DEVELOPMENT OF THE ERASMUS+ BLENDED LEARNING TRAINING MODULE 'MARAWAS: MANAGEMENT OF RADIOACTIVE WASTE'

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ABSTRACT

The Erasmus project 'Blended learning in radioecology and radiation protection' started in Sept 2015 with 8 academic partners from the CHERNE (Cooperation for Higher Education on Radiological and Nuclear Engineering) network in collaboration with a regulatory body and research institute. The total project consists of the development of 12 ECTS 'distance' learning activities offered in 6 modules on the project platform and the organisation of 12 ECTS 'mobility' training activities offered in 6 themes. In the framework of this Erasmus+ project, UHasselt (Diepenbeek, Belgium) organised a training school in Management of Radioactive Waste 'MaRaWas' in November 2016.
Twenty students, 3th bachelor and master in nuclear engineering of six project partners, registered for this course. The module comprised a five days training module with lectures, experimental sessions, technical visits and a round table discussion dealing with radioactive waste in different aspects and contexts. Pre-training and tasks were offered using a separate module on the blended learning platform of the project in order to distribute a study guide and background course material, subjects for group tasks and practical information. The enrolled students were divided in groups of 4 students of at least 3 different nationalities. Next to the specialised radioactive waste management skills, communication, collaboration, networking and team building between students with different backgrounds in knowledge, skills and competences were hereby achieved.

1. Introduction

The Council of the European Union adopted on 5 December 2013 the Council Directive 2013/59/Euratom, laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation [1]. Member States have to transpose this new revised Basic Safety Standards Directive (BSS Directive) into their national legal systems by 6 February 2018. The future effectiveness of the regulated practices of this directive depends upon the well skilled and trained workers in the different fields as radiation protection experts (RPO) and radiation protection officers (RPO).
Article 4 of the directive defines RPE(73) and RPO(74) and under the chapter IX 'General responsibilities of member states and competent authorities and other requirements for regulatory control', RPE and RPO tasks are summed in articles 82 and 84 respectively. But no guidance in terms of education, training and experience levels are specified which can allow still a great flexibility by the member states upon implementation.
However, large efforts are made on both European and national levels in several networks and projects to elaborate the directive formulations into clear but comprehensive guidelines which should allow harmonisation and mutual recognition among the member states. HERCA (Heads of the European Radiological protection Competent Authorities) set up a special Task Force 'Education and training in RP' in November 2012 [2]. For RPE, they analysed the applicability between HERCA members of the procedure developed by ENETRAP for the benchmarking of national E&T on RP. For RPO, they made a new survey

on the current RPO requirements in the different HERCA member states. In their RPE/RPO workshop in Paris 2015, high expectations were formulated towards the ENETRAP III guidance as reference and tool for harmonization for RPO and RPE education and training requirements [3]. It was concluded that a common approach based on this guidance should be encouraged both for the implementation or updating of educational syllabi in universities and for the implementation and development of ongoing training for RPE and RPO. March 2016, ENETRAP III provided an extensive report as guidance for regulatory authorities and professional bodies on the roles of RPE and RPO, which specifies the knowledge, competences and practical skills of both [4]. The member states can use it as guidance in the development of their own specific training and recognition processes depending on their own legislative and educational frameworks. Waste management is listed as competence 21 in the basic training module 3 of the European reference training scheme proposed by ENETRAP III with two activities: 1) manage waste for an operation and 2) manage waste generated during decommissioning; and in the specialised module 5 'Waste and decommissioning'.
Waste management is an important economical factor in all processing industries especially for radioactive or radiological contaminated waste streams. RPEs are therefore confronted with nuclear waste management in very different contexts. The first step in nuclear management is the minimization, classification and quantification of hazardous levels and waste volumes during operation. Next step is the local short term storage and preparation for transport to a waste treatment facility and finally the conditioning and final disposal at the waste facility plant. Furthermore, the waste itself is very divers leading to different treatments, different exposure routes, different national legislations, … Organising a specialised training school in waste management for master students from different European partners of the CHERNE (Co-operation in Higher Education on Radiological and Nuclear Engineering) network was therefore a challenge. In this paper the first attempt in the framework of an Erasmus+ strategic partnership is proposed and discussed in detail.

2. Organisation

CHERNE is an open European academic network for co-operation in higher education on radiological and nuclear engineering. The goals of CHERNE are:

- to share competencies and facilities in organising teaching activities for their students, mainly at the Master level,
- to enhance the mutual support by learning from each other, by exchanging experiences and by regular mutual reflections.

CHERNE was founded in 2004 and since then 16 international projects were organised, mostly with European grants and more than 300 students could follow teaching activities in specific nuclear topics and at specific nuclear facilities enabled by the partnership. New activities are announced on their website http://www.cherne.ntua.gr/ .

The current Erasmus project 'Blended learning in radioecology and radiation protection' started in September 2015 for 2 years with 8 academic partners

- HAUTE ECOLE BRUXELLES BRABANT - BELGIUM
- UNIVERSITEIT HASSELT (UHasselt)- BELGIUM
- FACHHOCHSCHULE AACHEN (FH Aachen) - GERMANY
- UNIVERSITA DI BOLOGNA(UNIBO) - ITALY
- UNIVERSIDADE DE COIMBRA - PORTUGAL
- CZECH TECHNICAL UNIVERSITY IN PRAGUE(CUT) – CZECH REPUBLIC
- NATIONAL TECHNICAL UNIVERSITY OF ATHENS(NTUA) - GREECE
- UNIVERSITAT POLITECNICA DE VALENCIA (UPV)- SPAIN

in collaboration with the GREEK ATOMIC ENERGY COMMISSION – GREECE, a regulatory body, and THE NATIONAL RADIATION PROTECTION INSTITUTE (SURO) – CZECH REPUBLIC, a research institute. In this blended learning project, 'distance' education activities are developed and offered in 6 modules (2ECTS/module) on the E-learning platform (**http://edu.eeae.gr/**) in combination with one week 'mobility' training activities

offered in 6 different themes (2ECTS/week). The modules developed on the E-learning platform support the face to face learning activities in the training schools making it possible to reduce the actual mobility to 1 week. Nevertheless, extra modules can be added to the platform with dedicated content for the activities or practical information of the training school. In November 2016, the 'MaRaWas' (management of radioactive waste) training school was organised at Hasselt University (Diepenbeek, Belgium).

3. Marawas Trainingschool

3.1 One week training school: program of Marawas

Management of radioactive or radiological contaminated waste involves many different aspects. Organising a one week training school implies therefore the selection of specific activities which are specialised in one particular subject or which reflect this diversity. The latter was opted for the first edition of MaRaWas. Furthermore, students participating in an international training school have very different backgrounds in knowledge, skills and competences and the training school needs to set the framework for an optimal exchange of knowledge and collaboration between the different actors.
A key challenge that needed to be tackled specifically for a one week training school was to organise an efficient training without much time for introduction lectures and labs. On the other hand, the 2 ECTS of provided training needed to reflect a study load of about 60 hours which goes beyond a one week face to face learning activities. To achieve this goal, the practical sessions were linked to the developed e-learning environment in different ways. Firstly, an answers to questions session provided additional guidance on questions regarding the electronic study guide and the provided background material which had to be studied in advance. Secondly, divided in groups, the students needed to collaborate before the intensive training week in preparing a dedicated assignment on risk management. This assignment was to prepare a small paper that after feedback should be presented during an interactive round table session. The advantage of this approach was also that the members of the different groups already interacted before the training session which facilitated the collaboration during the training school.
The final program (figure 1) comprised a five days training with lectures, practical sessions, technical visits and, as mentioned, a round table discussion dealing with radioactive waste in different aspects and contexts. Due to the higher security level nowadays the practical organisation and registration for the training school had to be started more than 4 months in advance, even before the start of the academic year. Especially for the technical visits a lot of administration had to be fulfilled to get access to the facilities for students and teachers.

3.2 Practical organisation

Twenty students, 3th bachelor and master in nuclear engineering of six project partners, registered for MaRaWas. They were divided to obtain mixed teams of 4 students with at least 3 different nationalities. Figure 2 presents a selection of pictures taken during the different activities.
As discussed before, the first day started with an answers to questions session in which students got feedback on questions they formulated in advance during the pre-training phase. Followed by a session of short presentations of PhD research linked to waste management. 5 supervisors helped the teams of students with three practical half day exercises in the labs:

- decontamination and waste management in a radiochemistry lab
- portal monitoring and intervention training
- reuse of NORM in the production of geopolymers

Monday	Tuesday	Wednesday	Thursday	Friday
Arrival in Diepenbeek Welcome Answers to questions Phd short presentations	practical exercises a, b, c	Technical visit : Belgoprocess : waste management Tecnubel : lecture - demo decontamination techniques	Technical visit: portal systems in several industrial settings (medical/ waste/scrap/…)	Preparing reports and oral presentations
21-25 NOVEMBER 2016				
practical exercises a. Decontamination lab b. Detection portal c. NORM2geo-polymers	practical exercises a, b, c	Technical visit : Euridice - Long term waste management Exhibition and underground laboratory Hades	Lecture of Niras Presentations and discussion of topic in round table : Waste managment in different EU countries Social event	oral presentations and Evaluation practical exercices : Erasmus + members Farewell drink

Figure 1: Program of 1 week training school MaRaWas-2016

Next, the students visited different waste treatment facilities near Mol. At Belgoprocess, they could see how different types of radioactive waste are treated and conditioned and how temporary storage for Belgian radioactive waste is organised. Tecnubel demonstrated their services in the total maintenance and cleaning up of nuclear and non-nuclear facilities, the rehabilitation of the surrounding sites, but also in the decontamination, dismantling of certain components. And at the site of Euridice, they visited the exhibition and the underground research lab Hades and learned about the feasibility of long term storage of high level waste in Boom clay formations at a depth of 225 m. The last technical visits on Thursday morning were focussed on the on-site monitoring of waste in order to prevent radiological contamination at a hospital and at a steel production plant. Thursday afternoon started with an invited lecture of an expert of NIRAS (National institute for radioactive waste and enriched fissile materials) which covered in detail the Belgian radioactive waste management. Afterwards the students presented their topic of the round table. 2 weeks in advance, the teams were asked to submit a small paper on an assigned topic:

- Stakeholders in the medium and long term storage of radioactive waste
- On site waste management and monitoring in hospitals
- Waste management in university labs (on site) across Europe
- Transport procedures of radioactive waste to a treatment facility
- Approaches for the management of NORM waste in EU

The papers were evaluated by 2 separate reviewers selected among the home institute professors. Feedback was formulated to improve their presentation and the round table discussion. The round table was attended by 2 experts, professors of the partner institutes, all students which resulted in a critical reflection on the topic from many different aspects beyond the technical ones, like ethical, public perception, differences in regulation…

Finally, on Friday, the students presented the results of one of their practical sessions. The final mark for each team of the training school was based on the evaluations of the paper, the round table, the presentation and performance in the practical sessions.

Figure 2 : Actvities in MaRaWas

4. Critical reflection

The evaluation of this training school can be done from different perspectives. The students highly appreciated the practical exercises and technical visits, the expert lecture at the round table and the social event. The use of the e-learning module to prepare certain activities using the study guide and background documents was evaluated as helpful and made it possible to reduce the real mobility to one week of intensive activities. Only the preparations of the topic for the round table could have been more efficient if the instructions were more elaborated, especially because the students didn't know each other yet. The practical organisation asked a lot of work in advance but was an overall success. The guidance of the training activities was accomplished thanks to the efforts of many colleagues, external experts at the technical visits and round table. Due to this close guidance a much lower students/tutors ratio was accomplished than possible in normal courses. Nevertheless, this intensive program with different training activities in such multinational and multidisciplinary group of students would not be possible otherwise and a financial support is certainly needed. Moreover, the financial support of this training school by Erasmus+ and University Hasselt not only facilitated the mobility and hosting of the students. Also the cost for the organisation of the activities (labs, technical site visits, social event,…) were covered. For future organisation without the financial support, a fee needs to be asked from the participants next to their mobility cost.
During this week, the individual student teams and the entire group became more close and some of them decided to attend also future training modules in the scope of this Erasmus project. The aims of this training school was not only to enlarge their knowledge and skills in

nuclear waste management but also to obtain competences in collaboration before and during the course, in English communication, team work and networking. For sure these students experienced the differences in nuclear training among different partner institutes and appreciated each other qualities.

5. Acknowledgements

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6. References

[1] Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom. Official Journal L-13 of 17 January 2014.

[2] http://www.herca.org

[3] http://www.herca.org/herca_news.asp?newsID=46

[4] Richard Paynter, Joanne Stewart, Annemarie Schmitt-Hannig, Michèle Coeck, Antonio Falcao, 'European Guidance on the Implementation of the Requirements of the Euratom BSS with respect to the Radiation Protection Expert and the Radiation Protection Officer', March 2016 available on http://enetrap3.sckcen.be/en/Workpackages/WP7