Factors influencing learning in MOOCs (Massive Open Online Courses)

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Abstract. *Massive Open Online Courses (MOOCs) are remote courses that stand out in heterogeneity and quantity of their students. Due to the peculiarity of being massive and the large amount of data generated, it is necessary to identify which factors influence the learning process based on collaboration. Thus, the objective of the research was to identify the variables that can promote autonomous and critical learning. The results of a Systematic Literature Mapping have brought us important evidence in the process of developing a collaborative framework in MOOCs.*

Keywords*: Collaborative Learning; MOOC; Engagement*

Introduction

Massive Open Online Courses (MOOCs) are an online course modality that can accommodate many students. Oliveira (2013) defines MOOC as an educational environment made available through the Web (through AVA and/or Web 2.0 tools and/or Social Networks) whose main objective is to provide a large number of students with the opportunity to access new knowledge and learning objects.

Loizzo and Ertmer (2016) add that MOOC provides a means of connecting thousands of students from diverse backgrounds, backgrounds, and cultures to topics of global concern, going beyond passive learning to the active connection of learners, not just with content, but with colleagues from different backgrounds and abilities, and thus form a massive community of social learning.

The benefits that MOOCs can bring to learning are undeniable, given that, according to Khalil (2017), it is possible to reduce the knowledge gap among students from the different perceptions and exchange of knowledge generated, since they attract different profiles of students and work in learning contexts focused on educational experiences that integrate collaboration and interactivity, enabling active and critical learning.

Although MOOCs have several strengths and provide various educational opportunities and benefits to participants, there are several challenges to overcome, such

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as: context replication (Nelimarka *et al.*, 2015), difficulty in profiling (Chauhan *et al.* , 2015), high dropout rates (ZHOU, 2016), difficulty of assessment (ZHONG and XU, 2017), language barriers (ZHOU, 2016), promotion of collaboration (ZHANG, 2016), among others. Holanda and Tedesco (2017) state that most of these difficulties are due to the large number of students and their heterogeneous backgrounds.

Thus, this research aimed to identify the factors that can contribute to the development of a more collaborative MOOC in the process of learning construction. For this, a Systematic Literature Mapping (MSL) was carried out to identify the different approaches described in related works.

The article is organized as follows: Section 2 presents the methodology of Systematic Mapping conducted in the context of identifying factors that may influence the process of collaboration within MOOCs. In Section 3 we discuss the evidence found as answers to the research questions defined in the MSL protocol. Finally, Section 4 presents the conclusions and perspectives for the continuity of work.

2. Methodology

This research used the Systematic Mapping of Literature as a research method because it provides an overview of the field of interest and is very useful when one wants to broadly examine the investigation phenomenon, seeking to understand what occurs in the state of the art, identifying thus possible existing gaps (Petersen *et al.*, 2015).

In order to understand how a MOOC should be planned that promotes the construction of critical learning, under the collaborative pillars, we sought in the literature to identify the characteristics that need to be considered in the process of developing a MOOC. Seeking to define which approach of the MOOC collaboration process is reported in the surveys, the following research questions were defined:

Q1. How often do publications address collaboration in the learning process in MOOCs?

Q2. What types of surveys are published related to MOOCs?

Q3. What factors influence the collaborative process in massive environments?

For the definition of the search string the following keywords were considered:

Referency	Category	Synonyms
C1	MOOC	Massive Enviroments
C2	Collaborative Learning	Cooperative Learning

		CSCL Social Learning Group Learning Peer Learning
C3	Methods	Approaches Tecniques Tools

Thus, the mapping used the following search string, relating various forms of approaches or tools that enable collaborative learning in MOOCs:

> (MOOC OR Massive Environments) AND (Collaborative Learning OR CSCL OR Social Learning OR Group Learning OR Peer Learning) AND (Methods OR Approaches OR Techniques OR Tools)

The following were used as electronic databases: ACM Digital Library, IEEE Xplore, ScienceDirect - Elsevier, Scopus and ERIC to select the articles, as they are reference bases in academic research. As inclusion criteria we had: a) The article discusses specific and applied research in MOOCs and b) The article reports experiences related to aspects of collaboration. Regarding the exclusion criteria, the following were defined: a) Duplicate articles; b) Opinion articles; c) Articles that have not been published in periodicals or conference proceedings.

To classify the selected studies, Wieringa *et al.* (2006): a) Validation research - demonstrates technique that has not yet been implemented in practice; b) Evaluation research - techniques that are implemented in practice and an evaluation is performed; c) Solution proposal - a solution to the problem is proposed and a case study and other arguments can be presented; d) Documents of experience - Explicit the author's personal experience explaining what is and how something was done in practice.

3. Analysis and Discussion of Results

From the systematic mapping steps, it was possible to find evidence that can be useful in the process of building a more collaborative MOOC environment and that promote learning built on the involvement and active participation of students.

We found 223 scientific publications. To select articles have been read the title, abstract and keywords of all articles. Of the 223 publications were read in full 30 articles

selected after the evaluation based on the inclusion criteria identified. Figure 1, below, synthesizes the selection steps of the articles made in the mapping process:

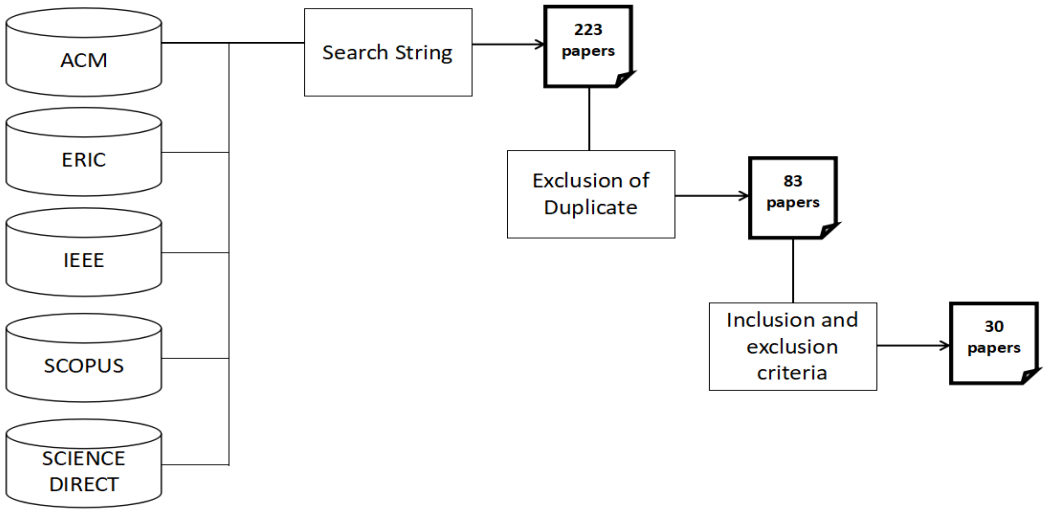

Figure 1: Selection of articles

It is important to note that the steps of Systematic Mapping were carried out from October 2018 to April 2019, totaling 5 months of research. When analyzing the selected articles, it is observed that 18 were published in Journals, 3 are from Ph.D. theses; 2 are book chapters and 7 have been published in conferences. Figure 2, below, shows the number of publications per year.

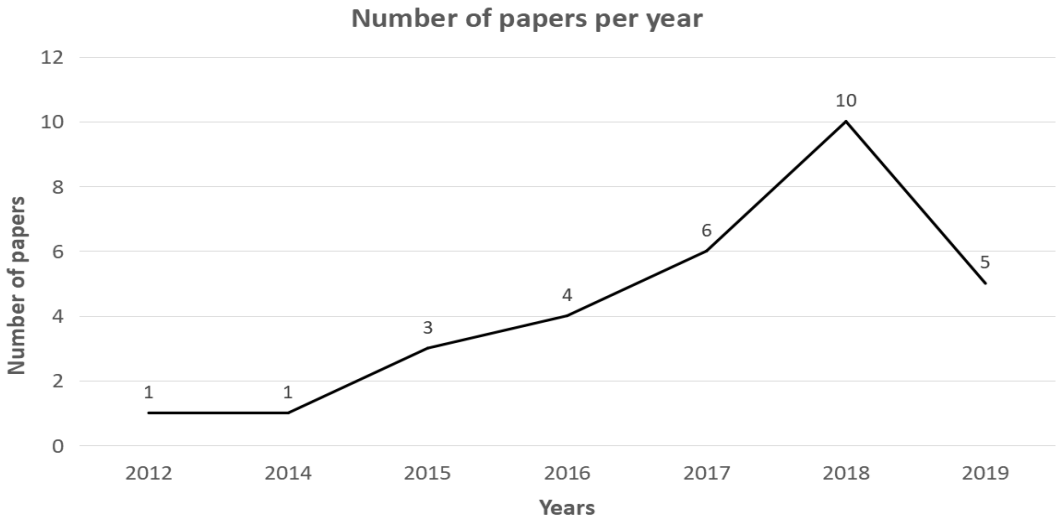

Figure 2: Number of publications per year

In addition, it is important to highlight the evolution of the discussions over the years. Thus, the analysis reveals that the research focused on the improvement of MOOC

environments more concerned with the interaction and motivation of the students becomes evident in the years of 2018. Evaluating the frequency of publications, 83% of the publications are concentrated in the last four years, which shows the growing importance and potential of the area. Thus, the need to improve collaborative learning in the MOOC environment is increasing, given the difficulties and challenges already observed in previous research.

It is also important to highlight the types of research that were found in the mapping, considering the classification proposed by Wieringa *et al.* (2006). Figure 3 shows that most articles selected make proposals and perform validation from a case study, an experiment or through arguments. Thus, the mapping shows that most of the research is aimed at proposing solutions to aspects related to the construction of more autonomous learning, and to try to validate them.

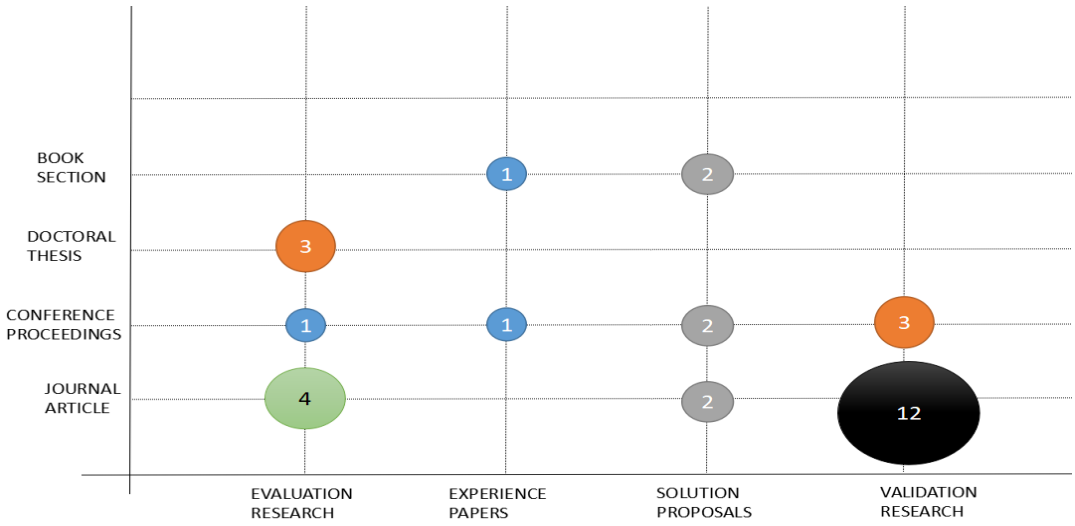

Figure 3: Contributions from the studies

In relation to the factors that may influence effective collaboration and, consequently, learning centered on the exchange of information, through discussions and active engagement on the part of the students, the evidence pointed to the following items, seen in Figure 4, below shows all the factors that were cited in the selected surveys. The Ability Factor was the most talked about in the research. Abeer and Miri (2014) comment that the prior knowledge of the student is an important characteristic to conduct discussions that can promote a critical and reflective attitude about the content that is being approached. Israel (2015) complements by stating that fostering interaction

between people of different skill levels can improve student achievement and learning experiences.

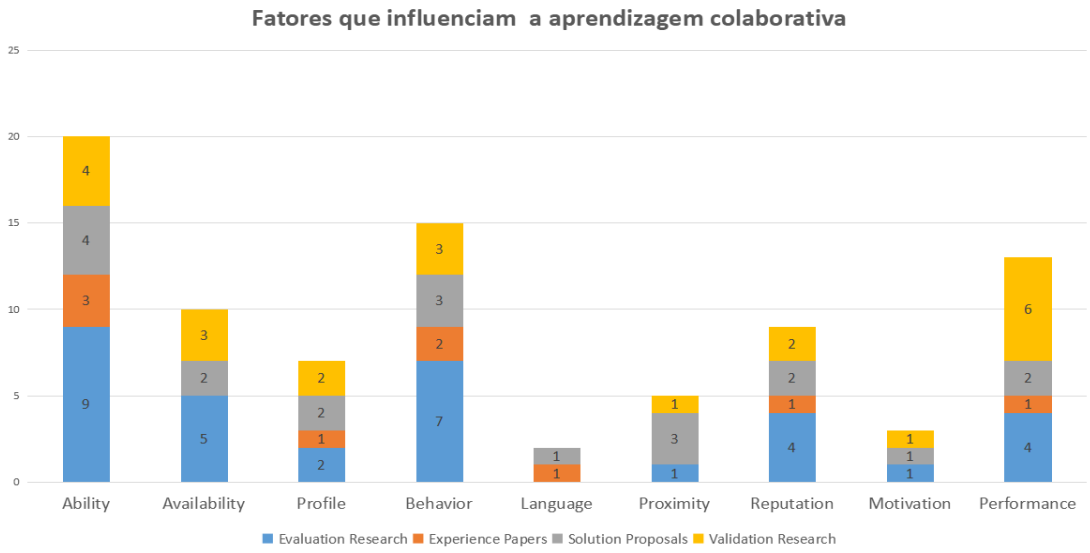

Figure 4: Factors that influence collaborative learning

However, just considering the prior knowledge of the student does not give any guarantee that there will indeed be an effective interaction. Thus, the Behavior factor is also found in the mapping. Regarding this factor Pursel *et al.* (2016) state that students interacting in the environment are more likely to complete the course. Bonnafini (2017) goes further and states that participation in different tools and activities in the environment maximizes student learning opportunities in MOOCs. Osuna-Acedo *et al.* (2018) reinforce that forum participation supports the completion of the course of the participants, which reinforces the idea that learning is a process of forming connection networks.

The performance of the student along the course is a characteristic also well evidenced in the research. This is because identifying the student's progress throughout the course, it is possible to generate strategies to ensure the continuity of their progress and to promote interaction with other classmates as described by Xing (2019). In addition, factors such as availability (30% of articles), reputation (30%), profile (23%), proximity (16.6%), motivation are important to be considered in the process of promoting collaboration in MOOC environments. Thus, collaborative learning has the possibility of intensifying more active learning because it stimulates the capacity for interaction and negotiation of problem-solving by building knowledge more autonomously.

Final Considerations

Collaborative learning aims to dynamize the learning process through systems that implement a collaborative environment among users. With the rapid expansion of MOOCs, it is necessary to reflect on the procedures inherent to its construction in order to provide teaching models that favor collaborative learning experiences. In this way, it is necessary to understand how collaborative learning can be promoted within this environment in order to guarantee effective learning.

Thus, the Systematic Mapping carried out brought important contributions to the identification of characteristics that must be observed in the collaborative process. It has been identified that in the last four years the frequency of publications has been expressive regarding this concern, which shows that it is an emergent difficulty in MOOCs and that needs more attention. Regarding the types of research found, most of them transcend the field of discussions, since alternative proposals are based on the analysis of surveys, case studies and experiments carried out to support and validate the studies carried out.

In addition, the present research has brought important evidence in conducting the development of a Recommendation System of students in MOOC environments, by identifying characteristics that need to be evaluated in the recommendation process in order to generate a more efficient learning and to ensure that MOOC can be an alternative centered on the different contexts and motivations of the students.

As limitations of the search it can be mentioned that some bases have specific sizes of characters (such as IEEE), being necessary to divide the search string in smaller parts requiring multiple queries and several repeated studies as return. As future work, it is recommended to conduct a survey with specialists in the field of DE, such as teachers, monitors and managers who have experience in building and living collaborative environments to validate the findings found in Systematic Mapping. In addition, a Systematic Review may be conducted to obtain more detailed and insightful information about collaborative learning in MOOCs.

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