Equal class

Implementation of Remote Laboratories

EQUAL-CLASS Project

Summary Report

Engineers Qualified in Higher Non-University VET Institutions – Providing Arguments and Evidence for NQF/EQF Classification

This project has been funded with support from the European Commission and the Austrian Federal Ministry of Education and Women's Affairs (BMBF). The content of this publication reflects the views only of the author, and neither the Commission nor BMBF can be held responsible for any use which may be made of the information contained therein.

BMBF Bundesministerium für Bildung und Frauen

Lifelong Learning Programme

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Project Information:

Project title:	Engineers Qualified in Higher Non-University VET Institutions – Providing Arguments and Evidence for NQF/EQF Classification
Project acronym:	EQUAL-CLASS
Programme:	Lifelong Learning Programme, Leonardo da Vinci
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1. Introduction

This is a condensed summary of work carried out in the EUQAL-CLASS project.

For more comprehensive documentation, visit the project website: www.equal-class-eqf.eu

EQUAL-CLASS is a European Commission-funded project which aims to analyse and compare qualifications in the field of **mechatronics, electronics/electrical engineering** across different countries, with particular focus on their **classification within National Qualifications Frameworks** (NQFs) and the **European Qualifications Framework** (EQF).

This chapter describes the implementation and outcomes of the Remote Laboratories experiment within the EQUAL-CLASS project, in which Remote Laboratories were used to assess and compare learners' PLC (programmable logic controller) skills.

The objective of this approach was to assess whether comparable information on learning outcomes, and additional evidence regarding the classification of comparable qualifications, could be gained by the use of Remote Labs. In addition, this approach aimed to bring schools in different European countries together to foster sustainable cooperation and secure mutual support in the future development of laboratories.

What is a Remote Laboratory?
The term 'Remote Laboratories' refers to online laboratories used to remotely conduct real experiments. These are scalable (accessible via internet) e-learning instruments especially for use by those studying technical and natural scientific disciplines.

The underlying technology allows for collaboration and (for instance) joint programming in online-laboratories across long distances and national borders. At the same time, tasks can be assigned and undertaken regardless of time and location.

Thus, results from the Remote Laboratories experiments should address and provide answers to the following questions:

- Are the students in the different vocational schools equally successful in completing their tasks?
- What are the differences and similarities between the results of different countries?
- Can the results be used as additional evidence for the comparability of qualifications and their classification?

2. Methodology used

In a first step, teachers at the participating VET schools and colleges had to be instructed in the use of Remote Laboratories and lesson preparation. By March 2014, a total of 164 learners from 10 classes in Germany, Austria, Lithuania, and Switzerland had been trained in the use of 30 remote PLC workstations. Of these students, 150 had logged onto the examination task by the end of May 2014, with 112 passing and 38 failing the examination.

All students who successfully passed the examinations (test score better than 50 percent) were issued a certificate and a certificate supplement, as shown on the next page.

Remote Laboratories experiment – participants:	
Austria	HTL St. Pölten
Germany	Grundig Akademie
Lithuania	Kaunas College
Switzerland	ABB Technikerschule Baden

With support from: CEyeClon, Siemens and SITELA

A questionnaire was designed and distributed to the teachers and/or trainers who worked with the Remote Labs as partners in the EQUAL-CLASS project, in order to learn more about their experience of the experiment.

Table: Remote Laboratory experiment - overview

Purpose	Assess and compare learners' PLC (programmable logic controller) skills.
Format	Remote Laboratories: training + examination
Countries involved	Austria, Germany, Lithuania, Switzerland
No. of learners participating in the preparation classes	164 learners from 10 classes
No. of learners taking the Remote Laboratories exam	150 learners
No. of certificates awarded	112 certificates

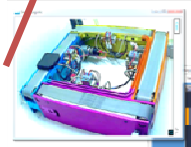
How do RemoteLabs work?

This example shows an educational setting with remote workstations on PLC (programmable logic controller) control technology.

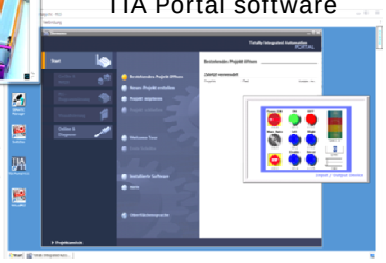
Classroom learning:
Learners in control engineering classes enhance their knowledge through operating in a real laboratory environment.

Student PC with free CEyeClon viewer software

Learners work in the classroom:
Learners operate a remote laboratory workstation in real-time using a PC: The student's PC functions as screen and keyboard of the remote PC. A camera image of the remote system is transferred to the screen of the student featuring synchronous sound. This function only requires the free CEyeClon viewer software and any Windows-compatible operating system.



Remote PC with STEP 7 TIA Portal software



Live stream of the band model transmits real-time image and sound of the system

Easy access via Internet:
The viewer software provides access to the workstation and shows it in a media and working window.

Every workstation is physically built up

Remote workstations can be used in real working life. This shows a mechatronic band circulation with a pneumatic transport unit for logistics.

Network camera

Real conveyor-belt model

Remote workstations in a rack system
Remote workstations can be centrally set up and maintained. Regardless of the actual distance, learners have the opportunity to operate these workstations.

Photo credits: Grundig Akademie, ABB Technikerschule, HFT Mittelland

3. Results from the Remote Laboratories experiment

The participating schools' experience with implementing the Remote Laboratories experiment was very positive. Remote Labs were considered by the participating engineering schools and colleges as a new and interesting way to foster sustainable cooperation in the future development of their laboratories. Furthermore, they allow students and instructors to perform both exercises and examinations at any time regardless of their location providing they have access to the internet.

At the same time it must be noted that the results from this experiment provide limited evidence for the comparison of levels of learning outcomes achieved between learners of different programmes/qualifications.

The following observations were made when analysing and comparing the results from the Remote Laboratories experiment:

- Results show a Gaussian normal distribution curve.
- The questionnaire responses and the analysis of the examination results indicate that the implementation of the PLC was quite difficult for the students, and this is reflected in the fact that the instructors had to provide a lot of support.
- There are significant variations in the pass rate between the different classes, ranging from 38.9 percent to a pass rate of 100 percent.
- Regardless of the average score per class, each class shows top scoring individual student results, i.e. learners with a score of more than 90 percent of achievable points.
- Some classes had only 20 lessons on the subject of PLC, while others had up to 140 lessons. The different number of PLC-specific lessons shows in the test scores and also in the amount of support required by the learners on how to use and operate the systems.
- English language proficiency could be a factor in individual results, but this could not be verified.

Participating schools had lesson plans with different subject emphasis; these could not, of course, be altered a great deal in the implementation of this project. Another significant factor is that in some schools PLC-specific lessons are taught in early semesters while other schools leave this teaching until later semesters. Naturally, this may explain some variations in the level of learning outcomes achieved.

For the purpose of the public report, the decision was taken not to produce a 'ranking' based on the detailed results by VET institution, but instead to publish an anonymous summary of classes classified by number. The full report on the detailed results and analysis of the Remote Laboratories experiment can be downloaded at http://www.equal-class-eqf.eu/results/.

Example: Certificate and certificate supplement for successful participation in the Remote Laboratories experiment

European Project EQUAL–CLASS
using PLC (Programmable Logic Control)
and Remote Laboratories

Certificate

We have the honour to inform you that the student

Dominique Muster

Date of birth: 9 Feb-1988

has successfully participated to the PLC (Programmable Logic Control) exercises using the appropriated skills in practical applications with remote laboratories.

The exercises were specified and performed by the European project team EQUAL-CLASS in cooperation with the board of EUROPACE, the institution of the European Association of higher educated professionals.

Wien, March 2014

EQUAL-CLASS Project

EUROPACE

3 About the EQUAL-CLASS project

The EQUAL-CLASS project studies qualifications in the field of **mechatronics** and **electrical engineering/electronics** that can be obtained in higher non-university VET[1] institutions or comparable institutions in Austria, Germany, Lithuania, Portugal, and Switzerland.

The qualifications are examined from three different perspectives – learning outcomes, learners, and graduates – with particular focus on their **NQF/EQF classification**, e.g. through

- the implementation of "Remote Laboratories", i.e. online laboratories used to remotely conduct real experiments in order to learn more about learners' knowledge, skills and competence;
- an online survey among graduates to learn more about their occupations and positions in the labour market.

4 Further information

This summary report summarises the results from the Remote Laboratories experiment carried out within the EQUAL-CLASS project in a condensed form. Further documentation is available from the project website.

For more information about the EQUAL-CLASS project, visit http://www.equal-class-eqf.eu/.
Project reports and other results are available in the 'Results' section of the website: http://www.equal-class-eqf.eu/results/

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1 Vocational Education and Training

Equal class PROJECT

ENGINEERS QUALIFIED IN HIGHER NON-UNIVERSITY VET INSTITUTIONS – PROVIDING ARGUMENTS AND EVIDENCE FOR NQF/EQF CLASSIFICATION

Comparing qualifications in mechatronics & electrical engineering/electronics

European Qualifications Framework (EQF) levels 5-6
in Austria, Germany, Lithuania, Portugal and Switzerland

3 perspectives

LEARNING OUTCOMES
(THEORETICAL – DESCRIPTIVE)

Structured description and comparison of qualifications based on learning outcomes

- Using adapted methodology from the ‚ZOOM' project
- Comparing qualification profiles
- Comparing the assessment of knowledge, skills and competence

LEARNERS
(PRACTICAL – PERFORMANCE TESTING)

'Remote Laboratories'

- Online laboratories to remotely conduct real experiments
- Testing learners' PLC* knowledge, skills and competence
- Learners in the participating countries have to solve the same programming exercises online.

* PLC = Programmable Logic Controller

GRADUATES
(LABOUR MARKET)

Alumni survey

- Comparing graduates' occupations and positions in the labour market
- Web-based questionnaire in four different languages
  - Job level and status
  - Degree of responsibility
  - Career prospects
  - Type of tasks executed

+

How can learning outcomes acquired in the workplace be taken into account?

Desk research & interviews

- Validation and recognition of non-formal/informal learning
- Higher NQF/EQF level?

Can the results provide additional evidence for the classification of qualifications in the National/European Qualifications Framework?

Aims: Providing and testing a set of methodological tools

- for transnational comparison
- for the creation of transparency and
- for raising the understanding of a qualification

Further information: www.equal-class-eqf.eu
Duration of the project: 10/2012 – 09/2014
Partners from: Austria, Germany, Lithuania, The Netherlands, Norway, Portugal and Switzerland

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Lifelong Learning Programme

GRUNDIGAKADEMIE

ABB Technikerschule

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HTL ST. PÖLTEN

EU pro VET

CONSULTUR studies&analyses

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