

Evaluation Results from the European Credit System for Vocational Education and Training Based Pilot Training Course for Radiation Protection Worker

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Abstract. This paper presents the process of development of methodology for pilot implementation of European Credit System for Vocational Education and Training (ECVET) for Radiation Protection Worker, the development of ECVET-based training course and the results of the evaluation of the pilot training.

The evaluation of the pilot training was carried out by the assessment of the trainee's answers for the questionnaires and on the basis of collected feedback from the participants: trainees, lecturers and observers.

The evaluation of the results showed that the pilot training fulfils completely the assigned tasks: to test the methodology, which was developed for the implementation of pilot ECVET project and to monitor the effectiveness of the training scheme. Areas of improvement were highlighted with regard to duration of laboratory practices, application of interactive ways of learning and assessment of the individual's learning outcomes.

The obtained results will be used for the development of the criteria and the procedure for mutual recognition of curricula, courses and training sessions supporting the training. Mutual recognition will support mobility of VVER professionals and nuclear researches based on comparability of acquired knowledge and skills following the ECVET approach.

Keywords: ECVET, NPP, radiation protection, pilot training, VVER.

1 Introduction

Within the European Union (EU) there is a strong need for maintaining and preserving knowledge and nuclear competence including VVER competence. CORONA I and II projects correspond completely with the EU ambition to support and develop European collaboration in this area by means of creating conditions for preservation and further development of expert experience in the area of nuclear energy through improvement of personnel training and conditions for maintaining professionals' qualification.

CORONA I project (2011-2014) "Establishment of a Regional Center of Competence for VVER Technology and Nuclear Applications", co-financed by the EC Framework Program 7, was focused on building the VVER competence.

Its continuation CORONA II project "Enhancement of training capabilities in VVER technology through establishment of VVER training academy" is co-financed by the HORIZON 2020/Euratom research and training programme 2014-2018 and has the aim to provide a structure for training and qualification of personnel for serving VVER technology as one of nuclear power options used in EU as well as for training in nuclear applications. Such approach should allow unifying existing VVER related training schemes according to IAEA standards and commonly accepted criteria recognized in EU. One of the main tasks of CORONA II Project is to apply a set of activities towards pilot implementation of the ECVET.

A nine-partner strong consortium was established for the implementation of CORONA II project. Nine (9) organizations from seven (7) countries – Bulgaria, Czech Republic, France, Germany, Hungary, Russia and Spain participate in the project:

- Kozloduy Nuclear Power Plant Plc. (KNPP), Bulgaria – Coordinator
- Institute for Nuclear Research and Nuclear Energy (INRNE), Bulgaria
- Risk Engineering Ltd (REL), Bulgaria
- Nuclear Research Centre (CV Rez), Czech Republic
- European Nuclear Education Network (ENEN), France
- Engineering Support and Intellectual Solutions GmbH (ESIS), Germany
- Budapest University of Technology and Economics (BME), Hungary
- Moscow Energetic Physics Institute (MEPhI), Russia
- Tecnatom, Spain

2 ECVET Approach

The ECVET is a European instrument to support life-long learning, the mobility of European learners and the

flexibility of learning pathways to achieve qualifications. ECVET is developed by Member States in cooperation with the European Commission and is adopted by the European Parliament and the Council on 18 June 2009 [1]. The ECVET is considered as a useful tool to overcome the differences in the requirements of qualifications regarding the proposed training schemes of the partner countries.

ECVET tools and methodology comprise the description of qualifications in terms of units of learning outcomes with associated points, a transfer and accumulation process and complementary documents such as learning agreements, transcripts of records and ECVET users' guides [1].

ECVET is based on:

- Learning outcomes, which are statements of knowledge, skills and competence that can be achieved in a variety of learning contexts;
- Units of learning outcomes that are components of qualifications. Units can be assessed, validated and recognized;
- ECVET points, which provide additional information about units and qualifications in a numerical form;
- Credit that is given for assessed and documented learning outcomes of a learner. Credit can be transferred to other contexts and accumulated to achieve a qualification on the basis of the qualifications standards and regulations existing in the participating countries;
- Mutual trust and partnership among participating organizations. These are expressed in Memoranda of Understanding and Learning Agreements.

ECVET process is presented in Figure 1 [2].

The process starts from a provider, who signs a Learning Agreement with the host provider. The Learning Agreement is developed for each particular training. Qualifications are expressed in units of learning outcomes (LO).

Learning outcomes are statements about what a learner knows, understands and is able to do on completion of a learning process and which are defined in terms of knowledge, skills and competence (KSC). The learning outcomes are assessed by the provider. The Credits can be recorded in the Europass and transcript. Then they are validated and in a final phase, learning outcomes are recognized and accumulated as part of the intended qualification corresponding to a certain amount of ECVET points.

This ECVET system enables the attesting and recording of the learning achievement/learning outcomes of an individual engaged in a learning pathway leading to a qualification,

3 Development of the ECVET oriented Pilot Training Course

The aim of CORONA II project is to participate in the testing process of ECVET through pilot implementation. The steps which were taken are:

- Select one particular qualification for pilot implementation, which is subject to increased mobility;
- Define competence requirements for this qualification;
- Select appropriate training scheme for this qualification, based on the defined units of learning outcomes;
- Select two utilities playing the roles of sending and host provider and organization playing the role of competent authority;
- Perform at least one pilot training on selected course;
- Evaluate results and propose corrective measures.

The qualification of radiation protection worker was selected for pilot implementation amongst five shortlisted qualifications. The following specific criteria were elaborated for the selection:

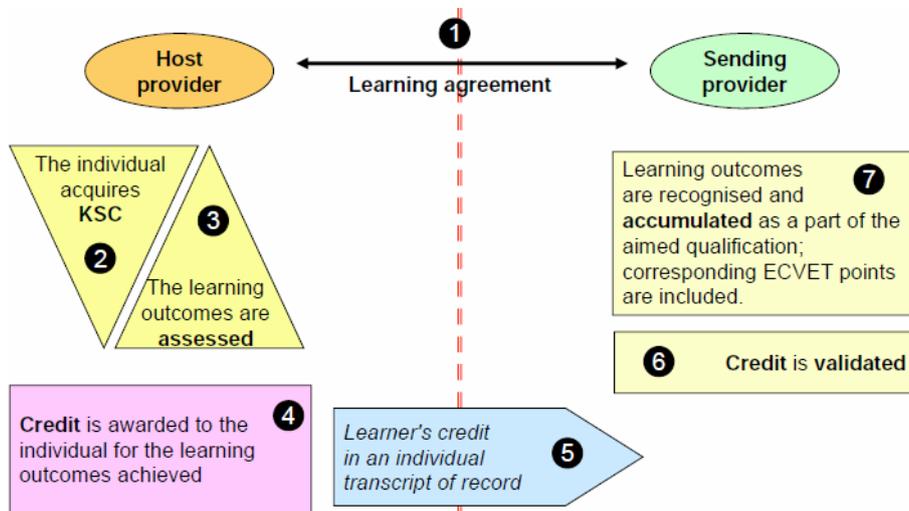


Figure 1. ECVET process.

- Availability of training programs and training materials;
- Language of the developed training materials;
- Complexity of the job profile and the training programs for the selected qualification;
- Availability of training provider;
- Availability of trainees.

The qualification of radiation protection worker meets the established criteria to the fullest extent than the other qualifications.

Two universities: BME, Hungary and MEPhI, Russia were chosen to play a role of host provider. The rest of the Consortium partners played a role of a sending provider.

The training program was organised in training courses (units) which correspond to units of learning outcomes. Each training course was organised in modules with aim to cover all knowledge, skill and competence items belonging to the corresponding unit. The lectures and laboratory practices were organised to cover the skills necessary to be achieved after attendance of the training.

The program contained 3 courses: Introduction to nuclear power, Radiation protection and Nuclear fuel and radioactive wastes. Two of them: Introduction to nuclear power and Radiation protection were developed and provided by BME. The course Nuclear fuel and radioactive wastes was developed and provided by MEPhI in the form of video conference. The training consisted of classroom lectures and laboratory practices. The duration of the training was 40 hours. The course language was English; therefore all training materials were prepared in English.

The target audience was established for non-nuclear professionals or students who graduated at least to the level of Bachelors or are currently Bachelor's students, with negligible prior knowledge or without knowledge and experience in nuclear could be trained. The pilot training was aimed at students or professionals working in support of nuclear facilities as civil engineers, physical protection employees, government employees, secondary school teachers, journalists, etc. The course should provide competences necessary for trainees to participate in further nuclear course(s) or to perform work related to VVER NPP, radiation monitoring and radiation protection of places of ionizing radiation for medicine and industry applications, radioactive waste management, customs offices, etc.

4 Conductance of the Pilot Training

The pilot training was provided from January 30th till February 3rd, 2017 at the premises of Budapest University of Technology and Economics (BME), Institute of Nuclear Techniques.

The topics (lectures, video conferences and laboratory works) covered during pilot training were:

- Introduction to nuclear power technology
- Radiation protection

- Nuclear fuel and radioactive waste

For each topic within the training programme the following information was provided:

- Objectives of the training course
- Requirements to the target audience
- Content of the training course (topics)
- Suggested duration of the course (in working days and in academic hours)
- Type of training – theoretical, practical, simulator / initial, refreshing
- Methods for evaluation

Eight trainees participated in the training.

During the pilot training two observers participated. The main tasks of the observation of conductance of the pilot training were to assess the training organisation and effectiveness and to evaluate whether learning outcomes have been achieved.

At the beginning of the training the trainees passed entrance tests in order to assess their level of experience and knowledge on the training topics. The tests were as follows:

- Jump-in Test questions in the topic of Introduction to Nuclear Technology
- Radiation Protection Worker Entrance test

Evaluation of obtained knowledge and skills and the training programme effectiveness were organized at the end of the training by the use of two questionnaires:

- Final Test questions about the content of the whole pilot training
- Participants Satisfaction Survey for the Radiation Protection Worker Pilot Training

The observer's evaluation was based on the preliminary prepared and agreed instructions. The instructions are intended for the unification of the observer's responses and to highlight important areas to be evaluated. The assessment was focused on evaluating whether learning outcomes have been achieved or not. The key aspects that were observed are:

- Organisation and management of the pilot training
- Training materials – content, quality, use of laboratory equipment
- Fulfilment of requirements for ECVET oriented training
- Assessment of trainees's achievements- types, criteria, alignment with LO
- Overall course evaluation

Table 1. Results of jump-in test: **X** – wrong answer, **✓** – right answer

No.	First name:	Family name:	1	2	3	4	5	6	7	8	Right answer:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Right answers:	
1	applicant	1	✓	✓	✓	✓	✓	✓	✓	✓	6/8 75%	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	8/14 57%
2	applicant	2	X	X	✓	✓	✓	✓	✓	✓	2/8 25%	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	7/14 50%
3	applicant	3	✓	✓	✓	✓	✓	✓	✓	✓	6/8 75%	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	7/14 50%
4	applicant	4	✓	✓	✓	✓	✓	✓	✓	✓	6/8 75%	X	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	8/14 57%
5	applicant	5	X	✓	✓	✓	✓	✓	✓	✓	6/8 75%	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11/14 78%
6	applicant	6	X	✓	✓	✓	✓	✓	✓	✓	6/8 75%	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11/14 78%
7	applicant	7	X	X	✓	✓	✓	✓	✓	✓	4/8 50%	✓	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	8/14 57%
8	applicant	8	X	X	✓	✓	✓	✓	✓	✓	4/8 50%	✓	✓	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	8/14 57%
9	applicant	9	X	X	✓	✓	✓	✓	✓	✓	3/8 38%	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	5/14 36%
Results of A. Kiss' test questions (BME).												Results of Cs. Pesznyak' test questions (BME).															

Table 2. Results of final test: **X** – wrong answer, **✓** – right answer

No.	First name:	Family name:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Right answer:	
1	applicant	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	17/25 68%
2	applicant	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	15/25 60%
3	applicant	3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	17/25 68%
4	applicant	4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	19/25 76%
5	applicant	5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	17/25 68%
6	applicant	6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	17/25 68%
7	applicant	7	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	14/25 56%
8	applicant	8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	17/25 68%
9	applicant	9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	14,5/25 58%
Test questions of MEPhI												Results of A. Kiss' test questions (BME).					Test questions of BME about radiation protection.												

At the end of the training the trainees were awarded certificates for attendance and for achieved competencies within the pilot training course.

5 Evaluation Results from the ECVET Based Pilot Training

The evaluation of the pilot training was carried out by the assessment of the trainees’ answers for the questionnaires and on the basis of collected feedback from the participants: trainees, lecturers and observers.

5.1 Evaluation of the results from Jump-in Test “Introduction to Nuclear Technology” and Entrance test “Radiation Protection Worker

The jump-in test consisted of 22 questions (8 were related to the Introduction to nuclear power technology and 14 questions were related to the Radiation protection) requiring the selection of the correct single answer out of several possible answers. The results of jump-in test are shown in Table 1.

As it can be seen from Table 1, the participants had at least the necessary knowledge (minimum one third right answers) prior to the pilot training. The knowledge of the participants seemed to be inhomogeneous. This fact and the fraction of wrong answers recorded showed the necessity of the rather introductory lectures of the pilot training.

5.2 Evaluation of the results from the final test

The final test consisted of 25 questions (5 were about the topic of Introduction to nuclear power technology, 10 were about the topic of Radiation protection while 10 were about the topic of Nuclear fuel and radioactive waste), requiring the selection of the correct single answer out of several possible answers. The results of the final test are shown in Table 2.

As it can be seen from Table 2, the knowledge of the participants became more homogeneous. The total average fraction of right answers is around two third (66%) varying between 58–76%. It is a remarkable increase compared to the results of the jump-in test where the total average of fraction of right answers was around half (50–55%) varying between 25–78%. This is correct in that case if we compare only the questions from 11th to 25 which were asked in both the jump-in and final test questionnaire as well (see in Tables 3 and 4 below).

Table 3. Comparison between results of final and jump-in test of the topic of production to nuclear power technology

Final test	Jump in test
Right answer: 5/5 100%	Right answer: 6/8 75%
5/5 100%	2/8 25%
5/5 100%	6/8 75%
4/5 80%	6/8 75%
4/5 80%	6/8 75%
4/5 80%	6/8 75%
3/5 60%	4/8 50%
3/5 60%	4/8 50%
2/5 40%	3/8 38%

Table 4. Comparison between results of final and jump-in test of the topic of radiation protection

Final	test	Jump in	test
Right answer:		Right answers:	
6/10	60%	8/14	57%
5/10	50%	7/14	50%
6/10	60%	7/14	50%
8/10	80%	8/14	57%
6/10	60%	11/14	78%
6/10	60%	11/14	78%
5/10	50%	8/14	57%
7/10	70%	8/14	57%
5,5/10	55%	5/14	36%

Summarizing the results from Tables 1, 2, 3, and 4 it can be stated that during the pilot training the participants' knowledge has been improved within the topics covered and got more homogeneous.

5.3 Evaluation of the participants satisfaction survey

The so-called participants' satisfaction survey was filled out by all of the trainees directly before adjourn of the training.

All of the participants agreed that:

- the faculty had a good command of the subject matter of the training;
- the raised questions were answered adequately.

Most of the participants agreed that:

- the learning objectives of the pilot training were clear to them;
- the participation in this course enabled them to develop learning goals relevant to the Radiation Protection Worker certification;
- the knowledge, skills and attitudes supported by this course match those those they expected for radiation protection worker;
- their own expectations for this course were met.

5.4 Observer's evaluations

The main conclusions from the observer's evaluation are as follow:

- (1) *Organisation and management.* The level of organisation was very good. The working conditions were appropriate for carrying out the training. The laboratory practices were provided in well-equipped facilities.

Balance between classroom training and laboratory practices for topics "Introduction to nuclear power" and "Radiation protection" was satisfactory. The topic "Nuclear fuel and radioactive wastes" was covered by lectures in the form of video conference only. The size of the group was appropriate and corresponding to the conditions for conducting lecturers and laboratory work. The lecturers have large experience in training. They presented training materials in a structured and logically sequenced way.

- (2) *Training materials.* The training materials were provided during the pilot course, which facilitated the trainees for using them for the self-study during the course.

- (3) *ECVET oriented training.* The training program was prepared to support ECVET-based qualification design and was focused on skills and knowledge. The purposes of learning activities were presented clearly. Modules were oriented towards occupational activities and tasks. Job oriented learning activities were in the focus of the learning process. The training materials were clear and understandable.

- (4) *Assessment of trainees.* Appropriate tests (questionnaires) were developed for evaluation of the training. The types of assessment criteria were clearly defined. They were elaborated in order to assess the effectiveness of the pilot training and trainees' achievements.

- (5) *Overall course evaluation.* The pilot training fulfils completely the assigned tasks.

6 Conclusion

The evaluation results showed that the pilot training completely fulfils the assigned tasks: to test the methodology, which was developed for implementation of pilot ECVET project and to monitor the effectiveness of the training scheme. Areas of improvement were highlighted with regard to the duration of laboratory practices, application of interactive ways of learning and assessment of the individual's learning outcomes. The fulfilled monitoring of the conducted training, collection of feedback from the participants: trainees, lecturers and observers and evaluation of trainees' achievements will be very helpful for the validation and recognition of units of learning outcomes.

The obtained results will be used for development of the criteria and the procedure for mutual recognition of curricula, courses and training sessions supporting the training. Mutual recognition will support mobility of VVER professionals and nuclear researches based on the comparability of acquired knowledge and skills following the ECVET approach.

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