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MOOC AS A VIABLE OPTION TO ENERGY SUSTAINABILITY AND TECHNOLOGICAL TRAINING

Adriana-Irene Carrillo-Rosas¹, María-Soledad Ramírez-Montoya²

¹*Centro Regional de Formación Docente e Investigación Educativa del Estado de Sonora (México)*

²*Tecnológico de Monterrey (México)*

Abstract

Nowadays, due to technological advances, continuous online training has been more relevant as part of professional and personal development of individuals. Massive Open Online Course (MOOC) is now a means to education that allows participants to partake in topics of their interest. In order to conduct this research, it was necessary to carry a systematic review of papers related to the design and implementation of MOOCs around the world. In order to apply these findings in the development of a series of MOOCs which will be held on the topic of energy sustainability. This work is based on the Project 266632 "Binational Laboratory of Intelligent Management of Energy Sustainability and Technological Training", with funding provided by the CONACYT-SENER Energy Sustainability Fund (Announcement: S0019-2014-01). The research question that guided this study was What are the management and academic factors that influence an MOOC to be effective?. The methodology used in this research was Meta-analysis, which allows to merge results from manifold experiments or quasi-experiments with the purpose of achieving an appraisalment of the size of the effect. A comparison among 16 case studies on the design and implementation of MOOCs was made, which provided the information needed to analyze each effect size. Among the most significant findings, it was identified that the following factors influence the effectiveness of an MOOC: high quality instructors and materials must be a part of these courses to maintain the interest of the participants, prompt feedback encourages participants to make contributions, forum activities are vital for doubts clearing and sense of belonging, and the implementation of an achievement board encourages participants to seek to reach their course goals. The results were applied in the instructional design of 10 MOOCs related to energy sustainability (<http://www.energialab.com/demo3/cursos/>) that are imparted in Mexico EDX platform within the project "Binational Laboratory of Intelligent Management of Energy Sustainability and Technological Training".

Key words: MOOC; training; renewable energy

1 INTRODUCTION

Training programs currently have different modalities that have impacted the daily lives of individuals, among them is positioned the education online and the MOOC (Massive Open Online Courses), the last one have had positive and negative criticism by the dropout rate, the form of access and the modality of work. However, Haggard says that MOOCs "reported experiences of learning and innovations pedagogical positive and that stand out the access, the empowerment and the construction of relationships and communities" (2013, p.4).

In Mexico, according to the data from INEGI (2016) the 57.4% of the inhabitants of the country, over six years, are internet users, so, in this connected context the Project 266632 "Binational Laboratory of Intelligent Management of Energy Sustainability and Technological Training", in which the funding were provided by the CONACYT-SENER Energy Sustainability Fund (Announcement: S0019201401) which is in process of developing a series of MOOC courses that address the theme of energy sustainability that allow you to include a large number of beneficiaries in the Mexican territory.

To improve the quality of the design of the MOOCs offered in the framework of this project was developed a literature review using the method of meta analysis. As a guide in this work was the research question what are the academic and management factors that influence to make a MOOC effective?

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2 FRAMEWORK: MOOC

The MOOCs have been called as a technology disruptive (Jasnani, 2013) that can support to those processes educational offering opportunities of learning to a without number of individuals without cost some. Then it describes information important that is must have as reference about them MOOC.

2.1 Origin of the MOOCs and their characteristics

In the year 2008 the term MOOC was used by first time for call a model of courses in line that were result of the Open Educational Resources Movement (Grainger, 2013). These first courses that were propelled by Downs and Siemens had the characteristic of be based in the principles of the connectivism and work through forums, blogs and meetings in line. The main objective of these MOOCs was that people could live a collective learning experience, in which the teacher is not the main actor, but another node in a network of knowledge in which all had significant contributions (Hollands & Tirthali, 2014).

Nowdays the MOOCs have been developed and have been widely accepted by private companies and higher education institutions (Honeychurch & Draper, 2013) and have positioned themselves as the component of the Open Educational Resources Movement with more publicity (Bonk, Lee, Reeves & Reynolds, 2015). The MOOCs have covered a large number of disciplines and areas of interest, but according to Cabero, Llorente and Vazquez (2014), all the MOOC have certain characteristics in common:

- Have dates specific of start and end.
- They can be evaluated.
- Developed in online environments.
- They are open and do not have requirements for admission.
- They are designed to allow a large number of participants of individuals can interact.

Also, Rodríguez and Ramírez express that “other aspect is that the MOOCs allows the continuance of learning throughout life in a very specialized manner by having new learning experiences for free” (2015, p. 2), that means that these courses provide quality education with no cost to the participant.

2.2 Types of MOOCs

Currently, there are a variety of ways to design and implementation of the MOOC, but Clark (2013) has made them a rating of eight types depending on the purpose and form of development:

- TransferMOOC has been called to those courses that continue to have the same structure as a traditional course, however they are mounted online and is expected to have success based in the recognition of the institution or teachers.
- MadeMOOC: this type of MOOC favors the design of videos explanatory, are used to develop skills or capacities specific, often promote it education formal.
- SynchMOOC: tend to be those MOOCs that have dates established of start and end, tends to do is work synchronous that is in tune with them weeks. He is expected that professors and students work in cohorts that would the motivation and the conclusion of the MOOC.
- AdaptativeMOOC: The MOOCs which have the characteristic of being Adaptive are developed based on algorithms that present personal learning experiences for each of the users. The analytics are highly used in this type of MOOC to change and improve the courses.
- GroupMOOC: the groupMOOC are courses in which involved small groups of people, waiting for that is have an approach to the work in team. The integration of the participants will be according to the geographical space, skill or some feature that set the course.
- ConnectivistMOOC: Consist in networks of people, each one brings knowledge to the other. This type of MOOC not has a structure fixed, but is each participant through the networks can create their own path.

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- MiniMOOCs: the miniMOOCs tend to be adjusted to the calendars of the Higher Educations institutions. At the same time, they are aligned to the goals and objectives of learning, in which the badge system is used.

2.3 Structure of the MOOCs

Usually, the MOOCs have an easy to follow structure (Jasnani, 2013), which consists in a welcome through a video or a note, all participants, including mentors, teachers and students are presented in a forum dedicated to the socialization. The classes begin with a session, which can be synchronous or asynchronous and are organized the subsequent sessions by objectives of learning.

While the content of the course have several purposes:

- Instruction teaching: in this section is where is found them videos, notes, readings and material didactic that the participant requires to get to them objectives of learning.
- Application: In this section is found the simulators, games, tasks and projects in what will demonstrate the objectives of learning have been achievement.
- Collaboration and construction: in this section, wherein collaborating and interact will be carried out, both formally and informally within mentors and peers, either through the institutional means such as blogs or platforms of the course or through social networking and micro-blogging that is generated from the work in the course.
- Challenges: The challenges are activities which will enable the participant to go beyond learning objectives, usually still in use although the MOOCs dates have closed.

3 METHODOLOGY

This study is developed through the methodology of the meta analysis, that allows according to Akobeng (2005) join different studies individual and unify them quantitatively to be analyzed through different technical statistics. The software used to do the meta analysis were Comprehensive meta analysis (Biostat Solution 2013) and SPSS, both are digital tools that help with statistical analysis. To infer the size of the effect was determined the standard error of the mean to calculate the 95 confidence interval percent (Card 2012).

The effect sizes are expressed in units of the standard deviation, which is formed by the subtraction of the averages between the control group and the experimental, the result is divided between the pooled standard deviation (Lipsey & Wilson, 2000). Different contrasts were made and was used the model of effects fixed.

3.1.1 Criteria of inclusion and exclusion

In the present study were compared and analyzed the results of 16 experiments and quasi experiments to determine the size of the effect.

The first analysis, which was the review of the literature was conducted in 207 different studies that were published in Scopus, Web of Science and EricDataBase with the theme of design and implementation of MOOCs, but were rejected because they did not have measurements that would determine the size of the effect. The objective of make this study was obtain a base that allow make inferences for bigger studies and that will allow have the understanding of the generalizations made (Card, 2012).

The inclusion criteria that were taken are:

- Should count with results quantitative of the implementation.
- Have a design experimental or quasi experimental.
- Addressing issues related to the design and implementation of MOOCs.

4 FINDINGS

While samples from control groups were very small and the confidence interval was less than 95 per cent, since it varied between 90% and 99%, this was due to that it is uncommon that control groups have in the implementation of MOOCs and even more to publish the data. However, this study allowed to arrive to some findings significant.

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As is said above, was determined the sizes of the effect of 16 studies (see table 1), that had samples from 10 to 1,800 participants both in the groups of control as experimental. Back to the coding identified 12 different sizes of effects, which were classified into two categories:

-category 1: instructional design.

-Category 2: interaction and motivation.

These two categories help to answer the question of the study research: What are the management and academic factors that influence an MOOC to be effective? Below it is narrate the main findings that had a size of the effect significant as to be taken in has within this study.

In the category of design instructional Ping Jong (2016) points out that generate small groups in the MOOCs allows that the objectives is carried to out and that the rate of desertion is lower. While Smith (2015) says that there is no significant difference in student achievement if the course is in mode online or MOOC. However, Kizilcec, Perez-sanagustin & Maldonado (2016) and Konat (2015) within the frame of the design instructional of the MOOC and its rear implementation found that the adaptive activities and the interactive simulators improve the disposal of the participants and rise the terminal indexes, while the application of strategies of self-regulated learning not show a difference in the achievement of the students.

Another feature important to consider for the design and implementation of the MOOC is that the learning is active, as it identified Vihavaiven, Luukkainen & Kurhila (2013) that through the flipped learning caused that the students are deeply involved in the activities of the course. Ghidari (2014) identified that has a blended learning class involving a MOOC is brings a greater academic advantage for the students than a traditional class.

In the section of interaction and motivation, it is important to highlight that Lesjak & Florjancic (2014) found that the role played for the mentor within the MOOC is very important, since communication processes generated together with the participants is one of the factors to prevent desertion. In turn, Hossain, Islam, Glinsky, Lowe, Lowe & Harvey (2014) found that unlike an online class, the MOOCs have the advantage that allow interact with students of different geographical areas which makes them more attractive thanks to the multicultural experience.

Another important finding is which suggest Colvin, Champaign, Liu, Zhou, Fredericks & Pritchard (2014) that explain that the students that coursed the MOOC developed more technological and academic skills than the students that participating in the class regular.

At the same time, Vihavaiven, Luukkainen & Kurhila (2013) and Sarlem (2015) developed a system of budgets in the MOOC that engage and motivate students in daily activities, causing the feeling of success at the end of the tasks involved in the course.

Table 1. *Effect size of the meta analysis.*

Study name	Statistics for each study						Std diff in means and 95% CI		
	Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value		
Konat, 2015	0.087	0.427	0.182	-0.769	0.903	0.156	0.876		
Colvin, Champaign, ILiu, Fredericks & Pritchard, 2014	1.536	0.174	0.030	1.196	1.876	8.848	0.000		
Bruff, Fisher, McEwen & Smith, 2013	-0.594	0.527	0.278	-1.627	0.439	-1.127	0.260		
Vihavaiven, Luukkainen & Kurhila, 2013	-0.651	0.207	0.043	-1.057	-0.244	-3.138	0.002		
Kizilcec, Perez-San Agustin & Maldonado, 2016	-0.397	0.079	0.008	-0.552	-0.242	-5.025	0.000		
Firmin, Schioming, Whitmer, Willet, Collins & Sujitparapitaya, 2014	0.349	0.037	0.001	0.278	0.421	9.557	0.000		
Ghadiri, 2014	-0.096	0.176	0.031	-0.442	0.249	-0.547	0.584		
Ping Jong, 2016	0.077	0.169	0.029	-0.255	0.408	0.453	0.651		
Labarthe, Bouchet, Bachalet & Yacef, 2016	-0.133	0.034	0.001	-0.199	-0.067	-3.945	0.000		
Sarlem, 2015	-0.050	0.267	0.071	-0.574	0.474	-0.187	0.852		
Smith, 2015	-0.627	0.293	0.086	-1.201	-0.052	-2.138	0.032		
Lesjak & Florjancic, 2014	0.000	0.097	0.009	-0.190	0.190	0.000	1.000		
Hossain, Islam, Glinsky, Lowe, Lowe & Harvey, 2015	-0.345	0.291	0.085	-0.915	0.225	-1.185	0.236		
	0.049	0.022	0.000	0.008	0.092	2.247	0.025		

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5 CONCLUSIONS

As one of the modern modalities of study, the MOOCs are a very young pedagogical proposal that is on the way of consolidation, this alternative seeks to strengthen the processes of teaching and learning, not only in education but in private and business. It is clear that there is still a long way to go, but the analysis of information and systematic review of the literature can pave the way for a wider frame of reference and that provide greater opportunities for success to the MOOC.

The design and implementation of them MOOC must be linked to the specific needs of the possible participating, by this is important to take in consideration the experiences that have been captured in multiples studies of case. However, the combination of academic and management factors that are concatenated are the key to avoid that the number of students decreases and to maintain a high quality of education.

The processes of motivation and interaction that are performed by the mentors and teachers of the MOOCs can seem as isolated efforts, however, the participants have designated that the approach between the different actors generates an environment that conducive to the continuity and completion of the course.

Not necessarily a MOOC is better than a face to face or online class, however, they allow to reach geographical and temporal spaces that the presentiality does not consent. It also permits the development of specific skills and knowledge in a large number of people at the same time. It's still a pending task to find out how to connect the nodes of knowledge which the connectivism points and boost the MOOC as a window to new ways of learning.

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