Innovating nuclear engineering education and training through open and online culture

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IV. Conclusions and future work
• Largest university in Spain (more than 200,000 students)

• 43 years of distance education experience in higher education and life long learning

• Leader in the application and research of forefront technologies for teaching and learning (e.g. LMS developments, AVIP technology, mobile learning apps, virtual and remote laboratories, serious games, etc)

• Digital contents production (TV, radio, Internet broadcast, etc)

• Local centers (62 national and 15 abroad) and widest offer of virtual courses in Spain

• Pioneer in OER in Spain (OCW, OPEN UNED, MOOCs platform, digital repository). Awarded by different organisms (OW Consortium, Miriadax)

• EADTU quality label
Research Areas

- Remote and online Labs
- Mobile and ubiquitous learning
- Biometrics in evaluation
- Augmented Reality
- Education Technology Trends
- Learning Objects / OCW / MOOCs
- Virtual Assistants
- QR Codes
- Serious Games
DIEEC DEPARTMENT (Researches)

➢ Remote Labs

➢ Biometrics in Evaluation
DIEEC DEPARTMENT (Researches)

- Augmented reality

- Learning Objects
DIEEC DEPARTMENT
(Researches)

➢ Education Technology Trends
DIEEC DEPARTMENT (Projects)

**IN-CLOUD.** Innovation in Universities and Businesses - Erasmus+ Strategic Partnership nº 2015-1-IT01-KA202-00473


**GoLab** - Global Online Science Labs for Inquiry Learning at School Programa FP7: Acción de investigación - FP7-ICT-2011-8 - Project number 317601
## DIEEC DEPARTMENT (Projects)

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<td>Asesoría en Tecnologías Educativas y Gestión del Conocimiento</td>
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© Go-Lab Project - Global Online Science Labs for Inquiry Learning at School
Co-funded by EU (7th Framework Programme)
MOOC Platforms

- Miriada X: 2 MOOCs
- UNED Abierta: 2 MOOCs
- unX: 3 MOOCs
- WePrendo: 3 MOOCs

Main features:
- Spanish speaking countries
- Videos
- Communication between students
- P2P evaluation
- Community + social gamification (Karma, badges)
- Content collaboration
MOOCs in Miríada X

App development and entrepreneurship with App Inventor

• April 2015 – June 2015
• Mobile development for users without technical knowledge for Iberoamerica

Augmented Reality App development and entrepreneurship with Vuforia

• April 2015 – June 2015
• Innovative Augmented Reality apps for unemployed people in Spain
MOOCs in UNX

App development and entrepreneurship with App Inventor
• October 2012 – June 2014
• Mobile development for users without technical knowledge for Iberoamerica

App development for STEM teachers with App Inventor
• October 2013 – June 2014
• Mobile development for STEM teachers without technical knowledge for Iberoamerica

Augmented Reality App development for STEM teachers with Vuforia
• October 2013 – June 2014
• Innovative Augmented Reality apps for STEM teachers in Spain
MOOCs in WePrendo

P2P communication for App development and entrepreneurship: AllJoynt
- September 2013 – June 2014
- Mobile apps with P2P communication

App development and entrepreneurship through context-aware services:
- September 2013 – June 2014
- Mobile development with context-aware services

Augmented Reality App development and entrepreneurship with Vuforia
- May 2013 – June 2014
- Innovative Augmented Reality apps for unemployed people in Spain
MOOCs

Open data practical course: Business opportunities linked to open data
• October 2012 – December 2013
• Research about Open and Linked Data

Electronics experimentation with a remote laboratory (VISIR)
• April 2013 – June 2014
• The first international MOOC published with a remote lab.
• Experimentation with real analogue circuits through the Web using a remote lab for electronics.
UNED Nuclear Engineering part of the Power Engineering Department

- Engineering Education
  - Bachelors
  - Masters
  - Doctorate studies

- Nuclear Engineering Research activities
  - TECF3IR research group led by Javier Sanz www.tecfir.com
    - Activation and neutron analysis studies mainly in fusion applications
    - Computer developments and applications for nuclear analysis, activation
    - Analysis and applications to safety, waste management and
    - Radioprotection analyses in the nuclear field
    - UNED main researcher in over 40 national and international projects and
    - Responsible of the development of ACAB activation code
    - Currently is leading several activities within Fusion for Energy, ITER IO,
    - And EUROfusion (Euratom/Horizon 2020), some in the frame of the
    - Safety Program for DEMO.
  - Innovation in nuclear engineering ETI activities
    - Group coordinated by Mercedes Alonso
Our approach in the context of nuclear education

• The need of a highly effective communication, mainly in issues concerning nuclear safety culture, demands a new approach in education, training and information (ETI) activities.

• Open Course Ware (OCW) and Massive Online Open Courses (MOOCs) could be very helpful for the dissemination in nuclear engineering, especially regarding the extended nuclear phobia in our society.

• Online and blended learning can be spread to cover special training needs nationally and internationally

• Nuclear Knowledge Management is a very relevant topic, and very much related to education, so we are also working in this direction to have a broader view of the educational needs

We are gathering UNED very valuable expertise to bring education innovation to the nuclear engineering field
Early approaches to online courses and MOOCs

- Online pilot course on ADS systems in collaboration with CIEMAT within the 7th Framework Program of ENEN.

  Access to the open video of the presentation in NESTet2013 (psw: nuclear)

- Redesign the pilot course on ADS Systems into a MOOC.

  Access to the open video of the presentation in IYNC 2014
Early approaches to online courses and MOOCs

• A MOOC for the medical doctors sector, addressing safety culture in all types of nuclear activities including security applications, was offered during the 2nd stakeholders meeting of FP7 NUSHARE Project.
MOTIVATION

To shorten the knowledge gap between nuclear specialists and the general public promoting knowledge development about the field through **open online educational contents**

Nuclear Safety Culture improvement

European Union Objectives
Open learning in Nuclear Engineering: State of the art
OPEN ONLINE COURSES ON NUCLEAR ENGINEERING

UNED: Extensive search on open educational resources

Scarce offer of OER and open courses on nuclear engineering
Two MOOCs in Nuclear Engineering

Pittsburgh University

Access to the general information about the MOOC
Access to the actual MOOC in its FutureLearn platform

The new MOOC from Open University The Science of Nuclear Energy started 23 May 2016
Access to the open video of the presentation:

"MOOCs in Nuclear Engineering – Challenges and Opportunities"


Access to the 3 presentations on Digital Learning for XXI Digital Learners

1st part: The role of digital technologies in the modernization of Higher Education in Europe

2nd part: e-learning and digital learning: current perspectives

3rd part: What can we do?
Actual Guidelines

- **A MOOC in a H2020 Project**: Specialized MOOC within H2020 ANNETTE European Project led by ENEN.
- **Fukushima Accident MOOC**: Informative and basic MOOC about Fukushima Accident for the general public.
- **Educational Innovation in Nuclear Waste Transmutation**: International online course on nuclear waste transmutation to be implemented and tested by nuclear engineering students of an UNED’s Masters Degree.
- **Nuclear Knowledge Management Course**: Knowledge Management Course for professionals of nuclear organizations.
- **Open Courses Database**: Catalogue of nuclear engineering open online courses.
Project within H2020 led by ENEN: ANNETTE

• The aim of these courses is to strengthen the required competences for achieving excellence in Nuclear Safety Culture
• Production of a specialized modular MOOC focused on Nuclear Safety Culture
• Materials will be elaborated in collaboration with TECNATOM
ANNETTE WP5, e-learning and OPEN education
Work Package 5: ETI Actions related to Nuclear Safety Culture

• To provide the knowledge, skills and attitudes necessary to value safety as the most important aspect in nuclear activities.

• Production of MOOCs on nuclear safety culture which will have the objective to disseminate the contents of selected courses, thus reaching a wider public.
UNED & Tecnatom contribution

A MOOC in Nuclear Safety Culture
UNED participation in ANNETTE WP5

• Training for MOOC development (curators and facilitators)

• Methodological and technical assistant on MOOC contents, activities and assessment elaboration

• MOOC hosting and facilitation

• MOOC accreditation design and quality assurance
UNED participation in ANNETTE WP5

1. Training ANNETTE members involved in MOOCs development in OER / MOOC methodology: A MOOC-style course to design a MOOC

I. *Current basis of online teaching and learning methodology*

- Current trends in HE training and e-learning support
- Enriched learning environments mediated by technologies: new E&T scenarios
- The role of OER and MOOCs in HE

II. *How to design a MOOC*

- Selection of MOOC type
- Competences and Learning objectives
- MOOC structure: Modules
- Orientations and guidelines
- Learning materials I: videos for MOOCs
- Learning materials II: Searching and elaborating other multimedia materials
- Learning activities, both individual and collaborative ones
- Online evaluation: self-evaluation, online exams, peer-to-peer- evaluation
- Badges and MOOC accreditation and certification alternatives
- Participants’ support roles: curators and facilitators
2. Technical assistance for MOOC implementation and start-up in the MOOC platform

3. Training of ANNETTE members involved in the MOOCs to make use of the MOOC platform and its tools

4. Design of ANNETTE MOOCs’ accreditation and certification system

5. Implementation of ANNETTE MOOCs quality assurance system and evaluation under OpenUpEd benchmarks (OpenUpEd is the first, and, thus far, the only pan-European MOOC initiative. It was launched in April 2013 by EADTU in collaboration with the European Commission)
Fukushima Accident OCW to evolve to a MOOC

• A dissemination course about Fukushima Dai-ichi accident in OCW and MOOC versions.

• The objective of this course is to provide relevant information about the accident to the general public, explaining each event, the international reaction as well as the lessons learned.

• Any person could take the Fukushima Accident course, since it does not have any specific requirement.

• Also, additional materials will be available for any student with a technical or specialized background in order to make the course more interesting for them.
PLATFORMS
Motivation

• The great impact of Fukushima Dai-ichi accident in public opinion and in the media
  
  The information given in the media is not precise
  
  Information is sometimes polarised

The dissemination of nuclear knowledge in a mainstream environment to deal with the nuclear phobia
Course objectives (I)

To deliver the most relevant information about the accident:

- Giving a context to the accident
- Explaining each of its phases
- International reactions
- Lessons learned

- To reach the biggest possible audience:
  - Without previous requisites
  - Interesting also for technical or specialised personnel
Course objectives (II)

- Evolve towards a MOOC (Massive Open Online Course)
  - Online open course:
    - Web
    - Mobile learning:
      - Smartphones
      - Tablets

Fuente: 437
Course Contents (I)

Unidad Didáctica 1: La energía nuclear. Centrales

Unidad Didáctica 2: Contexto y antecedentes

Unidad Didáctica 3: El accidente nuclear
Unidad Didáctica 4: Consecuencias radiológicas y medias de protección.

Unidad Didáctica 5: Recuperación tras el accidente

Unidad Didáctica 6: Impacto del accidente y lecciones aprendidas
Course Structure

- Modular structure with 6 thematic units
- Study guide
- Initial and final survey
- In each thematic module:
  - ✓ Mini-Videos
  - ✓ Reference reading material
  - ✓ Complementary Material
  - ✓ Auto evaluation questionnaire
Course Structure

The learning process is adapted to ones path
- Recommendation: 1 week for each thematic module (6 weeks)
- Estimation of 1 credit ECTS (25-30 working hours of the participant)

- Possibility of UNED certification
- Exams with identity accreditation may be taken at national and international UNED Associated Centres

https://2aed3853f5130d242c336b494a6c36be0b0374e3.googledrive.com/host/0B-w-lBluX8fmt0N1hQblqvbF1pUUU1Z1hlUHFHS005S2lZZV9xUGY0VTMweDZ1RldDQ1E/index.html
Previous Pilot test experience for a first evaluation of the OCW course

- UNED´s Program of research networks for education innovation “Redes de Investigación para innovación docente”
  - Students of the subject: Basics on Nuclear Engineering in the degrees:
    - Ingeniería en Tecnologías industriales
    - Ingeniería Mecánica
    - Ingeniería Eléctrica
  - Voluntary participation
  - 1.5 additional ECTS credits

Objective of the evaluation

- Testing the contents of the open online course
- Development of new material in a collaborative way
  - Some optional more technical contents
  - Look for errors in the media regarding the accident to explain the facts in the correct way
- Evaluate for the nuclear engineering students:
  - Horizontal competences
  - The assimilation of the contents
  - The motivation generated
Conclusions (I)

An objective view of the subject by means of an open educational resource following MOOC philosophy

• The use of new tools and methodologies for education allow:
  ✓ A valuable contribution for the general public
  ✓ An excellent starting point to strengthen links between experts
  ✓ Encouraging the creation and co-creation of educational materials
Conclusions (II)

• We are searching for partners who want to participate in the production of a future MOOC

• We invite experts to collaborate in the testing of the contents that will be developed during the course evaluation process
Access to Fukushima OCW course
A pilot international online course on nuclear waste transmutation to be implemented and tested on a subject of UNED’s Master in Industrial Engineering

• The main objective is to test the pilot online course in a University related subject, as well as to improve the course evaluation methodologies to assess this experience.
<table>
<thead>
<tr>
<th>Activities</th>
<th>Duration</th>
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<tbody>
<tr>
<td>Watching videos and studying their PowerPoint presentations</td>
<td>15 hours</td>
</tr>
<tr>
<td>Studying additional materials</td>
<td>10 hours</td>
</tr>
<tr>
<td>Studying simulations and doing simulation tasks</td>
<td>5 hours</td>
</tr>
<tr>
<td>Forum participation</td>
<td>2 hours</td>
</tr>
<tr>
<td>Web conferencing assistance</td>
<td>4 hours</td>
</tr>
<tr>
<td>Final exam</td>
<td>1 hour</td>
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Tab 2. Course Activities within the Industrial Engineering Master subject
Knowledge Management Course for Nuclear Organizations

• An online course to develop the skills in the knowledge direction and management in the context of the nuclear sector organizations.

• The target group of the course are professionals from the nuclear organizations interested in organizational issues and, mainly, those ones of this sector who require flexible continuing education.

• The active participation in the learning process via the forums is key in the course.
• Study Guide

In each thematic module:

• Introductory video
  A first contact with the module subject with a nearer contact to the teacher
  https://canal.uned.es/mmobj/index/id/45849

• Video by an expert from the nuclear sector
  To know the real experience in relation with the subject of the module
  • https://canal.uned.es/mmobj/index/id/46501 (interview to Mikko Merikari STUK Regulatory body Finland, in english)
  • https://canal.uned.es/mmobj/index/id/46499 (interview to Didier Louvat Director of ENSTTI international nuclear training organization, in spanish)

• Readings (module material)
  Tuned to what the nuclear sector need to know

• Forum (specific questions)
  Centred in important subjects, so the readings can guide profound reflexions

• Exercise (sequentially linked between the 4 modules)
  At the end of the course this part in the different modules will configure a global exercise

• Evaluation test (reinforcing)
  To go over the key concepts
Additionally, we have special tools for online courses:

- **UNED aLF Learning Management System, with all its functionalities (MOODLE type)**

- **Additional networking resources: Blog, video channel (community)**
  - Video channel: to have a reference of all the knowledge videos that we are generating in the course
  - A place for all the community interested in NKM
    - The interested people who have made the course may keep connected
    - The interested people who are going to follow the course
    - All those interested in NKM
EVALUATION AND TUTORING ACTIVITIES
• The only university course on KNM in Spanish

• **Innovation in nuclear education with the use of ICT**
  - Flexibility
  - Active and participative learning
  - Networking

• **Practical for every organization**

• The implementation of NKM initiatives as a business objective

*We try to generate a better situation regarding NKM in the nuclear sector*
Access to UNED webpage

Access to the course learning platform

Access to the course open blog

Access to the open UNED Chanel with the course videos
Open database with the main available online open nuclear engineering educational resources

• A database including all nuclear online open courses worldwide, in English language, to provide guidance for the interested public.

• New tools and methodologies, like Data Mining, Semantic Web, are being evaluated to create this metadata indexed catalogue in the near future.
IN-CLOUD
Innovation in Universities and Businesses
Erasmus+ Strategic Partnership nº 2015-1-IT01-KA202-00473

DIEEC (Electrical and Computer Engineering Department)
UNED (Spanish University for Distance Education)

Manuel Castro (UNED)
Sergio Martín (UNED)
Mercedes Alonso-Ramos (UNED)
María José Albert (UNED)
Belen Moriñigo (UNED)
A methodology for the recording of videos in Computer Science MOOCs

1. The initial standpoint
   - The learning outcomes. What is the use of a video in a MOOC?
   - What material resources and other means we have?
   - The profile of the person recording the video regarding
     - Instructional design knowledge
     - Audio-visual production knowledge
     - Body language and voice awareness. How is your character?
     - Motivation, etc.
     - The design of the narrative structure. What do I want to explain?

2. The script
   - Means, tools and techniques to use
   - A stop in the way for creativity and to enhance motivation. The personal input
   - Harmonizing the script with the tools

1. The recording of the video
   - Do I need to be an actor to make a good video for a MOOC?
   - Timing and iteration
   - Rehearse and rehearse to be able to improvise
   - I try to find someone to look at me
   - First recording
     - The place and the position
     - One or more persons
     - The interview format
     - Lighting
     - The background
   - Feedback. Are the learning outcomes achieved?
   - Repeat if needed. Take care to keep fresh!

Annexes to the Guide: depending on the profile of the “producer”
Conclusions and future work (I)

- A contribution to a new educational approach in nuclear engineering in order to encourage other organizations to shift the traditional paradigm, and to innovate their teaching and learning methodologies, as done in many other knowledge fields, by incorporating online programs and different educational proposals based on the use of OER.

- These new proposals go in the direction of reducing ETI activities costs, specially difficult and expensive in the case of some nuclear engineering topics, usually taught in face-to-face sessions. They also allow the growth of dissemination activities among the society.

- Regarding bringing the general public closer to nuclear knowledge, OCW and MOOCs proposals are an excellent option thanks to their massive nature and cost effectiveness, and the flexibility that allows society to make compatible family and work responsibilities with achieving a reliable information and education in nuclear fields.

- These new teaching and learning methodologies are not only making significant contributions for the general public, but also they may become an excellent platform for networking activities to strengthen the links among expert personnel in different topics of study, and to enhance the education and the communication for the creation and co-creation of educational materials.
Conclusions and future work (II)

• These research guidelines encourage an open collaborative spirit. The spirit of listening follows the win-to-win theory. They are an ingredient for the change within the nuclear sector, enhancing the transparence, the communication, the ability to listen to criticism, etc., in order to establish a change in the communication in between stakeholders, and between the general public and the experts. This contributes to enhance nuclear safety culture, which is in the core of the sustainability of nuclear energy and the nuclear sector.

• Connected to these previous opportunities, the innovative concept of co-creation of contents through online collaborative tools, and the experience of nuclear engineering students participating in this kind of proposals, allow presenting the production of new contents as a new educational trend in the field.

• Finally, testing these activities by the students is also a new idea to apply to nuclear engineering education. With the integration of collaborative tools and methodologies as “pilot experiences” within regular courses, a wide search on open educational resources can be done in a reliable and complete way, likely increasing students’ motivation and engagement with their studies.
Conclusions and future work (III)

Innovative scenarios applied to education in a specialized, complex and no massive area of knowledge, such as nuclear engineering, are clearly necessary. In this sense, we agree with OPEN UK experts’ recent report with the idea that “Social learning is not just a means of sharing learning resources, but a valuable activity in itself. Learning together creates a ‘shared mind’ that combines different perspectives and alternative ways to solve problems” (Sharples et al, 2014), a relevant issue facing XXI century difficulties and challenges in the nuclear
Open video of the presentation:

“Sustainable education in nuclear engineering in a changing world:
The role of open education (as MOOCs) and blended learning”
Thank you so much!!