

# Open innovation and social construction through MOOCs of energy sustainability: contributions from theoretical foundation

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## SUMMARY

In the present work, social construction practices of learning given through MOOCs as spaces for open and collaborative innovation are analyzed. Through theoretical foundation and from an exploratory approach, the main variables related to the social construction of learning in massive open online courses and different propositions about the direction and intensity of such relationships are established. The results derived in which variables are communication and interaction. The results ensure that there is a need to propose a new organizational method for the evaluation of social learning. This study may lead to future research to strengthen practices for the social construction of learning in massive open online courses, and it may also help to propose new activities that promote social learning or determine what activities can increase the likelihood of success in the social construction of learning.

## Categories and topics

Training in the knowledge society, education

## General Terms

Social learning, open innovation, MOOC

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## Key words

Social construction of learning, communication, interaction, MOOC, evaluation of social learning.

## 1. INTRODUCTION

The access we have to the Internet to share knowledge is a valuable asset for institutions and in particular higher education institutions achieve a sense of innovation development. In this context, mass online open courses (MOOC which stands for Massive Open Online Course) are an important trend towards an educational environment and social innovation; this is why it is important to verify the variables involved in the social construction of learning, in this type of course,

In this projection towards new learning environments it is necessary to emphasize open innovation as a process of distributed innovation to take advantage of external and internal sources of knowledge, in order to bring a change [8] which is crucial for developing innovative and cutting edge [4]. At university level and considering the democratization of technology, innovation must involve applicability to generate a value [17]. Therefore, there is a need for educational institutions to offer training scenarios and actions that generate added values for continuous improvement in the construction of learning internally and consequently social level also.

The MOOC are considered new social contexts envision collaborative relationships with a wider variety of participants, opening ways for universities to get into this trend [20]. The characteristics and needs of modern society demand new educational models which processes are directed to self-learning, the management and use of information properly, the use of information and communications technology, and take social awareness to support collective growth [29]. In recent years, massive open online courses (MOOC) that do not align with the course content nor the instructor, but other students and knowledge, these have been carried out with great success [30]. Network connectivity that occurs in a MOOC drives, personally

relevant, highly motivated learning and socially situated [25]. MOOCs represent a change in instructional schemes and therefore in the design of training and expectations of student learning; being the basis of a MOOC aggregation and redistribution of a broad and diverse content set, its potential is based on using the network as a structure while adopting an open conception of learning and go a step beyond the educational open content, to make free not only material but also the processes of interaction, which become the center of learning [15].

The MOOC open a door to re-transform the teacher/learner interactions as have been until now, and especially the relations of the pupils themselves, because now built collaboratively their learning, hence the need for the MOOC to also discover the cultural diversity and linguistic of different sociocultural contexts, away from an initial formative imperialist model of standardization to bet on pedagogical proposals based on multiculturalism, diversity of contexts, multilingualism and synthesis of local culture with global [1].

Consequently, an open and collaborative environment displays a proposal for the construction of autonomous learning, but community or network to meet an emerging need in the knowledge society.

This work takes place in the context of the Binational project Laboratory for Intelligent Energy Management Training Sustainability and Technology, with funding from the Energy Sustainability Fund CONACYT-SENER (website <http://energiyalab.com>), where they develop and MOOC ten implemented in Mexico EdX platform. Specifically, the aim of this work is to identify, from a theoretical foundation, relevant information about the social construction of learning that arises from the MOOC, in order to justify a method to organize learning assessment Social.

The contributions of this work are designed to provide: (i) a summary of the evidence on the social construction of learning in MOOCs, (ii) a brief reference of open innovation in the field of education, and (iii) an approach to a method for organizing the evaluation of social learning.

This document is divided into five sections. The first begins with a brief description of the context in which this study is part of open innovation. The second section provides theoretical foundations of a social construction of learning in open innovation spaces and methodology to conduct this study in four MOOC of energy sustainability. The third section presents an approach to support a method to organize the evaluation of social learning. In the fourth section the methodology used in this paper is exposed. Finally, the fifth section presents the results and main conclusions of this paper and future work on the basis of the literature review.

## **2. OPEN INNOVATION IN EDUCATION**

A valuable element in the development of the Knowledge Society is open innovation, because it relates to the most current innovation processes demanded by institutions, including institutions of higher education, for knowledge management. There is an important strength when companies make the decision to link the research capabilities of universities to development and university-business-state strategy is created to facilitate interaction and generation of joint projects [2]. Innovate is to change and in this sense Internet has changed the way we produce, publish and

communicate information towards models where the information is produced mainly in digital formats and consumed through online media; as no physical entities for transport, only the electrical impulses that flow through the networks, the most important part of the added value of an electronic document is the intellectual creation [17].

Open innovation has become the umbrella that covers connects and integrates a range of activities, where academics and professionals rethink the design of innovation strategies in a networked world with interests in basic skills, collaboration and Internet [21].

While most open innovation in literature neglects the human side of open innovation teams, there are studies that examine the skills that professionals of open innovation need to work to meet the challenges they face. This competency profile for practitioners of open innovation adds a new perspective to the field of management of open innovation, focusing on how individuals can improve successful open innovation, generate new knowledge, build trust and agree on reciprocal commitments within the team open innovation [18]. Hence, the ability to achieve solutions and to be socially competent seems to be especially important for professionals of open innovation.

## **3. THE SOCIAL CONSTRUCTION OF LEARNING IN MOOC**

In the social construction of learning, communication and effective interaction are key elements. In theory, openness and scale of MOOCs can promote interactive dialogue that facilitates group cognition and the construction of knowledge [19]. It is difficult to say that in most MOOCs students learn to communicate to develop collective knowledge, this because the MOOC usually run in a short period of time, which does not easily encourage community spirit [31]. Moreover, in new educational environments is also necessary to examine the validity and scope of existing theories, because you can not neglect the wealth of research and evidence on the effectiveness of teaching methods, evaluation systems and itself the construction of knowledge, and the features of it to be a real learning, ie having the requirements of appropriation by the student, attribution of meaning and transfer [33]. Therefore, build socially learning through the MOOC involves demonstrating significant learning and prove them through social learning assessment.

Focusing on practices that construct socially the learning in alternative educational environments is a priority requirement because the pedagogical design of the MOOC is undoubtedly one of the most important elements in order to optimize learning outcomes [28]; results that can be measured with learning outcomes which are reached by the group of participants [24]. In fact, for e-learning communities achieve synergy effect learning is required to incorporate appropriate pedagogical models and have technological tools to develop and share knowledge [12]. The MOOC are usually based on the instructivist, behaviorist, cognitivist or constructivist pedagogy however, in most cases, students are not treated as sources of knowledge but as recipients or as builders of knowledge in the best scenario [14] and therefore we do not really know how to extract indicators for the assessment of learning [3]. Hence, challenges presented in these training environments to verify in them the social construction of learning and therefore its possible evaluation.

In this sense, provide students with the knowledge of a learning partner allows them to exchange knowledge; for example, on the basis of a cooperative learning task participants become aware of peer learning, where students with less knowledge will be motivated to increase their participation in the response to the knowledge of a learning partner who has more knowledge [27]. Consequently, understanding and management of this interaction have the potential to improve the exchange of knowledge among peers.

The contextual framework of this article are the MOOC, scenarios with a large volume of users thanks to its character open, participatory and online. Considering that, access to Internet and broadband have increased rapidly and the enormous growth of mobile connectivity particularly in the developing world has brought online content and interaction on a global way [32], it is conducive analyze practices for social construction of learning through MOOC offered by the binational Laboratory for intelligent management of energy sustainability and technological training of Mexico.

Laboratory, among other things, promotes the formation of talent related to the energy sector and the conversion of talent to support implemented through MOOC as entitled: The new electricity industry. Participating institutions with this project look for the generation of educational content that masifiquen and democratize access to information from the concept of energy and its efficient use by applying innovative educational techniques that transform traditional learning models [10].

#### 4. ASSESSMENT OF SOCIAL LEARNING

Collaboration and communication tools (forums and wiki) appear to facilitate learning itself and the development of learning skills. In this sense, the tasks related to learning by doing (planning, construction, design, proposing) in turn facilitate learning by discovery (search, questioning and exploration) and allow evaluation as a form of reflection and improvement (self-assessment, evaluation peer), so students develop learning skills based on their participation and responsibility through teamwork [16]. It follows that one of the methods for the evaluation of social learning would be one that leads to the analysis of moments where collaboration and communication in virtual environments as ways to build learning emerges.

It is important to mention that, when conducted the search for information related to the assessment of learning, significantly related secondary studies were not identified. However, the unsystematic literature that is of interest to investigate how the students perceive their learning group in terms of the relevant dimensions of social interaction, which opens a way to analyze if support strategies in virtual environments are effective in stimulating social interaction and if they develop skills to complete the task. This is an issue that has not yet been investigated [23] therefore, here one can see a conceptual vacuum and it is mentioned in studies by other authors.

#### 5. METHODOLOGY

A previous step to make this work was to carry out an initial exploration through the literature review, to identify existing secondary studies in the field [5]; for this reason it became an automatic search for the first six months of January 2016, in the following electronic databases: Scopus, ISI Web of Knowledge,

ScienceDirect, Google Academic. For this study, information articles published from 2010 to date, were extracted; however, the relevance of the contribution to the subject two documents were considered in 2006. The methodology works in the sense of acting judiciously, so sharp discriminating the most interesting ideas and negatively evaluating those that add little [26]. And [5]: The inclusion criteria was:

Items with an objective focused on the field of open and collaborative innovation.

Publications addressing an action, an initiative, a role model or a meaningful experience for the social construction of learning.

The articles that explain the social construction of learning through Massive Open Online Courses MOOC - like training environment for open and collaborative innovation.

The publications show strategies and activities within the MOOC to facilitate communication and interaction among participants in achieving learning.

Exclusion criteria were:

Articles that demonstrate the social construction of learning, but do not through the MOOC.

Publications, even when they have the social construction of learning through MOOC and do not show information on strategies or activities to carry out communication and interaction.

Publications dealing with MOOC but outside education, particularly the construction of learning.

The variables involved in this study are:

**Social construction of learning:** conceived as the construction and maintenance of cooperative efforts necessary for individuals to develop the skills necessary to manage individual and social level [22]. It is understood as a social construction of learning connections through communication and interaction arise in a social learning environment. To demonstrate the construction of learning is necessary to resort to the evaluation of social learning, in this context, comprises a process of analyzing information for decision-making, but with a social perspective [9].

**Open and collaborative innovation:** open innovation involves a process that makes more the use of internal and external knowledge in organizations [7]. In the open innovation model, companies market ideas in order to generate value for the organization [6]. Hence, it is understood as open innovation value-added research, such as the formulation of innovative strategies for social learning assessment.

**Communication practices in MOOC:** provide for the creation of communication systems, websites or documents of group writing, online discussion forums, chat rooms and videoconferencing who need educational strategies to promote learning [13] where it is expected that students actively contribute to the development of the curriculum through conversations, discussions and interactions [11]. Therefore, communication practices as the basic processes are understood to carry out the social construction of learning.

**MOOC practices interaction:** where social interaction through dialogue is in the center of knowledge construction practices; however, at present, much of the social dialogue is mediated by ICT, connecting individuals, groups and communities that share and promote communication and learning objectives [13]. In this context, it is understood the scenario of interaction practices as part of a collective creation of learning where each participant is

able to acquire the knowledge that is shared to build socially learning through collaboration.

## 6. RESULTS, DISCUSSION AND CONCLUSIONS

### 6.1 Results

Communication and interaction among participants of a MOOC are important elements that facilitate social learning; these elements are developed through collaborative activities such as forums, wikis or peer evaluation.

The results derived in which variables are communication and interaction. The results ensure that there is a need to propose a new organizational method for the evaluation of social learning.

These results are made based on the search for latest information, hence a greater number of items of more recent years by 2016 and is seen as part of this study:

**Table 1. Relationship between the year of publication and the number of articles analyzed.**

Publications of articles	Number of items corresponding to the indicated year
2006	2
2010	3
2011	2
2012	4
2013	5
2014	7
2015	7
2016	3
Total items	33

The following summary table presents the results of the search for literature and translate search results to a common measurement made:

**Table 2. Results search**

General terms	Theme of the article reviewed	Number of items reviewed by theme	Variable of research in article identified
Open innovation	Innovation	2	Open and collaborative innovation
	Open innovation	7	
	Open knowledge	1	
	Technology for education	1	
Social learning	Distance learning	1	Social construction of learning
	Instruccional design for new training environments	1	

Social learning: Multidisciplinary learning groups	3	
Communicative practices in the digital era	2	Communication practices in MOOC
Cooperative and collaborative learning in virtual environments	5	MOOC interaction practices
Teaching and learning through MOOCs	8	
Methods for the evaluation of social interaction	1	
Methodology: Literature review	1	Methodology
TOTAL:		33

### 6.2 Discussion

In the world of open innovation, collaboration becomes the key factor that adds an orientation to generate links within open innovation teams. In managing open innovation, skills required by a professional will lead to the generation of new knowledge, reliability and mutual commitment within the team [18]. Work teams, academics and professionals involved in this field rethink the design of innovation strategies where basic skills are combined, collaboration and Internet [21]. Consequently, the development of skills to work with a genuine collaborative approach gives prominence to the value itself is already open innovation.

Thinking about how to facilitate the social construction of learning leads to the analytical review of the elements that should be harmonically involved an educational process. Because the time period within which runs a MOOC is relatively short, it is not easy to promote community spirit [31]. However, authentic learning, student ownership, allocation and transfer direction are generated, to the extent that the efficiency of teaching methods, evaluation systems and construction of knowledge [33] evidence. Therefore, if you want to reach students with a training action, and in particular socially constructing learning, promote communication and interaction, etc, it should take special care to comply with its function all components, strategies and activities that integrate and give meaning to this training activity.

The issue of assessment of learning is essential to be addressed when we talk about an educational process. In this sense, the tasks related to learning, more than facilitate learning itself, allow focus to the evaluation, whether self-assessment or peer review as a form of reflection that leads to the improvement and development of learning skills based on participation and responsibility through teamwork [16]. Investigate how students perceive their learning group in terms of social interaction opens a way to analyze

whether support strategies used in virtual environments fulfill their role in promoting social interaction [23]. Hence, this study is the gateway for an analytical review of the social construction of learning through massive open online courses and reach an organizational method for the evaluation of social learning.

### 6.3 Conclusions

This paper provides evidence from a theoretical foundation on open innovation in education through the use of massive open online courses, (MOOC for its acronym in English), and how, from collaboration and interaction of its participants, there is the social construction of learning and possible evaluation.

An open innovation strategy, with long-term vision requires a comprehensive intervention where the company and academia join forces, especially its human talent to allow innovation to be sustainable, in this specific case, sustainability issues energy.

Open innovation is a concept that has attracted much attention, both in practice and in academia because the concept fits well with many of the trends in the broader field of management.

Participants of massive open online courses (MOOCs) can be considered first and foremost builders of knowledge and generating social learning rather than mere recipients of knowledge.

MOOCs may promote the interactive dialogue, which facilitates cognition group to share knowledge and build learning

The knowledge shared in a virtual learning environment is a source of motivation among students less knowledge with those of greater knowledge.

A good opportunity to analyze the social construction of learning are the MOOC that promotes CONACYT -SENER project through the binational Laboratory for intelligent management of energy sustainability and technological training.

Through the research it can propose support strategies that are effective in promoting social interaction in virtual learning environments.

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