Development and application of a mechanism for the evaluation of training events

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ABSTRACT

Quality assurance and quality control procedures might play an important role to maintain a high level of competence in Europe regarding radiation protection and to facilitate harmonisation and (mutual) recognition of Radiation Protection Experts (RPEs) and Radiation Protection Officers (RPOs). The ENETRAPII project (FP7-EURATOM) aims at developing European high-quality 'reference standards' and good practices for education and training in radiation protection. In Work Package 5 (WP5) the quality issue is addressed. Therefore, WP5 deals with the development and application of mechanisms for the evaluation of training material, training events and training providers by means of a transparent and objective methodology. The results can be used by regulatory authorities to benchmark their national radiation protection training programme and will be communicated to other networks, e.g. EUTERP. This paper addresses the comparison and evaluation of training events (courses and on the job training).

The proposed mechanism consists of two parts, one part for the comparison and evaluation of knowledge based learning outcomes gained in events and the other one for the comparison and evaluation of skill and attitude based learning outcomes gained in events.

The knowledge based events are compared with a descriptive system from 0 (no awareness) up to 3 (detailed understanding). The skill and attitude based learning outcomes from different events can be compared with a descriptive system fulfilled, non-fulfilled. With this mechanism an event can be compared with the standard European Radiation Protection Training Scheme (ERPTS), developed in WP4, to conclude whether an event meets the standard.

Together they form the comparison and evaluation mechanism for training events, where competence, knowledge and skills can be compared with the standard (ERPTS).

Keywords
Mobility, evaluation, training, course, event

1 Introduction

Today's challenges in the field of radiation protection involve measures to make the work in radiation protection more attractive for young people and to provide attractive career opportunities. In addition,

young students and professionals should be supported in their need to gain and maintain high level knowledge, skills and attitude in radiation protection. These objectives can be reached by the development and the implementation of a high-quality European standard for initial education and continuous professional development for Radiation Protection Experts (RPEs) and Radiation Protection Officers (RPOs).

The FP7 European Network for Education and Training in Radiation Protection II (ENETRAPII) project is a specific tool for EURATOM policy for education and training implementation in the radiation protection field. In addition, the project is a tool towards a mutual recognition of professional qualifications.
For the purposes of this project the Radiation Protection Expert can be defined as:
"An individual having the knowledge, training and experience needed to give radiation protection advice in order to ensure effective protection of individuals, whose capacity to act is recognized by the competent authorities."
and the Radiation Protection Officer as:
"An individual technically competent in radiation protection matters relevant for a given type of practice who is designated by the registrant or licensee to oversee the application of the requirement of the Standards".
These are the definitions as proposed during the second EUTERP workshop in Lithuania in 2008. These definitions became part of the draft EURATOM BSS directive [1].
To reach high-quality European standards for initial education and continuous professional development, there has to be an agreement between the European countries concerning the duties and responsibilities of both RPEs and the RPOs. These standards are developed in Work Packages 3 and 4 (WP3 and WP4) of the ENETRAPII project.
As soon as these standards are set, each country will be able to assess and benchmark their own education and training against the European standards. It will also be possible for a country to benchmark the knowledge, skills and attitude learning outcomes of RPE or RPO education or training in another country to their national standards. Shortcomings in education and training events become clear when it is possible to compare national standards of education levels to the European standards. Therefore one of the cornerstone work packages in ENETRAPII is work package 5 (WP5), entitled: Develop and apply mechanisms for the evaluation of training material, events and providers.
This paper addresses the comparison and evaluation of training events. In this document training events are defined to be both courses and on the job training (OJT).

1.1 Boundary conditions for the comparison of training events

To build a comparison system for training events, three boundary conditions were set. These boundary conditions are given and explained below.

- Nowadays learning outcomes are not only knowledge based, but also skills and sometimes attitude based. The comparison model for courses has to deal with all three types of learning outcomes.
- Training events can be followed by students that have different backgrounds. Due to this difference no entrance level can be specified. The comparison model for courses should be used without a prescribed entrance level.
- In the future e-learning will become more and more important in the field of radiation protection. This is one of the types of training and education that cannot be defined by the number of hours of a training event. Therefore the comparison model for courses cannot use the numbers of hours as a criterion to compare courses.

2 A mechanism for the evaluation of training events

Within Europe there are different systems that encourage the mutual recognition of different professions. The European project about European credits for vocational education and training is developed to allow the recognition by a given employer of the education and training received from an employee.
Examples are ECTS (European Credits and Transfer accumulation system [2]), ECVET (European Credit System for Vocational Education and Training [3],[4]), the proposed comparison table for

training material [5] and the underlying table with subjects for radiation protection training in the Netherlands [6].
The IAEA syllabus [7] and the European syllabus [8] in the field of radiation protection training are already reviewed in another paper [5], and will not be reviewed in this paper.

2.1 European Credit Transfer and Accumulation System (ECTS)

The European Credit Transfer and Accumulation System (ECTS [2]) is a standard for comparing the study attainment and performance of students of higher education across the European Union and other collaborating European countries. For successfully completed studies, ECTS credits are awarded. One academic year corresponds to 60 ECTS-credits that are equivalent to 1500–1800 hours of study in all countries irrespective of standard or qualification type and is used to facilitate transfer and progression throughout the Union. The entrance level for students in higher education is secondary school.

The ECTS will be complemented by the European Credit transfer system for Vocational Education and Training (ECVET) which the ministers responsible for vocational training in 32 European countries agreed to develop in the Maastricht Communiqué of 14 December 2004.

2.2 European credit Transfer system for Vocational Education and Training (ECVET)

The European Credit Transfer system for Vocational Education and Training (ECVET [3], [4]) is a European system of accumulation (capitalization) and transfer of credits designed for Vocational Education and Training (VET) in Europe. It enables the attesting and recording of the learning achievement/learning outcomes of an individual engaged in a learning pathway leading to a qualification, a vocational diploma or certificate. This approach is broader than ECTS, since not only high level of education, but all vocational education and training is included.

It enables the documentation, validation and recognition of achieved learning outcomes acquired abroad, in both formal VET and in non-formal contexts. It is focused on the individual, based on the validation and the accumulation of his/her learning outcomes, defined in terms of the knowledge, skills and attitudes necessary for achieving a qualification. ECVET is a system designed to operate at the European level, interfacing with national systems and arrangements for credit accumulation and transfer.

To work within the ECVET framework a learning agreement, must be developed between the employer of the participant and the training provider. The learning outcomes are explicitly stated in this agreement. When the education or training is finished the learning outcomes achieved are evaluated against the learning agreement. Credits are awarded for each of the learning outcome. The achieved learning outcomes are gathered in a portfolio together with their credits. This individual portfolio can be taken from one training institute to the other and to the current and future employer.

The learning outcomes have to be considered not only in the knowledge field, but also in the field of skills and attitudes. All together learning outcomes are than competency based.

2.3 Dutch table with subject for training in radiation protection

In the Netherlands a reference table [6] is used since 1984 for different levels of education and training in radiation protection. This table is divided in main subjects and subdivided in more detail. There are no numbers of spent hours in this table, but only a characterisation of the level of detail at which the (detailed) subjects are covered during the training, together with its training goal (Table 1). The advantage of using descriptors above hours spent on the different subjects is that the entrance level of students doesn’t have to be set. Theoretically people with different levels can enter all courses.

Table 1 Descriptors at which subjects are covered in training events (knowledge part)

Descriptor	Covered	Goal
0	not covered	-
1	global, qualitative	awareness of the subject
2	important subjects covered, quantitative	understanding of the subject
3	Detailed, quantitative	detailed understanding of the subject

The second part of the Dutch reference table [6] is about practical exercises that are part of the Dutch training in radiation protection. Since these are not knowledge based, the grades as mentioned in Table 1 cannot be used. The objectives of this part of the table are to learn skills and attitudes to the trainees. The grades used can be seen below in Table 2.

Table 2 Descriptors at which subjects are covered in training events (skills and attitudes part)

Descriptor	Description
+	Necessary
+/-	Optional
-	Not necessary

2.4 The final mechanism for the comparison and evaluation of training events

The ECTS is meant for higher education, so there is a prescribed level of entrance in the competencies of the trainees. The comparison table that will be proposed aims at being independent of the entrance level. For the same reason the IAEA syllabus [7] and the EC syllabus [8] about training in the field of radiation protection cannot be used, because they use class hours, which are dependent on the entrance level of the trainee.

ECVET is a system which can be used for all vocational education and training. Therefore ECVET is used in our approach to come to a comparison table. The comparison table has to be filled with learning outcomes in the three fields of competences needed to address in radiation protection training: knowledge, skills and attitude.

ECVET is used for functions within Europe with an EQF of 1 up to 6 at the moment. Since the RPE is an EQF function category 6 or 7 (see [9]), it can be difficult to use the exact approach of ECVET. For the RPO there should be no difficulty, but this is outside the scope of this work package.

In the ENETRAP-II project learning outcomes for the RPE are delivered by work package 4 (WP4). In the first interim report of WP 4 [9] learning outcomes of the first module can be found. The learning outcomes are developed according to Blooms taxonomy, adapted for radiation protection training. For the moment a full year of training for someone with a bachelor or master degree is defined in WP4 to consist of 60 ECVET points. The learning outcomes developed in WP4 will be used in the comparison table. Since in the approach of WP4 the ECVET points are connected to hours the ECVET points will not be used in the proposed comparison model.

At the moment, ECVET is in a developing stage. The real number of credits for one year of training is not yet defined. In future ECVET credit points can be used to compare different events in the field of radiation protection.

For the comparison of the training material, a comparison mechanism is developed [5]. It was concluded that it can be used for the comparison of training material. With the same descriptive method (Table 1) this mechanism is proposed to be used for the knowledge based learning outcomes in training events. For the comparison table the description of the grades in the right column of Table 1 will be used (see Table 3), since using the description of both the middle and the right column in Table 1 can lead to confusion as they are not unambiguous.

Table 3 Proposed descriptors for the comparison of training events (knowledge part)

Descriptor	Goal
0	-
1	(basic) awareness of the subject
2	understanding of the subject
3	detailed understanding of the subject

For the skills and attitude based learning outcomes, the same grades as for knowledge cannot be used. Therefore, as already mentioned before, other grades are proposed in Table 2. For the comparison and evaluation these descriptors will not be used. It seems more obvious to use 'fulfilled' instead of 'necessary'. Also the descriptor optional is left out.

Table 4 Proposed descriptors for comparison of training events (skills and attitude part)

Grade	Description
+	Fulfilled
-	Not fulfilled

3 Testing the mechanism for the evaluation of training events

The comparison system for training events consists of two parts. One part is a list of learning outcomes; the other part is a tool for the comparison of the learning outcomes. The list of learning outcomes can be used from the first interim report of WP 4 of the same project [9], where the learning outcomes are described for the European Radiation Protection Training Scheme (ERPTS) for the Radiation Protection Expert (RPE). Not all learning outcomes for the ERPTS were finalized at time of writing this paper. The comparison of the training events is therefore carried out by using only the learning outcomes for Module 1 of the ERPTS.

The table with learning outcomes of Module 1 of the ERPTS course was send out to all WP5 partners. The learning outcomes were split in two: knowledge based learning outcomes on the one side and attitude / skill bases learning outcomes on the other side. The partners were asked to describe the learning outcomes of their events, which are knowledge based, according to Table 3 and those which are skill / attitude based, according to Table 4.
For the comparison of training events the institutes have chosen one or more of their courses or other training events for RPE, RPO or Radiation Worker (RW). Five partners filled in the list for in total eight events. Apart from that the table was filled in by the WP leader of WP 4 for the ERPTS. At the moment of comparing, the learning outcomes of the ERPTS were ready only for module 1 [9].
All the institutes mentioned the level of the training event. In Table 5 (knowledge) and Table 6 (skills and attitude) the result is shown for the learning outcomes of events A up to H (different training events) and in the last column for the ERPTS Module 1. The indication given by the partner can be found on the last row.

Table 5 The filled list for knowledge based learning outcomes for 8 different events and the ERPTS.

Training event→	A	B	C	D	E	F	G	H	ERPTS
Explain the different modes of disintegration and desexcitation	2	3	2	3	3	2	1	3	3
Describe the different type of radiations emitted and their features	2	3	2	3	3	3	2	3	3
Define the notions of activity, intensity of radiation, half-life.	2	3	2	3	3	3	2	3	3
Explain the different phenomena of interaction of the radiations with matter (loaded particles, electromagnetic radiations, neutrons)	2	3	2	3	3	3	1	3	3
Define the linear transfer of energy	2	2	1	2	3	2	1	3	3
Interpret attenuation of gamma radiation as a function of thickness and Z	2	2	2	2	3	2	1	3	3
Define the operational quantities and UNITS	2	2	2	3	3	3	3	3	3

Define the absorbed dose, the doserate of absorbed dose	2	2	2	3	3	3	3	3	3
Explain the principle of performance of the detectors used in radioprotection	2	3	2	3	2	2	2	3	3
Indication of the level of the event by the provider*	W	O	E	E	E	W	W	E	E

* W: an RW course, O: an RPO course, E: an RPE course.

The knowledge based learning outcome of the standard ERPTS course is met, if the descriptor is at least the same as that in the last column or higher, i.e. in this case the descriptor has to be 3. For all events it was concluded by comparing the descriptors of the events with the ERPTS that there are shortcomings, except for one (training event H). This institute indicated that in their training event all their learning outcomes are covered detailed and quantitative (score 3).

Table 6 The filled list for attitude and skill based learning outcomes for 8 different events and the ERPTS (module 1).

Training event→	A	B	C	D	E	F	G	H	ERPTS
Calculate the activity of a source at any time...	yes	yes	yes	yes	yes	yes	no	yes	yes
Calculate the range of a beta radiation and the attenuation of a radiation using curves	yes	yes	yes	yes	yes	yes	no	yes	yes
Apply relationship between fluence, kerma and absorbed dose	yes	yes	yes	yes	yes	yes	no	yes	yes
Calculate the limit of detection, and others characteristics	no	no	no	yes	yes	yes	no	yes	yes
Use the appropriate detection device and probe vs. type of radiations	yes	yes	yes	yes	yes	yes	yes	yes	yes
Indication of the level of the event by the provider*	W	O	E	E	E	W	W	E	E

* W: an RW course, O: an RPO course, E: an RPE course.

The attitude and skill based learning outcome of the standard ERPTS course is met, if the descriptor is at least the same as that in the last column or higher, i.e. in this case the descriptor has to be yes. The descriptor of the ERPTS is yes, because we used the learning outcomes of the ERPTS. If using other learning outcomes it is possible that a skill or attitude based learning outcome is used that is not preferred by the ERPTS. In that case the descriptor in the column of the ERPTS is no. In a comparison the learning outcome is met, when the descriptor in the column of the comparing event is yes or no.
For all events it was concluded by comparing the descriptors with the ERPTS that some events have shortcomings. Events A, B and C do not deal with the skill: 'calculation of the limit of detection and other characteristics'. Event G only meets the skill: 'using the appropriate detection device and probe vs. type of radiation'. It is possible that the student however has knowledge about the other skills, but is not trained on the skill itself. Therefore learning outcomes should be considered to be not only one type of learning outcome. Learning outcomes as described above can be both knowledge based and skill or attitude based. In a newer version of WD 4.1 [10] this has been done for all learning outcomes.

4 Conclusion and discussion

The learning outcomes can be evaluated by the proposed mechanism for training events. Learning outcomes have to be subdivided in the type of learning outcome: knowledge, skill or attitude based, but can be allocated to more than one type. When this allocation is done correctly the proposed approach of a list of learning outcomes and two descriptive systems can be used. Shortcomings can be noticed and given back by an assessment team to the institute that sent in the event for evaluation.
A remark can be made that this list is not very detailed. Therefore it is rather difficult to give the right subscription to the learning outcome. When asking about 'Calculate the range of a beta radiation and the attenuation of a radiation using curves' it can be that in the course is dealt with beta radiation but not with gamma radiation. One does not know how to describe this learning outcome.
Point for discussion is the self-assessment.

4.1 Self-assessment

The evaluations showed that the proposed mechanism is very useful instruments. To make the evaluation as efficient as possible, we suggest performing the mechanism as a self-assessment. However we than have to take into account that one can fill in the list arbitrarily or choose the wrong descriptor.
Self-assessment cannot be done without a certain random auditing of an independent organisation or institute. This organisation can randomly judge whether the description of the learning outcomes in the list is carried out at the right way and if there is a certain conformity.
The organisation should exist of different education and training experts in radiation protection, mastering different languages to understand the content of the training event. Since the consequence of this auditing is far-reaching one should not do this task in as a volunteer, but one needs to be assigned to carry out this task

5 Acknowledgement

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6 Literature

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