Redesign of a pilot international online course on accelerator driven systems for nuclear transmutation to implement a massive open online course

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INTRODUCTION

In April 2013, a full-distance international pilot course on ADS (Accelerator Driven Systems) for advanced nuclear waste transmutation was taught by UNED-CIEMAT within FP7 ENEN-III project [1]. The experience ran with 10 trainees from the project, using UNED virtual learning platform aLF. Video classes, web-conferences and recorded simulations of case studies were the main learning materials. Asynchronous and synchronous communication tools were used for tutoring purposes, and a final examination for online submission and a final survey were included.

This summary presents a project to recast the pilot course on ADS for a Massive Open Online Course (MOOC) environment. MOOCs are large-scale online courses where thousands of participants may assist for free. In the mainstream practice, multi-week series of video lectures are facilitated and discussion on critical issues from that field are promoted in forums. Every participant is able to self-organize, to share and discuss the course material.

Collaborative learning and peer-to-peer support is enhanced in MOOC type courses, a quite recent and valuable tendency regarding higher education. Since 2008, MOOCs are being developed by the most prestigious universities in the world, through platforms like Coursera, Udacity, EdX, Khan Academy, etc. UNED also joined this worldwide movement, being at present the Spanish university with the widest catalogue of MOOCs, also available at OpenUpEd, the European MOOCs platform [2].

In our case, the introductory nature of the pilot course and the availability of most of its learning materials for an open web scenario make it an ideal candidate for a MOOC.

The growing interest for attracting personnel to staff the new positions that are arising in the nuclear arena [3] contrasts with the lack of open courses on nuclear engineering. An extensive search of open educational resources developed at the initial phase of the project has shown this situation.

These arguments moved us to redesign the initial ADS course into a MOOC, implementing also the lessons learned.

REDESIGNING THE COURSE

Course description

The learning process is conducted asynchronously, but a module of learning material is made available each week for study and homework exercises. The course covers a four-week period, each week containing around 70 min video lectures, self-assessment exercises and simulation analysis activities. This approach mimics a classroom course rather than a self-paced one.

The contents remain as in the pilot ADS course: basics, the source, the reactor, kinetics, dynamics and the role of ADS in the fuel cycle. We describe the main learning materials:

1) Video lectures. We have available from the pilot course 7 thirty-minute long videos with very dynamic slides. We have designed the partition of these videos to have small 5-10 min clips, adapted to MOOC methodology.
2) Recorded simulations of various case studies using Mathematica guided by the instructor´s voice.
3) An interactive application based on CFD (Mathematica free downloadable tool), exploring full solutions that describe the behavior of critical and subcritical reactors.
4) Additional readings, consisting of opensource articles and presentations targeted to create rupture points in order to make chapters more dynamic.
5) Self-Assessment quizzes. To help the student probe his/her understanding of the material, the platform allows to insert multiple choice quizzes. According to standard formats on MOOCs, we have set up a ten-question quiz

for each chapter and three for the number of attempts the student can make.

6) New study guides with indications to cover the basic knowledge and the knowledge related to each lesson are provided, based on the bibliography for the initial pilot course.

Interaction and Communication

To stimulate a collaborative environment, several discussion forums are available; with a structure defined by the teaching team, and threads defined by the students. The original teaching team is replaced by: a) facilitators, in charge of the follow-up of the course and the support to solve the most important problems or doubts, since the participants are promoted to learn between them, in order to diminish the educational burden of work, and b) curators, experts within the teaching team, called by facilitators for the hardest questions.

Discussion forums are essential in the learning process; they help to transform the course from passively watching lecture-oriented videos to actively engaging in learning-oriented dialogue teachers-students, providing also a meaningful dialogue between students to share doubts and deepen collective understanding of the material.

Chat rooms at designated times are scheduled for synchronous communication with the teaching team.

Evaluation of the learning outcomes acquisition

In the MOOC design the evaluation is being redesigned [4], as a much larger number of students is expected and this should be taken into account trying to avoid interaction between them to fulfill the examination.

In addition to the final on-line test based on multiple-choice questions, that makes testing easy to deliver and grade automatically, the new concept of peer assessment by letting the students grade each other's assignments and tests, is introduced in our MOOC design. In our case, two activities with peer-to-peer evaluation have been designed. Peer assessments leverage a grading rubric to help students to assess others reliably and provide useful feedback. The platform also employs a form of crowd-sourcing, in which multiple ratings are combined to yield a meaningful score.

Course evaluation

A final anonymous survey similar to the pilot case one may be filled out in the platform by participants, in order to get as much feedback as possible from them.

We are also designing a more complete survey of the whole process, from the questions to fill before the beginning of the course, and through surveys in each chapter, to follow expectations and achievements for each chapter of the course. In a broader approach, Learning Analytics will be extensively taken into account to document the learning process.

MOOC Learning Platform

An extensive survey of the existing platforms for MOOC courses has been made, and UNED COMA platform has been chosen for this particular design.

UNED COMA is the platform on which the MOOCs elaborated by UNED teachers are taught. As most of the platforms for MOOCs, UNED COMA meets the characteristics that define these courses: open, freely accessible materials on-line, high performance for huge volume of recurring access, and cope with safety restrictions for internet browsing.

CONCLUSIONS

MOOCs are a key trend for the next future in higher education as they can give support to new XXI century educational needs, such as lifelong education [5].

Converting a more traditional on-line course into a MOOC implies key changes in dynamics, forcing the expert team to come up with new approaches and ideas. Redesigning course materials, activities and interaction ways is just part of the work to be done. Perhaps, the major challenge to face is the assessment, where grading rubrics need special consideration.

The MOOC sustainability may be achieved by:

- Flip-teaching: used prior to face-to-face classes, mainly with good multimedia material, so these can concentrate more on solving problems or team work (learn by doing philosophy)
- Enlarging the knowledge about nuclear energy in the world, specially about Transmutation, coping with the need to "nuclearize" society.
- Being a part of a more extensive international course, like a Master's Degree, promoting students to attend.
- Serving as a pilot case MOOC in nuclear to gather experience and extend this tendency in the field
- Certification payment for an on-line exam and/or face-to-face exams in chosen locations (researched also by other MOOC platforms around the world)

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REFERENCES

[1] M. Alonso-Ramos, E.M. González Romero, A. Sánchez-Elvira, F. Ogando, J. Sanz, "Filling a Gap in the Field of Gen IV Nuclear Reactors E&T by Using Distance-Teaching Tools: the Development and Implementation of a Pilot Full-Distance Course on ADS Systems in the Framework of FP7 ENEN-III Project". NESTet2013. Madrid, 19-21 nov 2013. http://www.euronuclear.org/events/nestet/nestet2013/transactions/nestet2013-gap.pdf. Multimedia presentation: http://www.canal.uned.es/serial/index/hash/a9b7ba70783b617e9998dc4dd82eb3c5 password: nuclear

[2] C. Rodrigo (2013). "The role of MOOCs in Open UNED". European Association of Distance Teaching Universities (EADTU), The Open and Flexible Higher Education Conference 2013: "Transition to open and on-line education in European universities". Paris, 24-25 oct 2013

[3] "Nuclear Education and Training: From Concern to Capability", OECD 2012, Nuclear Energy Agency (NEA).

[4] How MOOCs Are Changing the Way People Learn. http://distancelearn.about.com/od/isitforyou/a/How-Moocs-Are-Changing-The-Way-People-Learn.htm

[5] L. Johnson et al. "NMC Horizon Report: 2013 Higher Education Edition", The New Media Consortium, 2013. http://www.nmc.org/pdf/2013-horizon-report-HE.pdf