-art into several dimensions. The study further provides critical discussion according to each dimension and suggests new opportunities for future research in MOOCs.

3 METHODOLOGY

The research was carried out in two main phases including data collection followed by template analysis of the literature review.

3.1 Data Collection

We collected data by applying the scientific research method of identifying papers from internet resources (Fink, 2005). This method includes three rounds. Firstly, we searched 7 major refereed academic databases[1] and secondly 18 academic journals[2] in the field of education technology and e-learning indexed by Journal Citation Reports (JCR), using the search terms (and their plurals) "MOOC", "Massive Open Online Course" and "Massively Open Online Course". These two rounds resulted in 128 peer-reviewed papers to be included in our study.

Thirdly, we applied a set of selection criteria as follows:

1. Research must focus on MOOCs in pedagogical, social, economic, and technical settings. Studies with political and policymakers views were excluded.
2. Papers providing experimental or empirical studies from actual observations and case studies with scientific data were included.
3. Papers presenting a new design of MOOCs were included. Studies with personal opinions or learner's anecdotal impression were excluded.

The result was 84 peer-reviewed publications which fit the criteria above (80 papers, 3 international reports, and 1 dissertation). Figure 1 shows the number of MOOCs publications between 2008 and 2013 which were found to be relevant for this study.

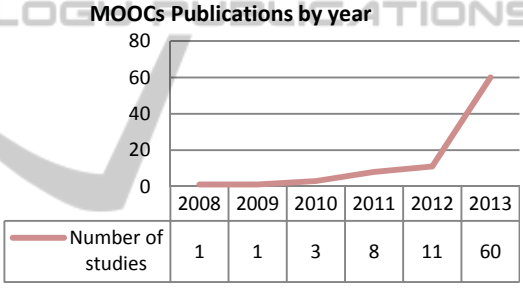

Figure 1: MOOCs papers by publication year.

3.2 Template Analysis

The second phase was using Template Analysis as classification technique for mapping MOOCs literature in several dimensions (King, 2004). In the first level of template analysis, we carefully read the MOOCs literature to be familiar with the domain context. Then, in the second level we formulated concrete codes (themes), based on the understanding of the studies domain and using the existing classifications by Liyanagunawardena et al. (2013b) and Pardos and Schneider (2013) as a reference to test reliability and credibility. Then, we identified seven codes as follows:

1. **Concept** included aspects in the literature which referred to the concept e.g. definition, history, and MOOCs types.
2. **Design** included design principals e.g. pedagogical and technological features.
3. **Learning theories** that have built the theoretical

[1] Education Resources Information Center (ERIC), JSTOR, ALT Open Access Repository, Google Scholar, PsychInfo, ACM publication, IEEEXplorer, and Wiley Online Library

[2] American Journal of Distance Education, Australian Journal of Educational Technology, British Journal of Educational Technology, Canadian Journal of Learning and Technology, Communications of the ACM, Continuing Higher Education Review Journal, Educational Technology Research and Development, Educational Theory, eLearning Papers Journal, Frontiers of Language and Teaching, International Journal of Innovation in Education, International Journal of Technology in Teaching and Learning, International Review of Research in Open and Distance Learning, Journal of Asynchronous Learning Networks, Journal of Computer Assisted Learning, Journal of Interactive Media in Education (JIME), Open Praxis Journal, The European Journal of Open, and Distance and E-Learning (EURODL)

background of the conducted MOOC studies.
4. **Case studies** e.g. experimental and empirical studies.
5. **Business models** that have been followed in the different MOOC implementations.
6. **Target groups** included aspects which referred to learner characteristics.
7. **Assessment** included different types in MOOCs e.g. e-assessment, self-assessments, and peer-assessment.

After having a stable code template, we had several internal meetings to discuss each code and create a mapping of the 84 publications that were selected in this review into the seven identified codes as depicted in Figure 2. This template analysis has been done manually using printout tables.

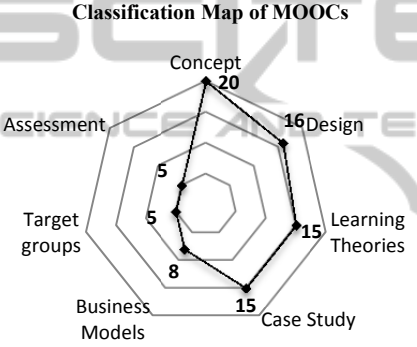

Figure 2: Classification Map of MOOCs.

4 MOOC STATE-OF-THE-ART

In this section, we analyze and discuss in detail the MOOCs state-of-the-art based on the template analysis dimensions (codes) that have been identified in Section 3. For the critical discussion part, we apply the meta-analysis method which aims to contrast and combine results from several studies into a single scientific work (Fink, 2005).

4.1 Concept

The first dimension in our analysis is "concept". Nearly 25% of the literature reviewed in this paper focus on the MOOC concept. To clarify the MOOC concept three aspects have been considered in the reviewed literature, namely definition, history, and types.

4.1.1 MOOC Definition

Various definitions have been provided for the term MOOC by describing the four words in the MOOC acronym. The key elements of MOOCs are depicted in Figure 3:

- **Massive(ly):** In MOOCs, massiveness reflects the number of course participants. While most of the MOOCs had few hundred participants some courses reached over 150,000 registrations (Allen and Seaman, 2013); (Russell et al. 2013). Massive refers to the capacity of the course to expand to large numbers of learners (Anderson and McGreal, 2012). The challenge is to find the right balance between large number of participants, content quality, and individual needs of learners (Brown, 2013); (Esposito, 2012); (Laws et al., 2003).
- **Open:** Openness includes four dimensions (4Rs) Reuse, Revise, Remix, and Redistribute (Peter and Deimann, 2013). In the context of MOOCs, it refers to providing a learning experience to a vast number of participants around the globe regardless of their location, age, income, ideology, and level of education, without any entry requirements, or course fees to access high quality education. Openness can also refer to providing open educational resources (OER) e.g. course notes, PowerPoint presentations, video lectures, and assessment. (Anderson and McGreal, 2012); (Schuwer et al., 2013).
- **Online:** the term online refers to the accessibility of these courses form each spot of the world via internet connection to provide synchronous as well as asynchronous interaction between the course participants, (Brown, 2013); (Schuwer et al., 2013). In some variations of MOOCs (e.g. blended MOOCs), learners can learn at least in part face-to-face beside the online interaction possibilities (Stewart, 2013).
- **Courses:** The term course is defined in higher education as a unit of teaching. In MOOCs it refers to the academic curriculum to be delivered to the learners, including OER, learning objectives, networking tools, assessments, and learning analytics tools (Allen and Seaman, 2013); (Voss, 2013).

The original concept of MOOCs is to offer free and open access courses for massive number of learners. However, scalability issues and low completion rates, (less than 10% in most of the offered MOOCs) constantly concern the MOOC providers (Brown, 2013); (Trumbić and Daniel, 2013). Moreover,

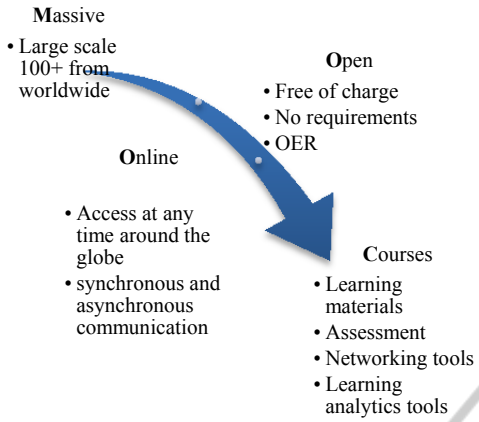

Figure 3: Key elements of MOOCs.

several MOOC providers either charge fees for their courses or offer courses for free but learners have to pay for exams, certificates, or teaching assistance from third party partners (Brown, 2013). Thus, we believe that the original definition of MOOCs will change as a result of the various challenges and rapid developments in this field.

4.1.2 MOOC History

Dave Cormier and Bryan Alexander coined the acronym MOOC to describe the "Connectivism and Connective Knowledge" (CCK08) course launched by Stephen Downes and George Siemens at the University of Manitoba in 2008 (Boven, 2013). This new form of learning and teaching has led Stanford University to offer three online courses in 2011 (Yuan and Powell, 2013a); (Rhoads, et al., 2013). These courses significantly succeeded in attracting a big number of participants, thus turning a qualitative leap in the field of MOOCs. Driven by the success of the Stanford MOOCs Sebastian Thrun and Peter Norvig started to think about MOOC business models and launched Udacity as a profit MOOC model in 2012 (Peter and Deimann, 2013). Two other Stanford professors Daphne Koller and

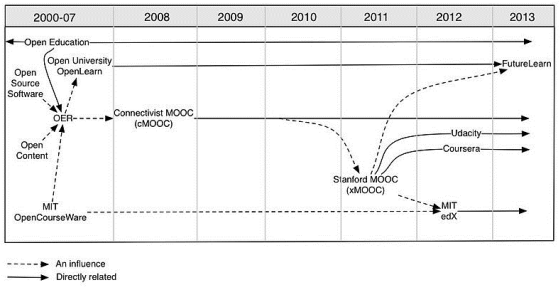

Figure 4: MOOCs and open education timeline (Yuan and Powell, 2013a).

Andrew Ng have also started their own company Coursera which partnered with dozens of renowned universities to provide a platform for online courses aiming at offering high quality education to interested learners all over the world. (Schuwer, and Janssen, 2013); (Dikeogu and Clark, 2013). Additionally, Massachusetts Institute of Technology (MIT) and Harvard University launched edX as a non-profit MOOC platform. Figure 4 shows the MOOC and open education timeline (Yuan and Powell, 2013a).

Although these MOOCs platforms have different objectives, they share the focus on building large learning networks beyond the traditional teaching environments.

4.1.3 MOOC Types

The current MOOC literature categorized MOOCs into two main types "cMOOCs" and "xMOOCs" (Smith and Eng, 2013). Moreover, new forms have emerged from xMOOCs. These include "smOOCs" and "bMOOCs". Figure 5 shows the different types of MOOCs and their underlying learning theories.

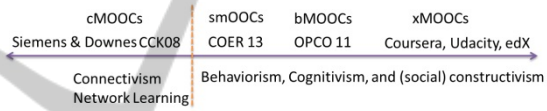

Figure 5: MOOC types.

The early MOOCs launched by Downes and Siemens (CCK08) were driven by the connectivism theory and were thus referred to as connectivist MOOCs (cMOOCs). cMOOCs provide space for self-organized learning where learners can define their own objectives, present their own view, and collaboratively create and share knowledge. cMOOCs enable learners to build their own networks via blogs, wikis, Google groups, Twitter, Facebook, and other social networking tools outside the learning platform without any restrictions from the teacher (Kruiderink, 2013). Moreover, peer-assessment was used to grade assignments or tests based on pre-defined rubrics that improve students' understanding of the content. Thus, cMOOCs are distributed and networked learning environments where learners are at the center of the learning process. Figure 6 depicts the key concepts of cMOOCs.

On the other hand, extension MOOCs (xMOOCs) e.g. Coursera, edX, and Udacity follow the behaviorism, cognitivist, and (social) constructivism learning theories. In fact, in xMOOCs, learning objectives are pre-defined by

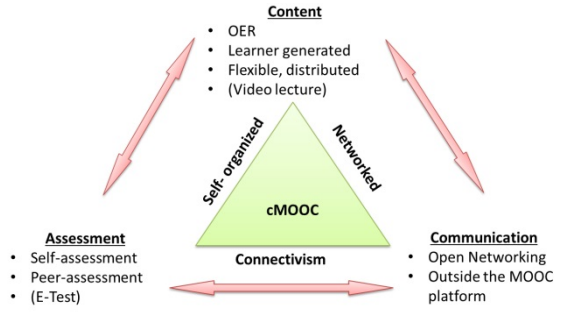

Figure 6: cMOOCs.

teachers who impart their knowledge through short video lectures, often followed by simple e-assessment tasks (e.g. quiz, eTest) (Kruiderink, 2013); (Stewart, 2013); (Daniel, 2012). Only few xMOOCs have used peer-assessment. Moreover, xMOOCs provide limited communication space between the course participants (Gaebel, 2013). Unlike cMOOCs, the communication in xMOOCs happens within the platform itself. The key concepts of xMOOCs are shown in Figure 7.

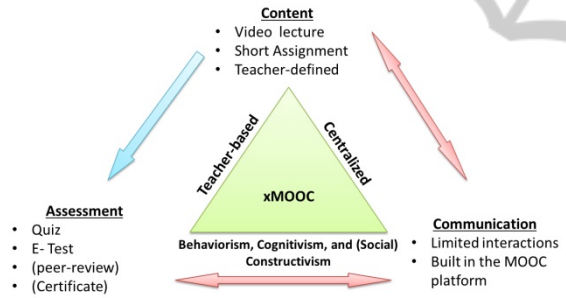

Figure 7: xMOOCs.

Recently, new forms of MOOCs have emerged. These include smOOCs as small open online courses with a relatively small number of participants (e.g. COER13) and blended MOOCs (bMOOCs) as hybrid MOOCs including in-class and online mediated instruction (e.g. OPCO11) with flexibility ways that learners can interacting in real-time that fit into around their motivation and to build learner commitment to the courses (Coates, 2013); (Gaebel, 2013); (Daniel, 2012).

4.2 Design

The reviewed studies on MOOCs design distinguish between pedagogical design principles that can engage learners to attend the courses and technological design principles that can make the MOOCs more dynamic.

4.2.1 Pedagogical Design Principles

Most of the teachers and researchers believe that MOOCs cannot completely replace traditional learning (Ovaska, 2013). As a consequence, there is an increasing focus on hybrid MOOCs (Szafir and Mutlu, 2013). In order to encourage learners to complete the course, Vihavainen, et al. (2012) offered bMOOCs with support of scaffolding of learner's tasks using a purpose-built assessment solution and continuous reflection between the learner and the advisor. In other studies, the integration of social networks in bMOOCs added new value in learner's interactions and activities (Morris, 2013); (Calter, 2013).

McCallum, Thomas and Libarkin, (2013) designed alphaMOOCs (aMOOCs) as a mix of cMOOCs and xMOOCs by building collaboration teams. McAndrew (2013) designed a project-based MOOC (pMOOC) by structuring the offered MOOC around a course-related project. Guàrdia, et al. (2013) analyzed the learners needs in a MOOC and presented a set of pedagogical design principles that focus on improving the interactions among learners. Bruff, et al (2013) discussed some pedagogical design ideas that provide guidance on how to design bMOOCs. The authors focused on competency-based design, self-paced learning, pre-definition of learning plans (objectives, schedules, and assignments), as well as open network interaction and collaboration tools that rise motivation and avoid losing interest and drop out from the course. And, Grünewald, et al. (2013) suggested peer-assistance through the course to solve learning difficulties.

4.2.2 Technological Design Principles

MOOCs are include several technology features that support different important activities in the learning experience such as interaction, collaboration, evaluation, and self-reflection (de Waard et al., 2011b); (Fournier et al., 2011). The tools used in the reviewed literature can be classified into three main categories, namely collaboration, assessment, and analytics tools.

Most of the MOOCs provide collaboration work spaces that include several tools to support learners in communicating with each other such as forums, blogs, video podcasts, social networks, and dashboards (McAndrew, 2013); (Mak et al., 2010). Different e-assessment methods are applied in MOOCs. While most of xMOOCs use traditional forms of e-assessment like eTests and Quizzes,

cMOOCs rather focus on self-assessment and peer-assessment (Kellogg, 2013); (Spector, 2013).

In MOOCs it is difficult to provide personal feedback to a massive number of learners. Thus, several MOOC studies tried to apply learning analytics tools to monitor the learning process, identify difficulties, discover learning patterns, provide feedback, and support learners in reflecting on their own learning experience (Fournier et al., 2011); (Giannakos et al. 2013).

4.3 Learning Theories

How learners learn through MOOCs? In other words, how they absorb, process, build, and construct knowledge? This is a simple question, but the answer is quite complicated. Behaviorists and cognitivists believe that learning experience is a result of the human action with the learning environment (Kop and Hill, 2008). Constructivists, by contrast, believe that learning is an active process of creating meaning from different experiences and that learners learn better by doing (Anderson and Dron, 2011). In the last years, technology has changed the way we learn as well as we teach (Viswanathan, 2013). And, the social Web has provided new ways how we network and learn outside the classroom. These opportunities are reflected in recent learning theories and models. These include connectivism which views learning as a network-forming process (Martin, 2013); (Tschofen and Mackness, 2012); (Kop, 2011); (Siemens, 2005) and the Learning as a Network (LaaN) theory which starts from the learner and views learning as a continuous creation of a personal knowledge network (PKN) (Chatti, 2010).

Back to the main question how learners learn through MOOCs? As discussed in Section 4, MOOCs are running in two major categories: cMOOCs and xMOOCs. CCK08 was the first MOOC designed based on the principals of connectivism (Kop et al., 2011). The aim of CCK08 – and other cMOOCs – is to build and construct knowledge through the interaction in learner networks (Cabiria, 2012); (Bell, 2011); (Chamberlin and Parish, 2011). Rodriguez (2013) pointed out that some cMOOCs indeed succeeded to improve the learner's motivation. On the other hand, xMOOCs were based on the behaviorism and cognitivism theories with some (social) constructivism components that focus on learning by doing (i.e. experimental, project-based, or task-based) activities. This wave of MOOCs is similar to the traditional instructor-led courses offered at universities that are organized around video lectures, and e-assessment. Most of the researchers in the reviewed literature put a heavier focus on xMOOCs as a new model of learning and teaching in higher education (Milligan et al., 2013); (Rodriguez, 2012). Few researchers stressed the importance of social components in xMOOCs. Blom et al. (2013) reported that xMOOCs become more social using collaboration tools e.g. forums and wikis. Purser et al., (2012) suggested that the idea of peer-to-peer in collaborative learning helps learners to improve their learning outcome in xMOOCs.

In general, cMOOCs reflect the new learning environments characterized by flexibility and openness. On the other hand, xMOOCs offer high quality content as compared to cMOOCs. To fill this gap, hybrid MOOCs bMOOCs have been proposed to combine the advantages of both cMOOCs and xMOOCs.

4.4 Case Studies

Several case studies of MOOCs have been discussed in the reviewed literature. In Table 1, we compare different case studies in terms of learning theories, design elements, structure, tools, and assessment (Malan, 2013). We selected six case studies that are representatives for different MOOC types. To represent cMOOCs we selected CCK08 (Rodriguez, 2013); (Bell, 2010); (Mackness et al., 2010); (Fini, 2009). From xMOOCs we selected edX as non-profit platform and Coursera as profit platform (Cooper and Sahami, 2013); (Portmess, 2013); (Rodriguez, 2013); (Subbian, 2013); (Machun et al., 2012); (Hoyos et al., 2013). In addition, we selected OPCO11 as an example of bMOOCs and COER13 and MobiMOOC as examples of smOOCs (Arnold, 2012); (de Waard et al., 2011a); (Romero, 2013); (Koutropoulos, et al., 2012).

These different MOOCs share some common features that focus on video-based lectures, the support of open registration and informal learning, and the use of social tools. Most of the MOOCs apply traditional e-assessment tools (e.g. E-Tests, Quizzes, MCQ). Peer-assessment is mainly used in cMOOCs and bMOOCs and self-assessment rather in smOOCs. The majority of the reviewed case studies implement the behaviorism, cognitivism, and constructivism learning theories. Only few case studies (e.g. CCK08 and MobiMOOC) include elements that are borrowed from connectivism, such as personal learning environments and open networking.

Table 1: Comparison of MOOCs case studies.

Compare Item		CCK08	edX	Coursera	OPCO11	COER13	MobiMOOC
Learning theory	Connectivism	√	-	-	-	-	(√)
	Behaviorism	-	√	√	-	-	-
	Cognitivist	-	√	√	-	-	(√)
	Social constructivism	-	-	-	√	√	-
Assessment	E-Assessment	(√)	√	√	√	√	√
	Peer-Assessment	√	-	(√)	(√)	-	-
	Self-Assessment	-	-	-	-	(√)	(√)
Openness	Profit	-	-	√	-	-	-
	Open registration	√	√	√	√	√	√
	Download Material	-	√	(√)	(√)	(√)	√
Form	Formal Learning	(√)	-	(√)	(√)	-	-
	Informal Learning	√	√	√	√	√	√
Learning Tools	Video Lecture	√	√	√	√	√	√
	Face-to-Face	-	-	-	√	-	-
	Blogs, forums, social network	√	√	√	√	√	√
	Lecture Note, PPT and PDF	√	√	√	√	√	√

√ Completely (√) Partly - Not supported

4.5 Business Models

The initial vision of MOOCs was to provide open online courses that could reduce the cost of university-level education and reach thousands of low-income learners (Teplechuk, 2013); (Cusumano, 2013). Nevertheless, new business models have been launched e.g. in Coursera, Udacity, and Udemy. These business models are heralding a change in the education landscape that poses a threat to the quality of learning outcome and future educational pathways (Schuwer and Janssen, 2013); (Yuan, and Powell, 2013b).

Due to the huge budget that has been spent to develop MOOC platforms, MOOC providers are fighting to come up with new business models to satisfy their investors (Freeman and Hancock, 2013); (Guthrie et al, 2013).

Ruth (2012) reported his overview of potential business models such as offering courses for free and learners pay for certification, examination, and teaching assistance. Coursera, for instance, offers additional examinations for certificates. The question here is whether these certificates will be accepted. Green (2013) believes that if the universities provide MOOC credits, this will be a potential route to accept these certificates in the real market. To achieve this, MOOCs should meet the market needs by providing high quality content as well as high quality outcome (Lambert and Carter, 2013); (Gallagher and LaBrie, 2012).

4.6 Target Groups

Some demographics studies have been conducted to analyze target groups in MOOCs by determining their locations, age group, and learner patterns.

One major goal of MOOCs was to reach low-income learners particularly in developing countries. Studies, however, have shown that the vast majority of MOOC participants were from North America and Europe. Only few participate from South East Asia and fewer from Asia and Africa (Clow, 2013); (Liyanagunawardena et al., 2013a); (Stine, 2013). This is consistent with the analysis of 2.9 million participants registered in Coursera from 220 countries around the globe (Waldrop, 2013).

Possible obstacles that could prevent learners from Africa and Asia to take part in MOOCs include the poor technology infrastructure. Only 25% of Africa has electricity access (WEO-2012). And Africa has the lowest internet access all over the world with only 7% (Sanou, 2013). Asia is a continent with many different cultures and languages. Thus, linguistic issues could be a barrier to participate in MOOCs.

Stine (2013) and de Waard et al. (2011b) noted that around 50% of the participants from 31-50 age groups, which indicates that informal learners have more interest in MOOCs.

Several studies have reported a high drop-out rate that reflects the learner patterns in MOOCs (Waite, et al., 2013). Hill (2013) identified five patterns of participants in Coursera, as shown in Figure 8.

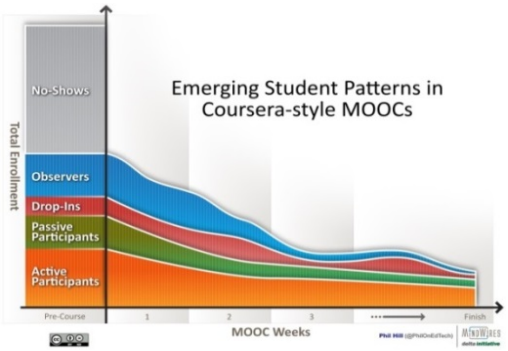

Figure 8: Pattern of participants in Coursera (Hill, 2013).

The vast majority were No-Shows participants who register but never log into the course. Secondly, observers who read content or discussions without submitting any assignments. Thirdly, Drop-ins participants who are doing some activities but do not complete the course. Fourthly, Passive participants who take the course and do tests but do not participate in the discussion. Fifthly, Active participants who regularly do all assignments and actively take part in the discussions.

Some studies explored pedagogical approaches to engage Observers, Drop-ins, and Passive participants to be active learners through e.g. game-based learning (Romero, 2013), social networking that help learners to create their own personal learning environments (Guàrdia, et al., 2013), and project-based learning (Irvine et al, 2013); (McAndrew, 2013).

4.7 Assessment

The ability to evaluate vast number of learners in MOOCs is indeed a big challenge (Yin and Kawachi, 2013). Thus, assessment is an important factor for the future success of MOOC. So far MOOC providers didn't offer official academic accreditation from their home institutions, which might indicate that the quality of learning outcome in MOOCs is different from university courses (Sandeen, 2013); (Gallagher and LaBrie, 2012). Currently, MOOCs are only providing a non-credit certificate e.g. completion, attendance, or participation certificate. In the reviewed literature, three main types of assessment were conducted in MOOCs, namely e-assessment, peer-assessment, and self-assessment.

4.7.1 e-Assessment

e-Assessment is often used in xMOOCs to gauge student performance. E-assessment in xMOOCs is restricted to closed question formats. These include exams with multiple choice questions based on machine grading (Conrad, 2013). This implementation of assessment is applicable in Science courses. It is, however difficult to apply e-assessment in Humanities courses due the nature of these courses which are based on the creativity and imagination of the learners (Sandeen, 2013).

4.7.2 Peer-assessment

Peer-assessment was used in cMOOCs and xMOOCs to review essays, projects, and team assignments. These assignments are not graded automatically, but learners themselves can evaluate and provide feedback on each other's work. This method of assessment is suitable in Humanities, Social Sciences and Business studies, which do not have clear right or wrong answers (O'Toole, 2013). Cooper and Sahami (2013) point out that, some learners in peer-assessment grade without reading the work to be reviewed or do not follow a clear grading scheme, which negatively impacts the quality of the given feedback. Therefore, more criteria and indicators are needed to ensure that peer-assessment is effective.

4.7.3 Self-assessment

Self-assessment is still not widely used in MOOCs. Sandeen (2013) and Piech et al. (2013) identified some self-assessment techniques. These include model answer as tool to students to cross check if the marks they scored are in tune with the model answers set by the educators, and learning analytics where the learners can self-reflect on their achievements.

5 CONCLUSION AND FUTURE WORK

MOOCs present an emerging branch of online learning that is gaining interest in the technology-enhanced learning (TEL) community. In the last few years after the launch of the first MOOC in 2008, a considerable number of research studies have been conducted to explore the potential of MOOCs to improve the effectiveness of the learning experience. The main aim of this paper was to compile and analyze the state-of-the-art in MOOC research that has been conducted in the past five years. 84 peer reviewed papers were selected in this study. A template analysis was applied to analyze and categorize the MOOCs literature into 7 dimensions, namely concept, design, learning theories, case studies, business models, target groups, and assessment.

The main result of our study is that the initial vision of MOOCs as a new learning environment that aims at breaking down obstacles to learning for anyone, anywhere and at any time around the globe is far away from the reality. In fact, most MOOC implementations so far still follow a top-down, controlled, teacher-centered, and centralized learning model. Attempts to implement bottom-up, student-centered, really open, and distributed forms

of MOOCs are rather the exception rather than the rule. In general, MOOCs further require key stakeholders to address a number of challenges, including questions about hybrid education, role of the university/teacher, plagiarism, certification, completion rates, and innovation beyond traditional learning models. These challenges will need to be addressed as the understanding of the technical and pedagogical issues surrounding MOOCs evolves. In the following, we suggest research opportunities in relation to each dimension:

- *Concept:* More theoretical work is needed to achieve a common understanding of the MOOC concept as well as a systematic mapping between the course goals and the MOOC type to be implemented.
- *Design:* it is necessary to conduct research on how to improve the MOOC environments by investigating new learning models (e.g. personalized learning, project-based learning, game-based learning, inquiry-based learning) and tools (e.g. learning analytics).
- *Learning Theories:* It is crucial that future MOOC implementations are backed by a solid theoretical background. A heavier focus should be put on cMOOCs as well as bMOOCs which have the potential to support different learning models beyond formal institutional learning. These include informal learning, personalized learning, professional learning, and lifelong learning.
- *Case Studies*: The field of MOOCs is emerging and it is needed to conduct and share more experimental studies with different MOOC formats and variations.
- *Business Models*: We need to identify new ways to think about business models that preserve the quality of the learning experience supported by MOOCs.
- *Target Groups:* We need to investigate new methods to increase the motivation of observers, drop-ins and passive learners in MOOCs through e.g. learning analytics.
- *Assessment:* it is necessary to go beyond traditional e-assessment methods and apply open assessment methods that fit better to the MOOC environments characterized by openness, networking, and self-organization.

This paper which compiles and analyzes the state-of-the-art in MOOC research is original because firstly it provides a comprehensive review of the development of MOOCs which have been lacking until now and secondly it examines the context within which further work can take place by identifying key challenges and opportunities that lie ahead in this emerging research area.

Our future work will focus on learner-centered MOOCs by providing a MOOC platform where learners can take an active role in the management of their learning environments, through self-organized dashboards and collaborative workspaces. The platform will be based on an app system that enables learners to select the apps according to their needs and preferences. These include a collaborative video annotation app as well as learning analytics apps to support self-reflection, awareness, and self-assessment.

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