A Systematic Mapping Applied to MOOC's Study

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Abstract: MOOC platforms are Web-based learning environments which allow a global participation on a large scale and with free access. The paradigm presents itself as a new teaching trend, changing the way education can be offered and funded worldwide. Many institutions are now investing in this teaching mode. However, since it is a web-based tool, the connection performance can impact both the way learning is experienced by the student as well as the operation of the platform. The "Quality of Experience" (QoE) concept has been widely used to refer to how users describe a service they have used while the "Quality of Service" (QoS) concept deals with the technical performance parameters that are associated with the connection quality. This paper starts the process of developing a systematic mapping around MOOC platforms, and QoS and QoE concepts, aiming to provide an overview of the current state of research on these issues.

1 INTRODUCTION

Starting with the emergence and operation of MOOC platforms (Massive Open Online Courses), or online courses, open coursesand mass education, the need to conduct studies of this new concept of teaching widens itself. "Massive" means it can be attended simultaneously by thousands of students; "open" means that anyone can do it and "online" means that the courses are Web-based and in a non-attendance mode. Siemens *et al* (2010, p. 4) sets this learning opportunity as being: "An online phenomenon, gaining strength over the past two years, a MOOC integrates social network connectivity, the facilitation of a recognized expert in a distinct field of study, and a collection of free access online resources (Siemens et al., 2010, p. 4)".

MOOC has been showing itself as the recent educational phenomenon. It represents a possible rupture in higher education in terms of online teaching and learning for some students (Mota et al., 2012). Such enthusiasm necessarily requires some caution, due to the fact that this concept is extremely recent (about to six years) and is still in the process of consolidation.

MOOCs are essentially characterized by being open and scalable courses. "Open" means that students are eligible to participate even if theyare not registeredin the educational institution that promotes the course. This possibility however is associated with minimum skills requirements on the part of the participant towards the use of computers as well as the technological infrastructure, preferably with broad band internet access that allows navigation without major problems (Mota et al., 2012). As for scalability, the courses must have the appropriate layout to meet an exponential number of registrations, which may reach thousands every time they are offered.

Furthermore, the accession of major universities to this model shows that it is an irreversible trend of learning. The main examples that may be presented are the universities of Stanford, Columbia, Duke, Princeton, among others with the "COURSERA" platform; "UDACITY", which was born of an experiment at Stanford University; universities as MIT, Harvard, the University of Texas, Berkeley and Georgetown with the "EDx", etc.

Moreover, British universities launched the Future Learn, created by the Open University and with the participation of Birmingham, the British Library, the British Museum and several other institutions.

Liyanagunawardena *et al* (Liyanagunawardena et al., 2013) present an article with a systematic review of the main MOOC's publications, highlighting forty-five articles reviewed. Such review was classified into eight different areas of interest: introductory, concept, case studies, educational theory, technology, participant focused, provider

focused, and other, and provides an analysis of the kinds of publication, year, and authors.

In order to get a better understanding about the possibilities and limitations, and deepen the studies in this new concept of teaching and learning, a study of Systematic Mapping was conducted (Kai Petersen et al., 2008, p. 71). This mapping makes a survey of the state of the art in the research on MOOC platforms and what has been discussed in the areas of Quality of Service (QoS) and Quality of Experience (QoE). According to Drogseth (2005, p.60) the QoE analyzes user-centric approaches, while QoS investigates approaches focused on technology.

Quality of Experience (QoE) is used to describe how students evaluate a service, and on the other hand, Quality of Service (QoS) describes the technical performance parameters which reflect the quality of an internet connection.

Quality of Experience (QoE) is a concept that has been extensively explored in the evaluation of communication and learning of platform based on internet access systems, but the term has not yet been broadly defined. Subjective parameters, such as expectations, emotions, usability and context should be taken into consideration for its definition.

Soldani *et al* (2007, p.3) defines QoS as "... the capacity of the network to provide a service to a guaranteed level." Already QoE "is how a user perceives the usability of a service when in use - how pleased he or she has a service in terms of, for example, usability, accessibility, retention capacity and integrity of service" (Soldani et al., 2007, p.3). In the same line of thought, Moebs (2008) defines QoE as "the degree to which a system meets the tacit and explicit expectations of the user for the experience."

This article is organized as follows. Section 2 describes the methodology used to create the mapping. Section 3 presents the interpretation of the results. Section 4 presents the conclusions and further work.

2 SYSTEMATIC MAPPING

Kitchenham, (2007) elucidates that a study of systematic mapping is a method that provides an insight into a particular area of research, in order to allow quantifying, identifying and analyzing results, establishing proof of research on a particular theme.

The systematic mapping can also be defined as a literature survey that identifies which types of studies can be treated by a systematic review, the place where they were published, in which databases they were indexed and what their results are (Petticrew and Roberts, 2006).

The study was conducted in accordance with the guidance provided by Petersen *et al* (2008, p.2) and the procedure consists of a five-step process (Figure 1): definition of the research issue, research achievement, sorting, keywords, summary and data extraction and mapping. Each step of the process generates specific result (second line of the image in Figure 1).

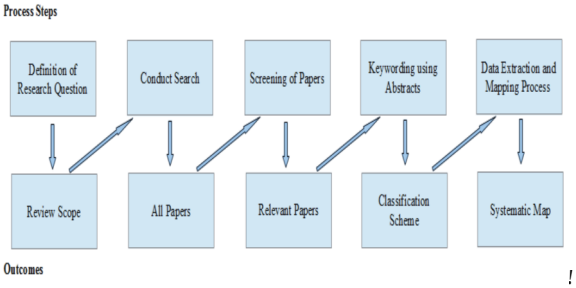

Figure 1: Sistematic mapping process.

2.1 Definition of Research Parameters

In a systematic mapping, the research questions (RQ) define the scope and focus of the work. The following issues have been identified:

- RQ1. What kind of work has beendone in the MOOC field and in relation to major platforms that offer courses in this format?
- RQ2. What is the current state of research on QoS and QoE applied to MOOC and education in general?

The answer to question RQ1 will provide an overview of what the academic community has been producing by topic.The RQ2 will provide a vision of what was produced in relation to the quality of service and experience applied to educational platforms and in particular to the platforms that offer MOOCs.

2.2 Conducting the Research

2.2.1 Search Strategy and Data Source

The major focus of the research was based on MOOC, that emerged from 2008 with the course "Connectivism and Connective Knowledge", launched by George Siemens and Stephen Downes, specifically to expand the discussion on the new theory of learning they created (i.e. the Connectivism). In consideration of that, every search

in this work has been made considering publications from the year 2008.

Since the initial exploratory period of the study up to the following stages of the searches, the strategy adopted was to consult the following databases for a search of the most relevant articles and publications: *IEEEXplore*; *ACM Digital Library; ScienceDirect*, because these academic databases add great number of conference proceedings publications, studies in science of human and computer sciences.

2.2.2 Primary Studies

Searches were initially made in the database of digital bookstore IEEExplore using keywords such as: "MOOC"; “e-Learning”; "QoS"; "QoE” and small conjugations for key words like “quality of service and learning ".

This pilot project totaled 36 keys. The search for the key words was conducted using predefined parts of the articles, namely:

- *Full Text* – It was sought the presence of the key throughout the article.
- *Summary* - It was sought the evidence of the key only in the summary of the article.
- *Keywords*- It was sought the keywords among the ones defined by the author.
- *Title* – The existence of the key described in the article title.

In the end, 144 searches were carried out in the IEEEXplore library.

The first item described as *full-text* was not considered in the assessment criteria for selection of articles, considering the broad range of information results culminating in a large number of articles.The importance of its use at this moment is justified to permit an initial visualization of the amount of articles that bring the keys in any part of the body of the text.

112,543 articles were obtained wherever the existing terms in the used keys had been located in any part of the text.

30,920 articles were obtained wherever the key lies in the summary, the keywords or the title.

Based on the first results obtained in this pilot study, and to ensure the final results would be valid and reliable, the research process moved towards a refinement of the keys.

2.3 Screening of Papers

The following keywords were used: QoS; QoE; MOOC; UDACITY; COURSERA; EDX; e/m/u/b-Learning; dropout; waiver; evasion; course; open course and several synonyms, derived words.

A grouping of keys process was also applied based on the research issues, which resulted in three groups:

- RG1 - "quality of service" associated with the term "education".
- RG2 - the term MOOC and major platforms.
- RG3 - "quality of experience" associated with "education".

(RG meaning: Research Group)

At this stage of the research, although there were only 44 simple search keys with few conjugated terms, such as: “quality of service” and “MOOC”, “quality of service” and “e-learning” for RG1, “MOOC” and “online, massive open online course”, “edx and MOOC”, “courser” and “udacity” and “mitx” for RG2, “quality of experience and MOOC”, “quality of experience” and “e-learning” for RG3, the terms were used in order to enhance the refinement of the searches in relation to the searches previously made.

At the end of this phase of searching, with the 3 (three) previously defined key groups with respectively 9, 27, 8 keys each, we obtained the figures presented in Table 1:

Table 1: first results.

	IEEE Xplore				ACM DIGITAL LIBRARY				Science Direct			
	Full text & Metadata	Abstract	Author Keywords	Title	Full text & Metadata	Abstract	Author Keywords	Title	Full text & Metadata	Abstract	Author Keywords	Title
RG 1, 9 Keys	1724	56	19	2	43	3	0	0	569	13	1	0
RG 2, 27 Keys	1194	194	47	99	1088	120	63	0	3910	47	11	4
RG 3, 8 Keys	2601	231	63	13	317	41	12	0	399	24	5	2
TOTAL	5519	481	129	114	1448	164	75	0	4878	84	17	6

Still working with the three groups of keys, it was made a reduction in the number of keys from the merge of the existing keys in each group.

From that point on, for each of the three groups (RG1, RG2, RG3), the keywords, their synonyms, derivatives and related words were grouped with the identifier OR and with the identifier AND, generating the following keys:

- RG1: ("distance learning" OR "online learning" OR "distance education" OR "online course" OR "e-learning" OR MOOC OR "massive open online course") AND "quality of service");
- RG2: (“courser” OR “udacity” OR “edx” OR “mitx” OR “harvardx”) AND ("massive open online course" or MOOC);
- RG3: ("distance learning" OR "online learning"

OR "distance education" OR "online course" OR "e-learning" OR MOOC OR "massive open online course") AND ("quality of experience").

2.4 Keywording using Abstracts

2.4.1 Repetition of Articles

The next step was to group the articles by their titles alphabetically.The existence of repeated articles was observed, due to the following circumstances:

- The same article found in more than one of the databases consulted;
- An article where the key took place both in the "Summary" field " and in the “keywords" field;
- An article found in more than one of the keys.

2.4.2 Selection of Relevant Articles

In order to improve the search results obtained in digital libraries, it was necessary to set up inclusion and exclusion criteria of items, taking into account the research issues defined at the beginning of the work (Kitchenham, 2007).

Inclusion Criteria

Proposed search keys were used in database consulting systems, and every article that was found has been considered as long as it meets the following criteria: the article relevance regarding the research questions; periodicals and full papers published in journals, conferences or symposiums; researches which associate QoE and QoS with MOOC and/or educational platforms.

Exclusion Criteria

Articles with titles that clearly show that they were not related with any of the defined issues were disregarded; studies which were not written in English; published studies in editorials, prefaces, summary of articles, interviews, news and reviews.

Inclusion and Exclusion criteria have been complied with every article by reading the title and the summary. Whenever that was insufficient, then the introduction and/or conclusion of the article was read.

After the first selection, we obtained 27 articles that have been reviewed and submitted to the last phases of the methodology.

3 RESULTS

3.1 Data Extraction and Mapping Process

Seeking to answer initial questions of research, there is an evolution in the number of articles that deal with the subject, and in 2008, 2009 and 2010 there were three articles published, five in 2011, seven in 2012 and six in 2013. Up to May 2014, the time of completion of this work, no publication was listed in the digital libraries, in 2014.

There were 17 articles found in IEEExplore; 2 on ScienceDirect; 5 in the ACM Digital Library (DL). We also observed the occurrence of articles that have been found in more than one digital library: 2 articles in IEEE and ACM DL and 1 in Science and ACM DL.

It is believed that the greatest number of articles found on IEEExplore may be due to the fact that it is a specialized library in the areas of data network and electronic and the QoS and QoE terms are often associated with this field of study.

3.2 Systematic Map

The classification proposed by Wieringa *et al* (2006), subdivided into categories, which proposes criteria for the evaluation and classification of articles was used to determine the type of research evaluated in each article. The classification suggested may be considered a general classification, which may be applied to any kind of research.

The articles were reconsidered individually and assigned into the categories that most reflect their content. Three articles were classified as validation research; 10 as evaluation research; 5 as suggested solution; 3 as philosophical work and 4 as experience work articles (Table 2).

Table 2: Categories x years.

	2008	2009	2010	2011	2012	2013	2014	
Validation Research		2	1					3
Evaluation Research	1		2	1	3	3		10
Suggested Solution	1	1		2	1			5
Philosophical Work	1				2			3
Opinion Work								0
Experience Work				2	1	1		4
	3	3	3	5	7	4	0	

3.3 Analysis of Articles

After the classification, it was observed that the articles address a wide range of topics related to the proposal of this study, however only two articles that specifically treat MOOCs have been found and both are studies of applied MOOC.

The first study describes the production of a course using MOOC on the Coursera platform and discusses the improvement of the quality and productivity of software professionals from the continuity of studies using the platform (Schmidt et al., 2013). The second study reports the experience of teaching through a MOOC and identifies positive and negative points (Egerstedt, 2013).

Several studies deal with the e-Learning theme and its quality. Nevertheless, such studies are more associated with the quality of service in a context that addresses technical performance parameters such as network conditions that may alter the connection, quality of content, network architecture, multimedia systems for the cellular phones segment and specific algorithms for network control. Some works seek alternatives to enhance the performance of the connection as a solution to achieve the improvement of e-Learning Services.

The works developed by Moebs (Moebs and Mcmanis, 2008; Moebs, 2008) identify the factors that most influence the QoE in the learning environment and propose a model for measurement of QoE. They present a proposal with five main components of QoE: effectiveness, usability, efficiency, expectations and context. These five components have been related with the user experience and therefore they can identify the factors that most influence the QoE in a learning environment. Thus, those factors are used to develop a hypermedia learning system.

Another discussed point was the quality of educational products (Rossi and Mustaro, 2012). It was based on quality of service, but the presented model works as a tool to improve the phases of development, self-evaluation or certification of educational products.

Among the studies that specifically address issues associated with the quality of experience, we find those that measure, evaluate and validate the QoE. Menkovski, V. *et al* (2010) present a methodology for measuring QoE, associated with the quality of video received by the user. In another work, Menkovski, Exarchakos, Georgios, Liotta, A (2010) present a method of construction of a QoE assessment model that operates continuously and in real-time.

Kalliris *et al* (2011) investigate the implementation and validation of QoE to streaming live internet courses.

In every article, QoE was associated with a more technical parameter, such as video and bandwidth of the connection.

Some articles investigate the relationship between QoS and QoE, like Muntean *et al* (2010) which draws up a method for the mapping of QoS parameters in order to improve the QoE of e-Learning applications for final users.

Wang *et al* (2012) and Dursun *et al* (2013) used the SERVQUAL model to assess the quality of a distance education service, so that the first work used a combination with another type of assessment, SERVPERF.

4 CONCLUSIONS

The literature review work on MOOCs, QoE and QoS was carried out systematically as a result of the recent MOOC offers. It is considered that the study of MOOC and creating a model for evaluating the Quality of Experience will allow a better use for the students and will ensure the quality of the courses offered.

An important aspect of the systematic mapping conducted revealed that few studies address specific issues to QoE. Only 2 research studies proposed specific assessment mechanisms. These numbers support the importance of further studies in this area.

Not only there was a need of searching individually QoE, MOOC and about teaching platforms, but also articles that explain the concepts and stablish background concerning important points. Some articles were reached from the bibliographies of the ones related by MS, others from searches of individual keys, sometimes containing a specific term, sometimes the name(s) of the author(s) in particular.

As future work, we will apply again the methodology to new databases, for example the B-On.pt for the period 2014, and develop mechanisms study to assess how these vectors can affect the quality of learning in MOOCs.

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