

Certification of ICT skills: a bridge between Universities and Industries

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Abstract

The paper addresses the topic of third-part certification of ICT skills, with particular attention to three projects carried on in the Italian Universities to “bridge” University teaching with Industry needs.

The first project concerns the adoption of ECDL as the way of assessing basic ICT skills owned by students entering the University.

The second project proposes a new certification scheme, aimed at verifying the capability of a University student to solve real problems by means of ICT tools.

The third project introduces professional ICT certifications into computer engineering and computer science University degrees.

1 – INTRODUCTION

The general idea of certifying some competences owned by people relies on two basic assumptions/activities. The first, fundamental step is the definition of the competences to be certified, in terms of topics and level of knowledge required to obtain the certification. This definition leads to the production of a *syllabus* (i.e., a detailed list of what the candidate to certification is expected to know) and the design of a certification process (e.g., an exam based on a given set of questions with an associated passing threshold).

One important aspect of this definition is the fact that – usually – it results from the joint effort of several actors, including in particular the institutions/persons that will supply to candidates the required competences (the *teachers*) as well as the institutions/persons that will demand services/supports from the certified people (the *users*).

The second important assumption about certifications is the clear separation between training phase (when the candidate learns the competences to be certified) and the assessment phase (when the candidate undergoes the certification test). This separation addresses in particular the involved bodies, since the certifier is expected to be different from the teacher: only in this case, in fact, it is possible to consider the certification as a neutral, third-part declaration of the level of competences owned by the candidate, thus avoiding the risk of self-referentiality which may arise if the candidate’s examiner is also her/his own teacher.

Main advantage of certifications can become also their main drawback.

From one side, a certification ensures that the defined competences are actually owned by the certified (with a credibility given by the reliability of the certifying body). This increases the mobility of the certified, whose competences are easily recognized even abroad.

From the other side, the certification hides any difference among certified: it just tells the user that all certified possess *at least* the competences defined by the syllabus, nothing about possible deeper levels of knowledge owned by one certified with respect to another one.

Just to give an example related to the most widely owned certification, the driving license just tells that certified people can be considered able to drive a car, without any discrimination between, say, myself and Michael Schumacher...

Mainly for this reason, Universities had (and have...) very limited involvement in certifications: they consider the self-assessment constituted by exams made by the teacher her/himself to her/his own students as the typical way of concluding a learning process, “certifying” that students reached a sufficient knowledge of the specific competences the teacher decided to give them.

In many cases this is a correct way of behaving: students who passed an exam in, say, Economics in a world-class University are in general far more competent than students who passed the same exam in a low-reputation one.

There are however at least two exceptions, which deserve particular attention.

The first one regards instrumental competences, not strictly related to the University course followed by the student. Typical examples of such competences are: the knowledge of the English language (considered as the worldwide *lingua franca*) for non English natives; the capability of using a computer as a normal working tool in daily professional activities. In these cases, third-part certification vs. self-assessment has the significant advantage of making these competences far more “recognizable” by the users (i.e., the Industries) of the graduated students.

The second exception – typically present in the ICT arena – is that of “vendor-dependent” certifications, aimed at evaluating the skills owned by candidates in using a specific technology provided by a specific, market-leading company. In this case, the meaning of a certification is twofold: from one side, it adds to the “competences portfolio” of the certified the statement that the specific technology is known by her/himself; from the other side, it tells to Universities that the ICT Industries consider the knowledge of that specific technology important enough to deserve a focused training.

In the following sections, we address the two exceptions recalled above in the frame of the Italian Universities and Industries, with particular reference to two projects – funded by AICA – aimed at introducing these kinds of certifications inside Italian Universities.

2 – BASIC SKILLS IN COMPUTER USAGE: RECENT PAST

As said above, the capability of using a computer as a normal working tool in daily professional activities is a “must” for all graduated people, regardless of the specific topic of the followed University course. This necessity has been recognized by the Italian University System in the frame of its recent restructuring.

2.1 – The Italian University System

Starting with the academic year 2001/02, the University System in Italy has been deeply restructured according to the Bologna pan-European agreement dated 1999 [1].

Main goal of the Bologna agreement – expected to be implemented all over the European Union by year 2010 – was the improvement and the standardization of Higher Education, in order to eliminate obstacles to the free circulation of people and help them to find jobs consistent with their education, regardless to their own original country.

To this purpose, the Bologna agreement introduced a sort of “Euro currency” for Higher Education, based on a uniform European Educational Space, with three year Bachelor degrees, two additional years for Master degrees, and three years for Ph.D. degrees. This scheme is also known as the “3+2+3 cycle”. According to the Bologna agreement suggestion, Italy has redesigned almost all University curricula to accommodate the 3+2 structure.

This restructuring also introduced the credit, as the measurement unit to quantify the learning effort required for students to graduate. In what follows, we denote the credit with the acronym CFU (Credito Formativo Universitario) to conform to its Italian name. Following the recommendations of the ECTS (European Credit Transfer System) a full time Italian University student is expected to “earn” 60 CFUs per year, where each CFU corresponds on average to 25 hours of student effort, including lectures, exercising, laboratories, and individual study.

It is worth noticing that this restructuring introduced several novelties in the organization of University courses. Among them, we can outline some of the most important ones:

- names of bachelor and master degrees are no longer fixed by the University Ministry, but they can be freely defined by each University;
- each University course (bachelor or master), to be activated, must belong to a “class” (e.g., class of the degrees in Information Science and Technology, class of the degrees in Information Engineering). For each class, the University Ministry has defined a minimum amount of CFUs (about two thirds of the CFUs required to graduate) to be dedicated to basic topics, to topics qualifying the class, to subsidiary topics, etc.
- for the first time in Italy, the instrumental topics already mentioned –knowledge of the English language and basic skills in ICT tools usage – have been considered compulsory for all courses/classes, and some CFUs have been assigned to them.

2.2 – The CampusOne project

Starting in year 2001, the Conference of Italian Universities Rectors (CRUI) launched a four-year project, called *CampusOne*, aimed at supporting Universities in the restructuring process outlined above [2]. *CampusOne* focused on improving quality evaluation and management of University courses through development of monitoring tools, exchange of best practices, tighter integration between Universities and industry.

Among its various initiatives, *CampusOne* gave particular attention to the basic computer skills each modern professional must possess, regardless to her/his field of activity. Hence, the project suggested to Universities how to “spend” the CFUs dedicated to the acquisition of the abilities in using a Personal Computer as a working tool, and especially how to assess whether their students actually acquired these abilities.

For the reasons discussed above, in the *CampusOne* project the certification approach to basic ICT competences has been strongly encouraged, also by means of funds specifically dedicated to support the adoption of ECDL (the well known European Computer Driving License) as the main certification scheme for assessing computer usage abilities by first-year students of most of the bachelor courses.

The dimension of the *CampusOne* project with respect to ECDL certification can be easily grasped by looking at Figure 1, which reports the number of ECDL certifications obtained by Italian University students after the launch of the project itself: it is just worth noticing that – after an obvious transient due to the start-up of the project – the number of certifications suddenly increased up to 19,000 per year, with slower increases in the following years.

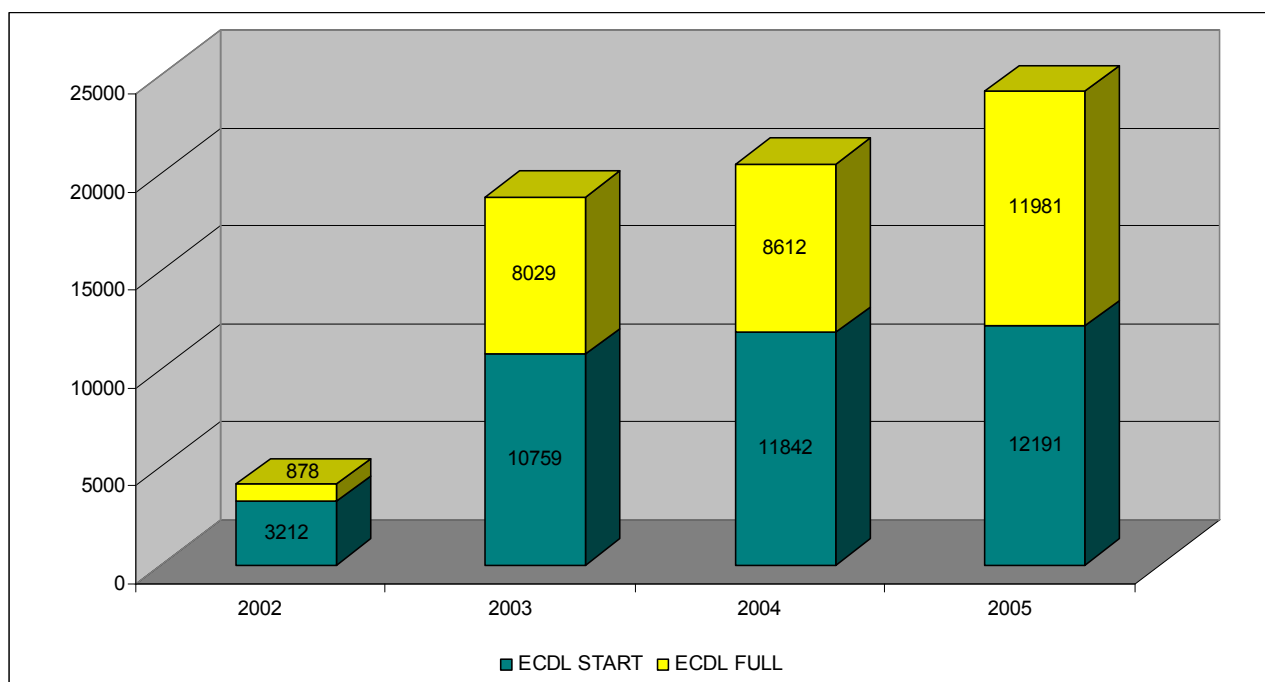


Figure 1 – Yearly distribution of the number of ECDL START and ECDL FULL certifications

To better understand the dimension of the *CampusOne* project with respect to ECDL certification, it is possible to compare the number of licenses with the number of freshman students who entered the University, as reported in Figure 2, which has been drawn using data published by the Italian Ministry of University [3].

From this figure, it can be seen that the percentage of freshman students (i.e., students entering the University for their first year in a bachelor) obtaining the ECDL license constantly increased over the years. By considering that ICT certifications were almost completely neglected by Universities before the *CampusOne* project, and that the figure takes into account ALL freshman students (including students enrolled in scientific courses, where the skills addressed by ECDL are generally already owned), the impact of the *CampusOne* project can be considered definitely significant.

However, future perspectives require some investment in different kinds of basic ICT skills certifications, mainly for the following reasons:

- the level of competences certified by ECDL is very basic, and definitely not adequate to high-profile professionals like students graduating in the knowledge era;
- the competences certified by ECDL are the capabilities of using basic ICT tools (word processors, spreadsheets, etc.) *without any reference to the professional activities of the certified*. In other words, these competences are “package oriented” (i.e., how to move around menus of the package) instead of “problem oriented” (i.e., how to use a package to solve a specific problem, typical of the field of activities of the certified).

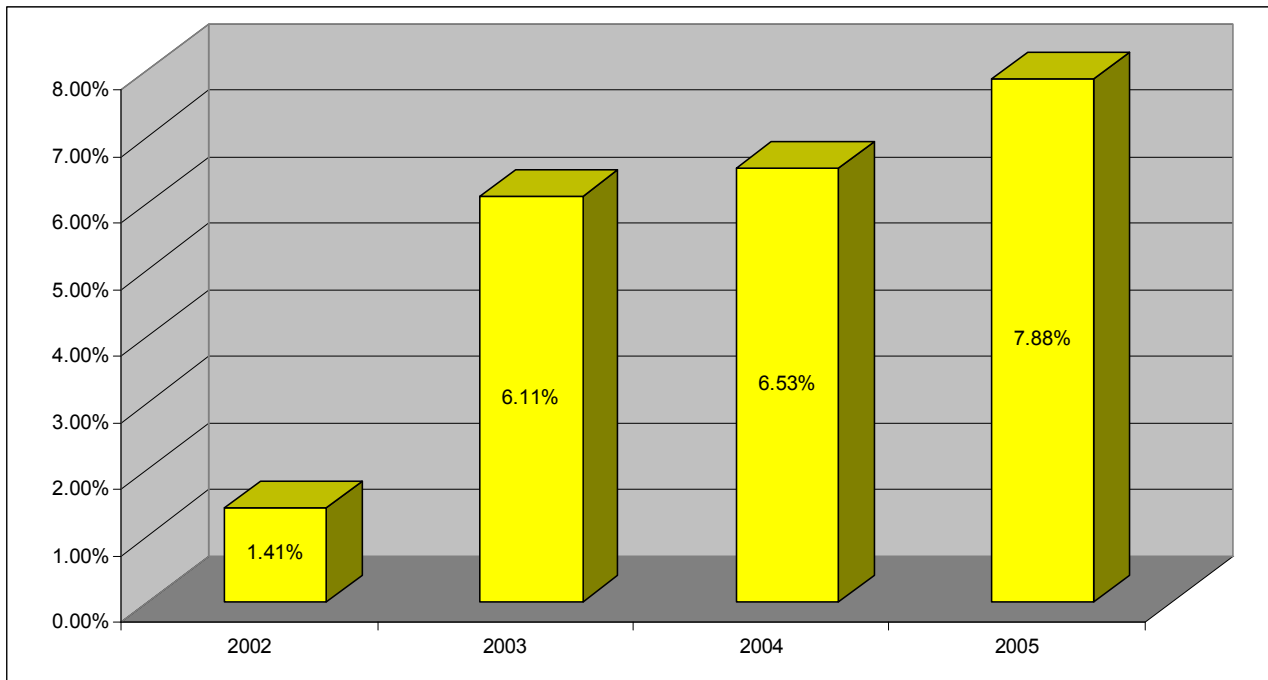


Figure 2 – Percentage of ECDL licenses vs. number of first-year students

3 – BASIC SKILLS IN COMPUTER USAGE: THE IT4PS PROJECT

IT4PS (Information Technology for Problem Solving) is a joint project between CRUI Foundation (the operating body of the Italian Universities Chancellors Conference: CRUI) and AICA involving several Italian Universities. The project started in the second half of 2003 and is expected to end by mid 2007 [4].

The main goal of IT4PS is to support and to enhance the acquisition – by University students – of advanced skills in the usage of productivity tools (spreadsheets and database managers) and the application of these tools to daily problems of the students themselves. To this purpose, the project defined a learning methodology based on a problem-solving approach, using problems typical of the various University courses to introduce students to the acquisition of the above-mentioned advanced skills.

In its first phase – mid 2003 to mid 2005 – IT4PS addressed three different areas of application of productivity tools in University curricula: Economy, Medicine and Pharmacy, and Statistics for Social Sciences. In these areas, the project produced the following:

- Didactic materials, supporting teachers in their practical explanations of the problem solving approach;
- 2 authoring systems, allowing teachers to prepare guided solutions to problems (respectively, with spreadsheets and databases) and students to compare their own solutions with those of the teacher in a self-evaluating environment;
- 6 reference books (published by McGraw-Hill Italy) applying, respectively, spreadsheets and databases to the three areas of application;
- 1 reference book (again published by McGraw-Hill Italy) for the authoring systems;
- Field-testing of the problem oriented approach in some 20 Universities, involving more than 250 students.

The results of the field-testing were definitely encouraging (both students and teachers had very positive feelings about the problem oriented approach). However, the skills acquired by students were in general not sufficient to allow them to obtain an Advanced ECDL certification, mainly due to the package oriented approach of the certification itself.

To address this problem, a second phase of IT4PS has been launched, and it is expected to end in mid 2007. The aim of this second phase is to define a certification scheme specific of the IT4PS approach, where students will be asked to solve significant, context-oriented problems instead of simply demonstrate deep knowledge of the productivity tools.

At present, several Italian Universities are teaching context-oriented usage of spreadsheet and/or database manager to around 200 students following University courses related to the three areas of application recalled above. Before summer, these students will undergo the certification exam based on a set of context-oriented problems to evaluate their capability of actually *solving a problem* with the ICT tool. Results of this work will lead to the formal definition of an IT4PS certification, first offered at the Italian level, subsequently “exported” to the European level.

4 – ADVANCED CERTIFICATIONS FOR ICT PROFESSIONALS: THE EUCIP4U PROJECT

This second project related to ICT certifications in Italian Universities moves from the existence of a certification scheme – EUCIP – defined at the European level to embed general and vendor-dependent competences for ICT professionals and ICT managers.

EUCIP (European Certification of IT Professionals) is an initiative of CEPIS (Council of European Professionals Informatics Societies) aimed at providing a professional certification as the result of a matrix of learning curricula for the development of ICT professionals competences.

The EUCIP matrix is organised in “competence levels” and “competence areas”, in the following way.

Competence levels

- *Core* level, which includes a set of competences required by all ICT professionals and managers. This level covers basic aspects of all the three fundamental areas: *plan*, *build* and *operate*, and it is considered compulsory for all ICT professionals and also for all managers having to deal with ICT systems implementation and maintenance. However, it is not sufficient to qualify as ICT professional, and must be complemented by the higher level.
- *Elective* level, certifying a specialized competence obtained by suitably composing elements – i.e., learning modules – coming from the three competence areas. These modules can be constituted by University courses, vendor-dependent certifications, documented professional experiences. The mix of modules owned by a candidate constitutes her/his own “competence portfolio”, and must conform to one of the professional profiles (e.g., *Network Manager*, *Business Analyst*, *I.S. Project Manager*) defined by the EUCIP scheme.

Competence areas

- *Plan*, devoted to analysis of requirements in the ICT framework and to planning of adoption of the related technologies in professional organisations and Industries. The area is connected to management processes, with particular emphasis to strategic decisions. Typical elements of this area are industrial organisation, return of investment, process analysis, funding, risk analysis, planning.
- *Build*, encompassing specification, development and acquisition of ICT systems. Core elements of this area are all the aspects related to design, implementation and integration of ICT systems.
- *Operate*, concerning the installation, the supervision and the maintenance of ICT systems. Fundamental aspects of this area are system integration, network management, release management, user support.

The EUCIP certification scheme has several interesting characteristics, which made it particularly suited to become a bridge between Universities and Industries.

First of all, it comes from the joint work of a group of people inside CEPIS, where Industries are well represented; thus it gives a clear picture of what European Industries consider as basic competences and advanced skills an ICT professional must possess.

Second, the scheme encompasses vendor-dependent certifications, but integrating them into profiles where methodologies and fundamental competences – typically addressed by Universities – play the role of the general “house” where specific competences become useful “bricks”.

Third, EUCIP considers significant professional experiences as part of the competence portfolio, thus allowing a structured way of addressing the area of lifelong learning, where people already working on the field can access Universities to improve and refresh her/his own competence profile.

Currently, in Italy, some joint activities are being carried on together by AICA and the Italian Institute of Engineers (Ordine degli Ingegneri) to use EUCIP as a general framework for identifying and assessing professional competences in ICT.

For all these reasons, in 2004, AICA, CRUI Foundation and the Italian inter-University ICT Consortium CINI launched the EUCIP4U project, aimed at introducing EUCIP into Universities.

The project started with the introduction of the EUCIP *core* certification for students in computer engineering and computer science, with the aim to develop into two subsequent direction:

- involve in EUCIP *core* also economists and technical managers;
- evolve towards EUCIP elective for computer engineers and scientists.

As a first activity, EUCIP4U made a mapping between the EUCIP *core* syllabus and most of the University curricula in computer engineering and computer science, to identify possible uncovered areas.

This phase – which highlighted a general mismatch between EUCIP syllabus and University curricula especially in the *plan* area – has been validated by asking around 200 students, following the third (last) year of University curricula in computer engineering and science, to undergo a simulated certification test. Results given in Table 1 clearly confirm the lack of competences these students have in the topics typical of the *plan* area.

Table 1 – Results of the EUCIP *core* trial (June 2004)

	PLAN	BUILD	OPERATE
Succeeding students	35.7 %	76.7 %	79.5 %

Then, the EUCIP4U project developed specific e-learning materials to fill the gap between University curricula and the EUCIP *core* syllabus, offering those materials to students at a particularly favourable rate, to let them access the “real” certification exam in a more comfortable way.

The results – reported in Table 2 – clearly show the utility of the specific training, but still highlight the difficulties for third-year ICT students to obtain the EUCIP *core* certification, despite their competence at least in all the topics addressed by the *build* and the *operate* areas. Surely, one of the main reasons for such a result is that the EUCIP certification is based on a multiple-choice set of questions in English language, whose knowledge by Italian University students is still too poor to allow them to deal with this kind of tests in a comfortable way.

Table 2 – Results of the EUCIP *core* exams (2004-2006)

year	PLAN		BUILD		OPERATE	
	Candidates	% of success	Candidates	% of success	Candidates	% of success
2004	166	52.4 %	181	70.7 %	179	65.4 %
2005	166	57.8 %	139	63.3 %	139	61.2 %
2006	238	60.9 %	213	68.5 %	200	67.0 %
TOTAL	570	57.5 %	533	67.9 %	518	64.9 %

5 – CONCLUDING REMARKS

The three projects above summarized – *CampusOne*, *IT4PS* and *EUCIP4U* – even if addressing ICT certifications from different perspectives and with different aims, share the same final considerations:

- third-part certifications of competences in the ICT area can be a significant contribution to the visibility and the mobility of graduated students, either aimed at becoming ICT professionals or ICT advanced users;
- cooperation between Universities and Industries in defining competence profiles is essential to supply to the ICT job market professionals capable of satisfying Industry needs but also able to dominate technological evolutions;
- Industry recognition of ICT certifications importance is absolutely critical to support diffusion of certifications inside Universities.

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