

European Network on Education and Training in Radiological Protection (ENETRAP) – New concepts and new tools for an ERPC

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Abstract

The ENETRAP project is a coordination action supported by the EU FP6 Programme (contract number FI6O-516529, April 2005-March 2007). The overall aim of ENETRAP is to determine mechanisms that in the longer term will facilitate better integration of education and training activities (with a view to mutual recognition across the EU) and to ensure the ongoing provision of the necessary competence and expertise at the level of the Qualified Expert. In a number of work packages strategies are developed to better harmonise the often largely different approaches to education and training in terms of technical content, duration, level, content and duration of practical work periods, etc. and to mutually recognise the qualification acquired in other European countries. The objectives of ENETRAP will be reached by a number of distinct activities, to be carried out in several work packages (WP). One of the tasks of WP 5 is to evaluate the e- and distance learning technologies, capabilities and methodologies, providing the pro's and contra's of the existing tools. Currently, a free platform based on MOODLE is chosen which in principle should allow all partners a cost free access. At this moment the platform is working and one module is running in a test phase.

1. Introduction

The ENETRAP project aims to establish a sustainable Education and Training (E&T) infrastructure for radiation protection as an essential component to combat the decline in expertise and to ensure the continuation of the high level of radiation protection knowledge. This infrastructure needs to offer both the initial training (“Education”, knowledge based, in general provided by the universities to students) and the continued maintenance of appropriate competencies (“Training”, usually provided by research and training centres, on all aspects of radiation protection and at all levels).

The main objectives of the ENETRAP project are:

- to better integrate existing education and training activities in the radiation protection infrastructure of the European countries in order to combat the decline in both student numbers and teaching institutions;
- to develop more harmonized approaches for education and training in radiation protection in Europe and their implementation;
- to better integrate the national resources and capacities for education and training;
- to provide the necessary competence and expertise for the continued safe use of radiation in industry, medicine and research.

These objectives are achieved via the establishment of a European-wide E&T network.

2. New concepts and new tools for a European Radiation Protection Course (ERPC)

The objectives of ENETRAP will be reached by a number of distinct activities, to be carried out in several work packages.

- WP1 Implementation and co-ordination of ENETRAP
- WP2 Assessing the training needs and capabilities within the EU Member, the New Member States and the Candidate States
- WP3 Recognition of and diplomas
- WP4 On-the-Job Training (OJT) programmes
- WP5 New concepts and new tools for an ERPC
- WP6 Comparison of the current ERPC syllabus with IAEA E&T modules and EU requirements
- WP7 Validation of the results and recommendations for a pilot course
- WP8 Establishment of a consortium of universities

In WP5, modern educational tools will be evaluated, such as distance learning. To this end, the feedback from the previous deliveries of the ERPC will be examined, with regard to its content and its methodology but also concerning its feasibility. In addition, a review will be carried out on the evolutions, approaches and methodologies aiming to provide education and training in radiation protection [6]. Attention will be given to existing distance learning packages and contacts established with the IAEA Inter Centre Network. This WP is coordinated by CIEMAT, INSTN and BfS are collaborating partners.

One of the tasks of WP 5 is to evaluate the e- and distance learning technologies, capabilities and methodologies, providing the pro's and contra's of the existing tools. Concerning the e-learning methodology, which can be defined as the management way of didactical resources in time, place and environment, 3 models were evaluated. Regarding the selection of an e-learning platform, we are proposing a matrix indicating the most adequate platform which can fit the requirements for the implementation and validation of a revised ERPC. Currently, a free platform based on MOODLE is chosen which in principle should allow all partners a cost free access. At this moment the platform is working and one module is running in a test phase. The course methodology is in preparation.

The WP5 objectives are:

- To review the state of art, future trends, and evolution of the e-learning technologies and e-platforms and to explore the pedagogical methodologies concerning open and distance learning ;
- to perform a survey of the new concepts, new training tools, their availability and suitability in the ERPC;
- To investigate the existing electronic tools used in RP E&T at European Universities, Institutions and International Organizations;
- To evaluate the capabilities of e-learning technologies and methodologies providing the advantages and disadvantages of existing tools;
- To propose a matrix indicating the most adequate tool which can fit the requirements for the implementation and validation of the ERPC;
- To increase the quality and the adequacy of the accessibility to these different tools;
- To identify the best learning resources and propose the most appropriate in order to develop one e-learning ERPC module;
- To prepare a pilot session to analyze the possibilities of using e-learning in PR training activities;

3. Methodology

The term open and distance learning (ODL) reflects both the fact that all or most of the teaching is conducted by someone removed in time and space from the learner, and that the mission aims to include greater dimensions of openness and flexibility, whether in terms of access, curriculum or other elements of structure.

In this sense, e-learning is considered as part of ODL, in which new multimedia technologies are used to improve the quality of learning and teaching, facilitating access to resources and services as well as remote exchanges and collaboration.

E-learning is based on material and communication tools through a virtual learning environment, supported by an e-learning platform. It also offers tools to follow the track of students' performance and sometime other tools as glossary, virtual library, searching tool, working group creation, etc.

One of the most important advantages of e-learning is the overcoming of barriers (anytime, anyplace, any pace and any subject). This allows a wider participation with the same standardised material, easily updated which, in most of the cases, decreases learning costs. E-learning tailors individual learning needs. In addition, students are in charge of their own learning steps.

The promotion and implementation of e-learning in the specific field of RP in the European Union, increases the participation because of the easier access to the training (anyplace), the less costs, avoiding travelling and stays, and the compatibility of working and training (any pace, anytime). This wider participation also decreases costs to organiser in a long-term. In addition, e-learning standardises training in all EU, offering the same material prepared by professionals who can be in different countries, and facilitating its updating. E-learning also favours student/professional relationship and experts in the EU.

On the other hand, RP e-learning allows simulations and practical exercises without ionising radiation exposures, which contributes to promote the ALARA principles.

Several EU initiatives aim to create a 'critical mass' of resources to leverage e-Learning development and use. The e-Europe 2005 Action Plan sets its targets on e-learning (market, campuses, grids...). E-learning is also among the objectives of the Information Society Technologies (IST) programme, which is part of the EU Research Framework Programme.

4. Evaluation of modern educational tools

ENETRAP WP 5 (New concepts and tools for a European Radiation Protection Course) tries to encourage a strategy and implementation plan in order to adapt the RP education and training to e-learning methodologies, stressed on identifying the best learning resources for the ERPC. In order to prepare the basis to execute a pilot session run, based on e-learning, an evaluation of the capabilities of e-learning technologies and methodologies, providing the pros and cons of the existing tools, has been carried out. This study was performed in two ways:

- 1) evaluation of e-learning educational models or methodologies (the method of management didactical resources in time, pace and environment); and
- 2) evaluation of e-learning platforms to indicate the most adequate one which can fit the requirements for the implementation and validation of the ERPC.

E-learning educational models

E-learning educational models can be grouped in three general models:

- A) VLE based on the elaboration, management and distribution of didactical content, including basic communication tools.
- B) VLE based on communication and teaching-learning activities, which includes didactical material management tools.

- C) Virtual management systems of Human Resources or Academic Communities, which include training tools, having their objectives a graterer scope than simple training.

Table 1 shows the most important tools and properties of the e-learning educational model B.

Table 1: Tools and properties of the e-learning educational model B

DIDACTICAL MATERIAL TOOLS	COMMUNICA-TION TOOLS	STUDENT TRACK-TOOLS	OTHER TOOLS	GLOBAL PROPIERTIES
WBT	e-mail	% Platform use	Help	Access Control
e-books	Telephone	Evaluations	Search	Disability Assistance
Files (pdf, doc, ppt, etc)	Chats	Exams	Links	Standard Compatibility
Videos (avi, etc.)	Forum	Exercises	Virtual Library	Antivirus and Worm Scam
Executables (exe)	Advertisements Table		Notebook	Security Copies
e- blackboard	Distribution List		Personal Web Site	Previous Training for Trainers and Trainees
Videoconference	Videoconference		Working Group Creation	
...	...		Progress Control Auto evaluation (trainees)	
			Send and download Files to Server	

E-learning platform analysis:

An e-learning platform consists of a specific software designed to support course, management and online communities in a secure and scalable manner by means of a modular architecture.

During this first period of ENETRAP, different platforms have been studied in order to guess which one could fit better to ENETRAP objectives. Two groups of platforms were considered:

- 1) free or open source platforms, available in internet, which are updated by a very active and dynamic community of users and developers. This is the case of MOODLE and ATUTOR.
- 2) commercial platforms as: ORACLE e-learning (ORACLE), QS-TUTOR (SATEC), IDT(DOMÈNECH S.A) E-TRAINING (ENCYCLOMEDIA) and others.

In order to obtain the most appropriate platform to fit ENETRAP needs, it was necessary to analyse certain aspects and compare them among all the studied platforms. Some of these aspects are: functionality, architecture, course organisation, design possibilities, communication tools, files management, Multilanguage possibilities, assessment tools, methodological resources, multimedia resources, also compatibility with other platforms, use and access conditions, necessary requirement, cost and security. Table 2 shows the most relevant characteristics of each platform.

Table 2: Characteristics of analysed e-learning platforms

N°	PECULIARITIES	DISADVANTAGES
1	<ul style="list-style-type: none"> - human resources: educational itineraries; training virtual groups - evaluative tools: random generator of examination tests 	<ul style="list-style-type: none"> - cost high - installation time: high
2	<ul style="list-style-type: none"> - compatibility: integrated with a tool qs-author to create scorm courses - contents: multimedia objects and contents formatted as html 	<ul style="list-style-type: none"> - cost : high
3	<ul style="list-style-type: none"> - contents: didactic units, exercises, glossaries, exams, ... 	<ul style="list-style-type: none"> - cost: high
4	<ul style="list-style-type: none"> - contents: easy way to design a course - cost: acceptable 	<ul style="list-style-type: none"> - concurrency: limited - Multilanguage module: still in developing
5	<ul style="list-style-type: none"> - interface: simple and intuitive - concurrency: unlimited - compatibility: scorm - statistical tools: register of learners access - multilanguage module: 34 languages - contents: multimedia and html format - evolution: groups of developers - resources: multiple educational resources 	<ul style="list-style-type: none"> - edition of contents: difficulties - maintenance: none - course administration: None - documentation about administration and use: limited
6	<ul style="list-style-type: none"> - compatibility: scorm - multilanguage module: package for 13 languages 	<ul style="list-style-type: none"> - contents: No multimedia possibilities

Among the commercially available platforms (1-4 inc.) and free or open source platforms (5-6 inc.) analysed were:

1. ORACLE I-LEARNING MANAGEMENT SYSTEM (ORACLE)
2. QS-TUTOR (SATEC)
3. IDT (DOMÈNECH S.A.)
4. E-TRAINING (ENCYCLOMEDIA)
5. ATUTOR (UNIVERSITY OF TORONTO, CANADÁ)
6. MOODLE (UNIVERSITY OF TECHNOLOGY OF PERTH, AUSTRALIA)

5. Results

Taking into account the previous considerations, to succeed in e-learning, a careful and sensitive change from traditional teaching to e-learning is necessary. An easy and friendly Virtual Learning Environment is essential. The quality of the learning material is another important point to succeed. A synergy between educators, instructors, designers, curriculum developers, e-learning technologists, etc. is important to prepare the learning material for this specific media. Finally, a high motivation of both trainers and learners is crucial as well as a good communication.

For the specific field of RP, depending on the level, specialization, responsibility and type of training (initial, continuous, etc) of a particular teaching, e-learning can be a solution. For continuous training and training of basic concepts, the first e-learning educational model analysed (model A) could be a good training tool. Students are in charge of their study (self-learning) with multimedia content which can include exercises and evaluations. Sometimes, a tutor can be behind the educational material in order to complement and answer student requires.

In order to train a specific RP practice (new technology, equipment, practice...) e-learning can support multimedia demonstrations and it can allow students to practice without exposure to ionising radiation and expensive equipment.

A combination of both presence and distance learning (blended learning), is the best option for a high level RP training. For the ERPC blended learning should be the best option to offer a high quality, successful and complete training. Therefore, the first e-learning educational model analysed (model A) is too simple and the last one (model C) is too extensive. As a result, model B will be the most adequate for ENETRAP objectives. In this case, teachers and tutors are always connected to the course to follow the learning process and to complement the student's requirements.

As a result of the e-learning platform evaluation, MOODLE, the platform developed by the University of Technology of Perth, Australia, under the Gnu Public license, was the platform chosen. The selection is based on the following features:

- simple and intuitive interface,
- powerful (great number of users),
- plenty of activities for learners, not only related to communication,
- compatibility with SCORM,
- statistical register of learners access,
- Multilanguage package for 34 languages,
- files loading by means of a web interface for teachers and learners,
- creation of html contents directly on the platform
- evaluative tools
- provided freely as Open Source software

Taking into account the previous results, CIEMAT is developing an on-line pilot RP session based on educational model B and supported by MOODLE. This session is being prepared in order to be included in the delivery of a pilot session for a revised ERPC. The chosen topic for the e-module is "Interaction of Radiation with Matter".

The on-line pilot RP session is based on a high quality material, a high level of motivation stressed on the communication tools and a continuous tracking of the student performance through exercises and evaluations.

The content can be followed via internet and it can also be downloaded as PDF format. At the moment, three types of exercises are available: numerical questions, short-answer questions and problems. A calendar with objectives distributed in time has to be well defined.

Some communication tools as forum, chat, email, etc are accessible. A teacher has to motivate and track the learner study. A final evaluation of the knowledge acquired has to be carried out. In figures 1, 2 and 3, the virtual environment and the different tools offered in the developed on-line pilot RP session of the specific matter "Interaction of Radiation with Matter" are shown.

European Radiological Protection Course You are logged in as Miguel Vidal (Log)

e-learning » ERPC Turn editing on

Activities

- Assignments
- Forums
- Quizzes
- Resources

People

- Participants

Online Users

(last 1 minutes)

- Miguel Vidal

Messages

No messages waiting
Messages...

Administration

Topic outline

- News forum
- Download zone
- subject matter in pdf

1 Radioactivity and nuclear physics

2 Interaction Radiation with Matter

- Agenda
- Table of contents
- 1. Introduction**
 - Introduction
- 2. Directly ionising radiation**
 - 2.1 Heavy charged particles**
 - Heavy charged particles
 - Summary2.1
 - Test 2.1
 - Question2.1
 - 2.2 Fast electrons**
 - Fast electrons
 - Summary2.2
 - Exercise2.2
- 3. Non directly ionising radiation**
 - Non directly ionising radiation

Calendar

<< January 2006 >>

Mon	Tue	Wed	Thu	Fri	Sat	Sun
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

■ Global events ■ Course events
■ Group events ■ User events

Upcoming Events

There are no upcoming events.

[Go to calendar...](#)
[New Event...](#)

Recent Activity

Figure 1: Main menu of the pilot session

ENETRAP

Sixth Framework Programme

Directly ionising radiation

Heavy charged particles

- [Introduction](#)
- [Specific ionisation](#)
- [Stopping power](#)
- [Range](#)
- [Practical consequences](#)

2. Directly ionising radiation.

2.1. Heavy charged particles.

This section describes the interaction of heavy charged particles with matter. Like more representative particle of this type, all discussion will use α particle.

2.1.1. Introduction.

It is possible to study the path of charged particles with a so-called Wilson or "cloud chamber". This is a recipient filled with a given gas at a pressure close to its equilibrium saturation vapour pressure. When the gas is locally disturbed by an incoming α particle, local condensation occurs. This provides a means of following the particle's trajectory. This condensation is equivalent to the initiation of cloud formation, hence the chamber's name. When the paths of α particles (or of any other heavy charged particles) are examined in such a chamber, it can be observed ([see Fig. 3](#)):

- that the paths of most particles have the same length in the same gas;
- The α moves mainly in practically straight lines;
- although some paths are distorted near the end;
- Practically none are disturbed at their beginning.

The first property is an indication of the discrete energy distribution of the α particles emitted by a single source. The three other properties indicate that scattering occurs only at the end of the path and is fairly rare. This is due to their high kinetic energy and large mass (of course, in comparison with the electrons surrounding the gas atoms).

The major processes occurring in the interaction between α particles and matter are *ionisation* and *excitation*

Figure 2: Subject matter

European Radiological Protection Course

e-learning » ERPC » Assignments » Exercise2.2

We immerse an electron source in an infinite water tank. This source emits electrons with a maximum energy of 1 Mev.

Estimate the range of the electrons for 5 different energies using the data base BANDRRI.

Select the follow energies: 100, 300, 500, 700, 1000

With the obtained range value

Upload the excel document.

Energy (Kev)	Range (g/cm2)	Range (cm)
100	3,4836986	3,4836986
300	4,1134934	4,1134934
500	4,344455	4,344455
700	4,4784727	4,4784727
1000	4,607168	4,607168

Figure 3: Exercise

6. Conclusions

For the specific field of RP, depending on the level, specialization, responsibility and type of training (initial, continuous, etc) of a particular teaching, e-learning can be a solution.

A strategy plan in order to adapt RP education and training to e-learning methodologies should be carried out taking into account the advantages and disadvantages of e-learning as well as the different RP training. In this sense, initial training and the unceasing maintenance of the level of competencies has to be available with such educational tools.

The promotion and implementation of e-learning in the specific field of RP in the European Union increases the participation because of the easier access to the training (anyplace), the less costs, avoiding travelling and stays, and the compatibility of working and training (any pace, anytime). This wider participation also decreases costs to organiser in a long-term. In addition, e-learning standardises training in all EU, offering the same material prepared by professionals who can be in different countries, and facilitating its updating. E-learning also favours student/professional relationship and experts in the EU. On the other hand, RP e-learning allows simulations and practical exercises without ionising radiation exposures, which contributes to promote the ALARA principle.

- One of the objectives of the European project ENETRAP is to identify the best e-learning resources for the RP education and training in the EU. The ENETRAP Working Group-5 (new concepts and tools for a European Radiation Protection Course, ERPC) is working in this sense and more specifically WP-5 tries to evaluate the modern educational tools to implement the ERPC as Open and Distance Learning using multimedia technologies (e-learning).
- E-learning is overcoming barriers, increasing participation, standardising material, is easily updated, and is decreasing learning costs. E-learning tailors learning to individual needs and students are in charge of their own learning steps.
- Therefore e-learning could be used to develop RP courses offering high quality material and relevant education tools. In addition to this, for the specific field of RP, e-learning

allows simulations and practical exercises without ionising radiation exposures, which contributes to the ALARA principles.

- Depending on the level, specialization, responsibility and type of training (initial, continuous, etc) of a particular RP teaching, e-learning can be a solution, offered as a self-learning with a basic communication tool or as a more complete teaching based on a combination of both presence and distance learning.
- This concept of training is compatible with the Bologna objectives for education and it is also important for the continuous professional development.
- An evaluation of the e-learning educational methodologies and existing e-learning platforms has been carried out. As an example of the e-learning potentialities, an e-learning pilot session focussed on “ Interaction of Radiation with Matter” is being developed with the MOODLE platform. The methodology selected is based on high quality material, a high level of motivation stressed on communication tools and a continuous tracking of the student performance through exercises and evaluations.
- The ERPC session performed by the WP5, in the framework of the ENETRAP project, evidence the real situation of the e-learning possibilities in the specific field of RP. *A combination of both presence and distance learning, (b-learning) is the best option to offer a high quality, successful and complete RP training.*

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