



## **Coordination and Alignment of Electrical and Information Engineering in European Higher Education Institutions**

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## **Introduction**

Mobility, recognition, Lifelong Learning (LLL), and accreditation are very important keywords for Europe, and also beyond Europe. Global educational policy is to encourage mobility of people, workers and citizens, during their studies and during their professional lives. The general objective of the Lifelong Learning Programme in Europe is to contribute through lifelong learning to the development of the European countries inside European Union (EU) as an advanced knowledge-based society, with sustainable economic development, more and better jobs and greater social cohesion, while ensuring good protection of the environment for future generations. The European Commission (EC) has stated an official directive and decision<sup>1,2,3</sup> establishing an action programme in the field of Life Long Learning (LLL) (2007-2013). In the field of engineering education there is a need and global interest in Europe to promote and develop mobility of students, beyond the existing exchange programs like SOCRATES-ERASMUS (since 1987) program and existing bilateral agreements between particular universities. Engineering education in Europe is facing the great challenge of changing conditions in the labour market, as many industrial companies work with projects across borders, which means projects involving participants from different countries and cultures working together on common goals. At the same time the future of European countries is very much dependent on the progress in technology. A great part of industrial production of all kind has been moved to countries outside Europe and involving the management of production plants all over the world. This requires the movement of specialists and better understanding of different skills and competences. Competition between different parts of the world to attract industrial investments makes it necessary to develop European policy on education, especially in engineering. Fast changing requirements and rapid changing technology make it necessary to develop a strategy for continuous education at all levels and to ensure recognition of qualifications and diploma all around Europe. One part of this process is LLL in EIE, described in the Official Journal of the European Union<sup>1</sup>.

On the basis to the work of about one hundred teachers in higher education institutions across the European Union, a synthesis of the LLL in the Electrical and Information Engineering field was analyzed with the objective of suggesting several experimental approaches and specific demonstrators to advance understanding of LLL. The project described herein, in the field of Electrical and Information Engineering, was aimed at fostering interchange, cooperation and mobility between education and training systems within the EU so that they become a quality reference.

## **ELLEIEC Project**

ELLEIEC project consisted of three main parts:

1. The first one was dedicated to LLL in EIE in Europe at the undergraduate and postgraduate levels, together with some recommendations.
2. The second part concerned best practices for the use of new technologies in EIE education in Europe and proposed guidelines for e-learning and intensive course's assessment.

3. The last one proposed two demonstrators of good practice for enhancing LLL in EIE in Europe: Virtual Centre of Entrepreneurship (VCE) and International Curricula Network (ICN)

In the following we present the outcomes and conclusions connected to parts one and three.

### **Analysis of LLL in electrical and information engineering (EIE) in Europe**

The objective of ELLEIEC work was to identify, analyze and make general recommendations on the future LLL-systems in Europe within electrical engineering at the Bachelor, Master, and Doctorate - levels. This work was designed to help develop attractiveness of mobility and improve cooperation between countries and universities. A key issue was the recognition of credit and qualification transfer within LLL-systems, internationally. The interest of a common approach at the European level comes from the mobility of employees in multinational companies and in general from the mobility of the citizens all around Europe. The knowledge of the higher education systems with their own rules and regulations informs routes to give EU-citizens information about possibilities for continuing education abroad. One of the main goals was to give potential candidates access to educational institutions/universities all over Europe, to give them good and efficient advice of how and where they can apply to fulfill their expectations for their future education. In order to clarify the state of the art about how to obtain Bachelor, Master, and Doctoral degrees in Europe, we decided to conduct a survey by questionnaires, one for the bachelor and master levels<sup>4</sup>, and one for the doctoral studies<sup>5</sup>. The target population of these questionnaires was the ELLEIEC partners, representing almost all European countries and other European universities for the countries not represented in the project. From analysis of the results of these questionnaires, this report presents a synthesis of some existing systems for measuring and counting lifelong credit accumulation, in relation to accreditation systems (which can vary as a function of the countries), analyses the system for the measurement of the levels, the kind of recognition given (course, module, term, diploma) and the transferability of these credits at the European level, both at the bachelor and master levels and for doctoral studies. All outcomes of the questionnaires are available on the project web-site<sup>6</sup>.

In order to include the different approaches of lifelong learning, it is necessary to explain the meaning of LLL & LLP, RPL (APL, APCL, APEL), ECVET, NQF and EQF:

- LLL (LifeLong Learning) & LLP (LifeLong Learning Programme), LLL & LLP<sup>7</sup>. The general objective of the Lifelong Learning Programme is to contribute through lifelong learning to the development of the EU as an advanced knowledge-based society, with sustainable economic development, more and better jobs and greater social cohesion, while ensuring good protection of the environment for future generations. In particular, it aims to foster interchange, cooperation and mobility between education and training systems within the Community so that they become a world quality reference. The strategy of LLL, as investigated in our project, covers the development of all forms of education, learning and lifelong skills upgrading for all: in the education system, in adult education and continuing training, at work and in the many other settings in which people learn and develop their knowledge, skills and competences.
- Recognition of Prior Learning (RPL), prior learning assessment (PLA), or prior learning assessment and recognition (PLAR), describes a process used by colleges and universities around the world to evaluate learning acquired outside the classroom for the purpose of assigning academic credit. Common ways individuals have acquired college-level learning

include: corporate or military training; work experience; civic activity; and independent study. As a whole, Recognition of Prior Learning (RPL) is a process that allows the competencies already possessed to be recognized, regardless of how they are obtained. These might include skills acquired on the job or from other life experiences that do not necessarily include formal training.

- APL (Accreditation of Prior Learning)<sup>8</sup>. Accreditation of prior learning (APL) is an opportunity for students to be given credits (or equivalences) for learning they have completed before starting University, or for studies or training that a student is currently doing outside of the University. It avoids the necessity of duplicating previous learning, whilst ensuring a system to demonstrate successful attainment of the learning outcomes appropriate to student's award. Prior learning may be experiential or certificated (next definition, see also LLL in the French system, in the next chapter).
- APCL (Accreditation of Prior Certificated Learning) is learning for which the student will have received a formal qualification, for example a Certificate or Diploma, or individual modules/course units completed at another institution.
- APEL Accreditation of Prior and Experiential Learning<sup>9</sup> is a process that enables people of all ages, backgrounds and attitudes, to receive formal recognition for skills and knowledge they already possess. A person's learning and experience can be formally recognised and taken into account to:
  - ✓ gain entry to further or higher education courses,
  - ✓ give exemption from certain parts of a new course of study,
  - ✓ qualify for an award in an appropriate subject in further or higher education.
- ECVET - European Credit system for Vocational Education and Training<sup>10</sup>. The objective of ECVET is to support and promote transnational mobility and access to lifelong learning in VET. While the EQF (European Qualification Framework) provides a common reference framework which is meant to serve as a translation device between different qualifications systems and their levels, ECVET provides a common methodological framework which is meant to facilitate transfer of credit for learning outcomes from one qualifications system to another, or from one learning pathway to another. It contributes to the permeability of learning systems, compatibility between autonomous education and VET systems and, in so doing, supports the possibility for learners to build individual learning pathways leading to qualifications.
- EQF - European Qualifications Framework<sup>11</sup> - acts as a translation device to make national qualifications more readable across Europe, promoting workers' and learners' mobility between countries and facilitating their lifelong learning. The EQF helps to compare qualifications throughout Europe to support Life Long Learning and educational and job mobility. The European qualifications framework has been a catalyst for countries to develop national qualifications frameworks (NQFs).
- NQF - National Qualifications Framework<sup>12,13</sup> aim to make national qualifications systems easier to understand and more transparent at national and international levels. NQFs describe what learners should know, understand and be able to do based on a given qualification as well as how learners can move from one qualification to another within a system. They have become integral to implementing the European qualifications framework (EQF). All countries have developed or are developing NQFs<sup>14</sup>.

As mentioned before, in order to visualize the present situation regarding the ways to obtain Bachelor and Master-levels in Europe, we conducted a survey by a questionnaire<sup>4</sup>. The working group for designing the questionnaire was set up by the members of the project representing almost all European countries. This working group had several meetings in order to design, test and validate the questionnaire, subsequently all the partners were invited to answer the questionnaire.

### **Analysis of the answers**

The statistical analysis of the questionnaire was undertaken and the results are described below. Responses were received from 37 universities representing 27 countries, 7 countries were missed. Almost 80% of European countries have answered the questionnaire and 20% are missing.

- 74% of the countries who answered the questions do use APL and 61% use APEL.
- 61% of the universities answering the questions use APL to allow admission for regular programme.
- 74% of the universities answering the questions use APL to allow a partial validation of the programme.
- Only 6% of the countries answering the questions use APL to allow validation of the complete programme.
- Only 43% of the countries answering the questions have a national body responsible for defining job profile references.

Our conclusion is that APL and APEL should be used in LLL such that both partial and full program validation should occur, as it is the case for example in France. In the French system we find three forms of qualification, i.e. the degree resulting from educational systems (college, university), the national qualification framework and the qualifications recognized by sector or professional bodies. For the last two cases the validation process have to involve the main players of this validation process, like public authorities, employers' and employees' representative bodies, training organizations and companies.

### **Recommendation & best practices**

The discussions in the working group of ELLEIEC-partners and the analysis of the questionnaire have given us the picture of the present situation in Europe. There are different practices concerning recognition of diploma and of obtained competencies in different countries and even in different universities.

Next, the results of our discussions and answers of our questionnaire are described.

- The system of ECTS credits should be implemented in all European countries, at the moment 78% of the countries do it.
- Diploma Supplement (DS) written in English will ensure the transparency and international understanding of existing educations. At the moment, only 78% of the countries are using it, and this practice is not even general within one country, since it differs from university to university.
- ECVET is known in almost all European countries, but used only by 73%. Our recommendation is to work to implement ECVET recognition across Europe.
- Similar to ECVET is the situation concerning APL/APEL. 57% of the countries practicing APL and only 35% using APEL procedures. France could be named as an example of best practice, where there exists the practice of validating a complete programme, which means giving a diploma based on APL and APEL.
- One of the key indications of taking care for LLL-continuing education of VET is having a department /office taking care of it. At the moment in most cases Academic/Scholar and International departments are collaborating, with the Academic/Scholar department managing the choices of courses and corresponding programmes and the International department managing the administrative aspects and the agreements.
- Especially there is need to improve the official recognition of the vocational training courses, as it is only 38% of the countries currently doing so.

The discussions in the working group of ELLEIEC-partners showed many differences in how APL and APEL are used in the validation of the programmes.

### **Proposed demonstrators for enhancing LLL in EIE in Europe: Virtual Centre of Entrepreneurship (VCE) and International Curricula Network (ICN)**

During the ELLEIEC project, two main experiments were completed. One concerns the development of a Virtual Centre of Entrepreneurship (VCE) and the other concerns the experiment of the implementation of the International Curricula Network (ICN) concept to some existing international programs, or for the design of international programs.

The Virtual Centre for Enterprise (VCE) is a learning space to which learners at any stage of their life can go to develop their competence in the knowledge, skills, and competences, and to develop better behavioural practices that will be of use to them in the planning, establishment and subsequent running of their own business. The objective of the ELLEIEC project was to establish the framework for the VCE, to create a small number of modules and undertake experiments to assess its effectiveness.

The VCE offers three modes of study by which learners can develop their enterprise knowledge, skills, and competences:

1. Mentor supported learning in which a student completes a module with the support of a mentor who may or may not be in the student's institution. The mentor also undertakes the assessment of, skills, and competences at the end of the module.
2. Self-study modules individuals can take at their own speed with embedded self-assessments.
3. A resource for tutors in European HEIs they can use in a blended learning module.

The VCE is not only open to students at all levels of their education, but also to individuals of all ages who wish to engage with enterprise. It therefore provides a Lifelong Learning resource for enterprise. It provides a pan-European resource for enterprise teaching and learning primarily contextualized to the Electrical and Information Engineering discipline areas.

The work aim for the International Curricula Network (ICN) was to propose a strategy in building a harmonized education offer for the European Electrical and Information Engineering sector. The ICN web portal is mainly based on the advertising of a common referenced courses database enhancing lifelong learning and ECTS recognition issues based on tools of the Bologna process structure and the EQF framework.

All the activities undertaken in this project are following these general objectives:

- to facilitate faster exchange of information on educational systems by means of a central Gateway,
- to harmonize the cross-recognition of diplomas, other qualifications and study periods considering the legal regulations of participating countries,
- to stimulate student and staff exchange and cooperation between start-up initiatives,
- to develop joint mobility networks and teaching materials,
- to participate in mutual quality assessment of learning tools.

The ICN web portal is the framework linking all ICN materials from several degree levels and different fields.

An ICN consortium could be based on an existing agreement like an Erasmus Mundus or a Curricula Development Programmes, but it can also be started by institutions willing to develop collaboration and partnership without external funding.

### **Strategic Alignment of Electrical and Information Engineering (SALEIE) project**

The follow-up project is named SALEIE<sup>25</sup>: Strategic Alignment of Electrical and Information Engineering in European Higher Education Institutions, which run from October 2012 to November 2015. In this project there are 44 European partners (mostly higher education institutions) and 1 Russian University. The main challenges addressed by this project are:

1. Ensuring graduates are prepared to enable Europe to respond to the current global technical challenges in the Green Energy the Environment and Sustainability, Communications and IT, Health, and Modern Manufacturing Systems (including Robotics), that is, a “new skills for new jobs” approach. This will embrace conventional education, lifelong learning and training for entrepreneurship.
2. Ensuring that programme and module governance is sufficiently well understood that issues of mobility, progression and employment are understandable by appropriate stakeholders including the accrediting bodies for professional engineers.
3. Ensuring all learners, irrespective of their background or personal challenges, including: dyslexia and dyspraxia; visual and audio impairments; and mental disabilities such as aspergers, autism, depression, anxiety; are given equal opportunity to education and are appropriately supported;

The aims of this project are to investigate and explore the named challenges and to:

- Build a shared understanding of the skills and competence needs of graduates to help European Companies respond to the current global technical challenges.

- Enhance current understanding of academic programmes and modules in terms of technical content and level of learner achievement as a means of improving clarity of learner skills and competence for mobility, academic progression and employment. At present careful scrutiny of application forms is often required when learners apply for academic experiences (such as work placements and ERASMUS exchanges) to fully understand how well the learner meets pre-requisite requirements; and how exchange programmes meet home institution requirements.
- Build a common understanding of current practices and issues associated with marketing programmes and the support of students from unconventional backgrounds and those with special needs. In this context special need are taken to include, but not be limited to students with: physical mobility problems; dyslexia and dyspraxia; visual and audio impairments; and mental disabilities such as aspergers, autism, depression, anxiety. Students with special needs often require adjustments to be made to infrastructure and teaching practices, adjustments that need to be carried out with sensitivity to the students involved.

The specific objectives of this project are to produce:

- Model programme and module curricula in the current global technical challenge subjects;
- Support for students with learners with personal challenges during their study and when wishing to undertake periods of study abroad through ERASMUS exchanges, for example
- Models for maximising accessibility of programmes to all learners;

The methodology that this project will follow is to audit current practice, design new models, integrate the models into trial institutions, monitor and evaluate the trials and analyse, report and disseminate the findings.

As a first step in this project questionnaire surveys will be used for an audit of the current situation and current practices in interest areas of this project.

At all stages throughout the project careful attention will be paid to the design and deployment of measurable indicators of project activities. For the surveys, number and breadth of respondents will be amongst the key measures. For the models more qualitative measures based on independent feedback (from non-partner HEIs and Industrial representatives) will be amongst the important measures. For the trial phase, feedback from the pilot institutions will be important quality indicators.

## **Conclusion**

The European Association for education in Electrical and Information Engineering, the body that has facilitated the formation of the project networks reported in this paper is committed to the development of engineering education and the understanding and enhancement of the electrical and information engineering system across Europe. Understanding of the issues of mobility and the transfer of learner achievements is the thread that ties the ELLEIEC and SALEIE projects together. As is reported in this paper the ELLEIEC project laid a solid foundation of understanding of credit transfer. The SALEIE project is taking this understanding forward by looking at the governance implications of learner achievement.

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