# Proposal por the implementation of a massive open online course (MOOC) with the open EdX platform for the Computer Engineering Career of the UNED, Costa Rica

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## ABSTRACT

The demand for computer engineers has grown considerably and in the Computer Engineering Career of the School of Exact Sciences, of the Distance State University (UNED), which it's population has grown a little over 3000 students.

It is for the foregoing that it is considered that by implementing a Massive Open Online Course (MOOC) in the Career, will allow offering training and knowledge on current and important topics, in a more agile and fast way, that facilitates the means and the needs of the students who want to adapt to these types of learning.

Furthermore, the objective of this article is to propose the implementation of a MOOC for the Computer Engineering Career, using the JAVA programming language and an edX platform.

Also, there is a review on MOOCs characteristics, practical issues and the experiences of the accessible implementation that were experienced of this proposal. At the end, the conclusions satisfy the importance of the user-centered design for the accessible work and the necessity of having clear objectives to avoid desertion

**Keywords**: MOOC, edX, accessibility, courses, UNED, Java.

## 1. INTRODUCTION

The Distance State University (UNED) is considered as the first option by young people who finish high school, which requires that some changes have to be made in teaching methodologies that are used.

The characteristics of the UNED students have varied according to the time passed. At this moment, the young population is imposed, and the female population. On occasion, the term that prevails in the university was heard, since they are the ones that are graduating in greater numbers and those that select the university as their alternative for higher education.

At the same time, being a younger population, they already come with the installed technology chip, so the way of providing education has also had to vary to some extent.

From there, the online or hybrid subjects have arisen. The latter because they combine traditional components of distance education with technological resources.
This is why, despite the fact that an online learning platform such as Moodle has already been used for the teaching of career courses, in its hybrid and virtual modalities, it is considered necessary to use a free and open platform for short courses and beginner's courses that introduce to more complex topics, both for students and for the general population.

A survey was also developed, consulting how familiar they were with the definition of MOOCs, to which many of the students responded having a basic knowledge of their existence, but that they consider that it can be a very convenient tool for online learning.

This research was carried out with the objective of proposing to the university the implementation of a free and open platform of courses, known as MOOC to support the process of construction of student learning, specifically for those of the Computer Engineering Degree.

In relation to the above, MOOCs rely on the use of ICTs, which according to Ríos (2017) quoting Cruz, et al 2016) constitute a means to promote knowledge to a very broad public in an open and free way through the Internet use [6].

The main objective of this investigation, it is shown how a basic Java programming language course can be implemented that complies with the rules of web accessibility and implemented in a MOOC platform using edX.

## 2. METHODOLOGY

The methodology used is descriptive – explanatory [1] since descriptive research is used because it analyzes the current situation, about the needs that are required to implement an accessible MOOC.And it is explanatory, because it is

proposed to develop techniques to improve the experience of students who access the course.

The objective is to propose the implementation of a MOOC in the Computer Engineering Career, in order to offer courses of introduction to complex subjects that are developed in other courses of the career in the beginning, then offer another series of courses that could be useful and of interest to the national and international population, without age restrictions, disability or any other.

Next, the development of the investigation is described.

### 3. ¿WHAT IS A MOOC OR COMA?

It is important the definition of MOOC, that according to the Training Center in Distance Education (CECED), of the Universidad Estatal a Distancia quotes as: "MOOC is the acronym in English of Massive Online Open Courses" or Massive online courses and open according to their translation into Spanish. [4]

The University of Nebrija (2016) defines it as "virtual courses". In turn, in Spanish they have been called Cursos Online Masivos en Línea (COMA):

Continuing with the University of Nebrija in its framework document "Teaching methodology and for learning for MOOC courses", it defines the following characteristics that it must possess:

**Massive**

Designed for an unlimited number of students (in principle), in which anyone who would like to enroll/register could do so.

**Open**

Hosted on a platform of free Access (under registration) and free (without taking into account the possible formal certification). In addition, the resources /content are published in general, under Creative Commons licenses.

**Online**

Online access and remote monitoring. It is possible to register from anywhere in the world (global access) through powerful technological platforms, prepared to support a high volume of students.

**Course**

Course structure and sequence, orientation towards learning. [13] (p. 5).

The question arises at this moment, where do these virtual, massive and open courses come from?

According to the Center for Communication and Pedagogy, its origins go hand in hand with two phenomena:
1.  The rise of content published in open and especially the Open Educational Resources.
2.  And Open Social Learning. [5] (par. 6).

That is to say, that it can be affirmed following the same line of the Communication and Pedagogy Center, that "since 1999 when the Massachusetts Institute of Technology (MIT) launched its OPenCourseWare project", online courses with teaching material with free and open content, it can be reused, as long as the author's appointment is respected.

Hence the tendency of many universities, in the UNED, to use online learning platforms or Learning Management System in English (LMS). [5] (Par. 7)

competitive alternatives in the edition and delivery of content, as well as support products. [11]

According to Acon y Cañipa (2017), when they establish the need for technology in distance education: pointing to Garcia (1987), who quotes a José Luis Garcia Llamas:

Distance education is an educational strategy based on the application of technology to learning without limitation of place, time, occupation or age of students. It involves new roles for students and teachers, new attitudes and new methodological approaches. [2] (p. 2)

That is to say, that the previous definition can be applied to the UNED because the online learning platform MOODLE is currently used as Learning Management System (LMS) in which the subjects with virtual or hybrid component are taught, and the use of subject-oriented pedagogical mediation.

The difference between a learning platform or LMS as UNED uses to teach its courses, and a MOOC is that the latter is to impart open and free resources, which can be reused, as long as the author or authors are cited. Another big difference is that a MOOC is available to anyone who wants to acquire knowledge without having to be a UNED student.

Also, Ríos (2017) comments accessibility as: Tim Berners Lee defines accessibility as: "The art of ensuring that, as much as possible, facilities (such as access to the Web) are available to people, whether or not they have deficiencies of one kind or another. "(Lee, 1999). [11]

Which means that, the MOOC would be providing access to sectors of the population as long as they have a computer and access to the Internet, regardless of their age, which in turn supports Web Accessibility.

As it is already known, the Training Center in Distance Education (CECED) of the UNED, has a MOOC platform where some of its courses are taught such as: Didactic strategies for individual learning, Development of didactic resources with technological support, Collaborative learning didactic strategies for online courses.

So the question is, why, if there is already a platform for free and open courses, is it necessary to propose an equal platform, but for the Computer Engineering Career?

To answer this question, it is important to indicate that the idea is not to offer the courses offered by the Career, such

as intermediate programming, which is done using the JAVA programming language. The idea is not to give the course itself, but some bases, examples and resolution of algorithms, in an introductory course to facilitate the delivery of teaching.

At the same time, that same introductory course would be available to the population not only national, but worldwide, who would like to take the course, since they are not limited.

In this sense, it is valid to rescue what Ríos (2017) indicates in relation to:

MOOCs must contemplate the elimination of technological barriers that do not allow accessible education processes to be properly completed. This requires the analysis of various techniques, and the development of educational content oriented towards virtual education, considering that technologies present

It is for the exposed, that then proceeds with the proposed implementation of a MOOC for the Computer Engineering Career

## 4. MOOC PROPOSAL

To make a proposal to implement a MOOC, there are several steps to follow, among which the following is considered:

### ¿What is required to install a MOOC?

A technological platform is required: that according to Ríos (2017) citing (Delgado, Andrea et al, 2013) is "a set of hardware and software created by innovative technology companies designing creative applications, unique and increasingly accessible to the user". [11]

According to Nebrija, most authors agree on defining two "macro categories", the xMOOC (they are Massive Open Online Courses integrated in "commercial" platforms) and cMOOC (the connectivism Massive Open Online Courses). (Siemens, 2012, cited by Nebrija, 2016) [13].

It is important to highlight the difference between them, cMOOC according to Nebrija, they are designed under the principles of connectivism. In turn, Siemens (2012), cited by Nebrija (2016) indicates that the focus is the creation of knowledge by students, creativity, autonomy, social learning and collaboration. (p.11)

On the other hand, according to Ríos (2017), quoting Moya (2013, p.166) the xMOOCs "are highlighted by the presence of short videos linked to other forms of self-assessment as content transmission material". [11]

That is to say, for the implementation to be carried out in the Computer Engineering Career, xMOOCs are considered more useful, because of the independence in learning that provides the resources that will be used.

The platform that is suggested to be used to implement the MOOC is Open edX since, according to Ríos (2017), "it

satisfies the best way, to be able to develop changes on it to reach the desired level of accessibility". [11]

### ¿What is required to implement Open edX?

The edX platform for free and open courses is a bit complicated, but it has the benefit that you can vary the code and make modifications if necessary to create an accessible MOOC. There are different ways of working with this tool, from contracting a direct service with a supplier [8] to using the tool considering different versions (master for those who want to enter the newest code directly or release, which are stable versions and already tested) to different installation methods. The same open edX site indicates the following installation methods (Batchelder, 2018):

**Devstack o developer:** An installation with Vagrant is used, which is useful if you want to modify the open edX code.

**FullStack o full version:** a version in Vagrant, which imitates a production environment.
  **Native**: it is an automated form of installation on an Ubuntu machine.
**Manual**: you are on your own, using scripts as a guide.

**Bitnami**: Installable pre-pack of images for the most popular platforms in the cloud. [3]

For effects, of the tests that were carried out in this pilot plan to include the course that we proposed, it has worked with the version Devstack, considering that it was necessary the modification of the code. However, the Open edX tool is highly configurable, therefore, it has not been necessary to modify the code, but to maintain high standards in the implementation.

The edX platform has several components (Pereira, 2013):
- LMS: Learning Management System
- CMS: Content Management System (also known as edX Studio)
- Forum: discussion forums [10]

According to the OpenSai manual (OpenSai, n.d.), the hardware needed to run OpenEDX, is:
- Ubuntu 12.04.5 LTS (Precise Pangolin)
- Minimum 4GB RAM
- CPU a 2.00 GHz minimum
- 25GB free hard drive
- 50GB recommended for production servers [9]

On the other hand, the official page of openedX suggests the following hardware (Mulloy, 2018):
- Ubuntu 16.04 amd64 (oraclejdk required). It could be thought that other versions, would work correctly but it is not like that. Only 16.04 is known to work.
- Minimum 8GB of memory
- At least one 2.00GHz CPU or one EC2 computer unit
- Minimum 25GB of free space, 50GB recommended for servers in production [7]
- For hosting on Amazon, a t2.large with at least

50GB EBS is recommended. The Amazon Linux AMI is a maintained and compatible Linux image offered by Amazon Web Services. By default, it has 8 GB in its root directory, so it is advisable to expand it before installing.

For the purposes of the development used in the pilot plan platform, the version of Ubuntu 17.04 was used with an 8 GB of memory, a hard disk of about 20 GB and the same one not virtualized. It works without problems, but it remains in consideration of those in charge of the implementation, if you want to use your own server or an EC2 type server like the ones offered by Amazon. In addition, it is convenient to make tests using the native version, since it would allow developers to have more facilities to control the code. However, if necessary the application of stress tests, and the configuration of the application server, especially to take into account the performance in production environments.

It is important to point out that the versions that use Vagrant, make use of virtualized server. This has the limitation that a virtualized server cannot be used on another virtualized server. Which is an important measure, if we are going to have our own virtualized server.

**Generating an accessible MOOC**

The development of an accessible MOOC under an edX platform requires the use of tools for the generation of subtitles and the inclusion of meta descriptions that can be read by voice assistants. Another important point is to consider the design and structure of the pages to be accessible and observe the usability principles of the W3C and WCAG 2.0. [12] [14]

Below are some figures as an example of how a course would work on an edX platform in a MOOC for the Computer Engineering Career. To do this, a main page is staged with three courses, an internal one divided into modules and an evaluation tool.

It is important to clarify the difference between the MOOC to be offered by the Career and the courses that are currently given in the university Moodle or LMS.

1.  The courses of a MOOC are short, direct and easy to understand.
2.  They do not seek to qualify, but to provide information and useful knowledge.
3.  They will open to the general population.
4.  It does not require any payment, since they are free and open, that is, they can be reused, as long as the author is cited.
5.  Certificates of participation or knowledge are not issued.
6.  The main idea is to provide basic knowledge on some complex topics, for example, JAVA, Operations Research for Engineering, among others, which will provide basic examples and simple explanations.

**Figure 1. Implementing a MOOC**



Figure 1. Ríos, 2017

In Figure 1, a main page of a MOOC is observed, which offers the Java course presentation.
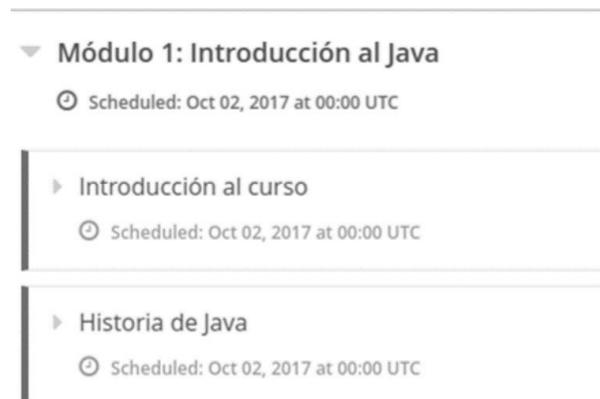
**Figure 2. Administration of a course**



Figure 2. Ríos, 2017

In Figure 2, a Java course divided into modules can be seen through the edX platform.

**Figure 3. Evaluation instrument in edX**

## Quiz: Historia de Java

(2 puntos posibles)

## Quiz 1

Cómo se le llamo inicialmente a Java?

- ◉ Javac
- ◉ Coffe
- ◉ OAK
- ◉ Desde su inicio se llamó Java

?

Una ventaja de Java es

- ◉ Es muy parecido a C++
- ◉ Solamente puede ser usado en Windows
- ◉ es un lenguaje que evoluciona a mucha velocidad
- ◉ Es multiplataforma

?

**Figure 3. Ríos, 2017**

In figures 1, 2 and 3, it is exemplified how the basic Java course is offered implemented in a testing platform, using edX in which 3 courses are offered: edX demonstration course, Test Course and Fundamentals of Programming in Java.

The main objective in a first stage is to offer free courses related to the career but not considered in the subjects. That is, simpler subjects as introductory.

In a second stage will proceed to provide courses, not necessarily related to the subjects of the career, but rather issues of popular demand, including Internet of Things (IoT), Robotics, Arduinos, Electronics, for example.

## 5. CONCLUSIONS

The advantages offered by emerging technologies to create MOOCs with accessible features are available and are mostly free. This would be a benefit that the university would offer to students and the general population, on courses that are not necessarily subjects from the career, but also on other topics of interest.

There are many universities and educational institutions that have begun to use and experiment with this teaching model. In Spain, the UNED has dared with its own version: UNED COMA, which allows it to have its own platform of online courses for all public and to be accessed, at any time, which will eliminate many barriers related to the time and with the evaluation.

It has been shown that the pace of learning adapts to the student, who decides what to do and when. This flexibility of schedule leads to several people with different professions and tasks: workers, students, housewives, among others, allow them access to these courses.

This option of the MOOC, seeks to provide to the people that is interested in particular topics and that cannot attend class or cannot connect at certain times, have the possibility to accommodate their time, once they have completed other tasks. In addition, when dealing with online and free education, the only truly important requirement is to have an interest in the subject that is going to be offered.

Geographical and economic barriers are eliminated. Although there are specializations for certain MOOCs if they have a certain cost, but always trying to maintain a standard that meets the needs of students.

Another great advantage is the globalization of these courses. You can attend classes and have access to materials prepared by top-level experts. Many of the professors who teach these courses on high-profile platforms belong to universities of great international prestige. All with their particular programs. We must consider that the UNED, of Costa Rica is part of that select group, as a first world university that offers 100% virtual courses.

## 6. RECOMMENDATIONS AND FINDINGS

The MOOCs or COMAs are an evolution of distance education towards virtual and another great step will be taken when they are recognized within the official degree system. Encourage the use of other techniques in the platforms created for this purpose, adapting the use of gamification.

Some studies related to the use of gamification have been revealed as a technique to help people to achieve the objectives and achievements of a course, and can be an important source to avoid the desertion, which is a highly risky factor of this modality.

Likewise, in the study of these activities we cannot forget the user-centered design, and the accessibility that is a common good for all users. Request support from the authorities to support this research, turning it into a permanent project of constant training.

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