Strategies to Promote the Development of E-competencies in the Next Generation of Professionals: European and International Trends

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Juan Cristobal Cobo Romani

Communication and Information Technology Department,
Latin-American Faculty of Social Sciences, Campus Mexico (FLACSO-Mexico)

Editor's Foreword

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Abstract

This study[1] analyses the effectiveness of policies, strategies and programmes that promote the acquisition of e-literacies, focusing in particular on the younger generation who will be joining the labour force in the next five to ten years. Based on the benchmarking of different studies about the impact of information and communication technologies (ICTs) on students' learning, this work proposes a re-definition of the term 'e-competencies'[2]. Moreover, a set of best practices for the development of the future e-competent labour force are identified. Although the scope for this paper is primarily the countries of the European Union, worldwide studies are also considered.

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[1] The work was developed during the period March-May 2009 at the Centre on Skills, Knowledge and Organisational Performance (SKOPE).
[2] During this research the terms 'e-competencies', 'ICT competencies' and 'digital competencies' will be used as synonymous.

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Introduction

Irrespective of age, political tendency or social position most people agree that it is imperative to adjust the current education system to the rapidly changing world of work. The integration of different trends such as globalisation, the information society[3], the current economic crisis and professionals' mobility make this necessity a collective concern.

From a global perspective, the OECD (2006) remarks on the current correlation between investment in human capital, labour productivity and the growth of nations. At the same time this international organisation refers to the mismatch between the skills taught in schools and those demanded by companies today, adding that many countries are experiencing skill gaps which are directly affecting the employability of the current and future labour force. In addition to a higher qualified workforce UNESCO (2008a) highlights capital deepening[4] and technological innovation as factors that lead to increased productivity and competitiveness in a knowledge-based economy.

This study proposes a general review of the main trends that shape the current education systems, particularly in relation to the adoption of ICTs as instruments to improve the learning process and facilitate the preparation of a more proficient workforce. This study provides baseline information about significant trends that are likely to have an impact on the development of e-competencies in the coming years. After carrying out a comparative analysis (benchmarking) this study identifies trends and criteria that should be considered in the designing of public policies, strategies and programmes that promote the acquisition of e-competencies in the European framework and particularly in the British context as recommended by the European Commission (2008c, p.2):

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[3] 'The information society is revolutionising many areas of everyday life, particularly access to training and knowledge (distance learning, e-learning related services), work organisation and mobilisation of skills (teleworking, virtual companies), practical life (e-health services) and leisure [...] In the light of these potential benefits and threats, the European Union has placed the information society at the heart of its strategy for the 21st century. Among other things it has launched a series of support and promotion actions (eEurope action plan) and adopted measures aimed at controlling and limiting the risks associated with the development of the information society such as an action plan aimed at promoting safe use of the Internet and combating unlawful and harmful messages.' (European Union, 2004). 'The 'information economy' consists of the economic activities of those industries that produce content, and of the ICT industries that move and display the content. These economic activities include the use of information and of ICT products by both people and business. The 'information society' includes the social impact of the information economy.' (OECD, 2005c).

[4] Capital Deepening: 'Increases in the amount of real capital per unit of labour'. (Atack, Bateman, Margo, 2004)

> Building higher skills through better education and training systems is an essential part of Europe's strategy to meet future challenges such as the ageing of society and to deliver the high levels of sustainable, knowledge-based growth and jobs that are at the heart of the Lisbon strategy.

The *Lisbon Agenda* has played a relevant role shaping the mid-term growth and employment agenda of the European Commission particularly during the first decade of the 21st century. This programme embraces objectives to attain the aspired levels of employability in the European labour force. These initiatives include improving the quality and effectiveness of education and training systems, better investment in human capital, encouraging the development of key competencies, promoting the creation of new knowledge (R&D) and innovation, creativity and entrepreneurship among other transversal competencies. The eight key competencies included in the *Lisbon Agenda* are: 1) Communication in the mother tongue; 2) Communication in foreign languages; 3) Mathematical competence and basic competencies in science and technology; 4) Digital competence; 5) Learning to learn; 6) Social and civic competencies; 7) Sense of initiative and entrepreneurship; 8) Cultural awareness and expression (European Commission, 2007).

In the context of education and employability it is interesting to see the importance that the notion of an ICT proficient workforce has achieved in the European agenda. Even from a broader perspective, beyond the European framework, the integration of technology in the classroom has almost become an 'essential' approach to improve the learning process (European Commission, 2007). In this context, the OECD has announced that their parametric-standardised evaluation: *Programme for International Student Assessment* (PISA[5]) could include a whole new section to evaluate the cognitive competencies related to the use of technologies. Under the premise that 'ICT forms an essential part of life in the modern world' this international organisation is evaluating application of a world-wide ICT skills test on 15-year-old schoolchildren.

In 2003, PISA undertook a survey to identify the extent to which students used computers and felt comfortable using them. For 2009 the assessment of reading electronic texts has been planned and for 2012 the goal is to implement supplementary

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[5] PISA is a regular survey of the knowledge and skills of 15-year-olds. The aim of the study is to assess aspects of young people's preparedness for adult life. The first cycle of the survey was during 2000. The study is repeated every 3 years. In the 2003 PISA study, 41 countries participated, and 57 countries took part in the study in 2006 (Turmo, Lie, 2006).

computer evaluations in focus areas such as assessing the development of a new ICT literacy. The idea is to test the ability of students to respond to different sets of questions related to the use of ICTs. Even considering that this new assessment has not yet been implemented, official OECD documents (OECD, 2005b; OECD, 2007a) show an awareness of the development of e-literacies.

In the framework of the post-industrial society, the widespread use of ICTs has brought significant transformation to the labour market. The expansion of ICTs is shaping a much more complex phenomenon than the simple computerisation of tasks. Nowadays the workforce demands highly skilled and educated employees, proficient in the use of ICT and able to manage information and knowledge. As well as the declining demand in *routine jobs*, carried out by low-qualified employees, there is a considerable increase in the demand for *non-routine jobs*. There are studies that register an increase in the demand for highly-qualified employees with abilities to perform cognitive, analytical and interactive complex tasks (Autor, Levy and Murnane, 2003).

The acquisition of ICT competencies is increasingly becoming a key requirement for employability (Card and Dinardo, 2002; Torrent, 2008). The described trends have been particularly prominent in the last decades and without doubt they have been influencing the education sector. The *Lisbon Agenda* and the PISA assessment are two different trans-national initiatives that are dealing with this phenomenon.

All these factors emphasise the necessity of a sharp shift in education. Considering this scenario, an increasing number of nations are trying to transform and update their educational systems supported by the use of ICTs. Some of them are just bringing computers and connectivity to the classroom; meanwhile others are systematically trying to reduce the gap between the e-skilled and the non e-skilled students.

This work is organised in three main sections. Each one of them analyses the main challenges that current education faces. The context of analysis is focused on how primary and lower secondary education (formal education, Key Stage 1 to 3[6]) reacts to the accelerated changes of a knowledge-based economy. The premise that supports this investigation arose from the idea that industrial and post-industrial

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[6] In the UK context: Key Stage 1 (children from 5 to 7 years); Key Stage 2 (children from 7 to 11 years) and Key Stage 3 (children from 11 to 14 years).

societies are increasingly dependent on the strategic use of knowledge, information and ICT. In that sense, significant improvements are required in the education sector to better train the generation of students who will join the labour force in the coming decade (2010-2020).

The next section of this paper presents an analysis of international studies which have evaluated the outcomes of ICTs in the teaching-learning process, predominantly in primary and lower secondary education. This comparative review analyses current studies which assess the consequences of ICTs in schools, identifying how *access* and *use* of ICTs impact on students' learning. This benchmarking explores the questions of how schools are embedding ICTs and whether ICTs enrich the students' ability to learn.

Section 3 offers a revision of the commonly used ICT skills definitions. Based on a critical review of those concepts adopted by international organisations, an updated description of the meta competency (e-competencies) and their underlying concepts is suggested. The new definition proposes an approach to examining what 'e-competencies' mean.

Section 4 identifies, articulates and suggests criteria, programmes and experiences that could support public policies and educational strategies to enhance the development of e-competencies. The best practices proposed in this section are the result of a literature review and expert interviews. The aim is to identify how to improve young students' preparation for their professional life and to recommend best practices.

The conclusions summarise the main findings described in this study and identify a range of national experiences that could be considered in future analyses. Finally, the paper suggests the necessity of consolidating a theoretical framework that can support the future academic and political initiatives in this field.

Benchmarking of Different Studies

A significant number of countries have incorporated in their agenda the inclusion of technology in schools. After a decade or more, there is a growing interest in evaluating the effectiveness of ICTs in students' learning (OECD, 2004; Balanskat, Blamire and Kefala, 2006; European Commission, 2008a). The British Department of State for Children, Schools and Families (DCSF), for instance, asked Sir Jim Rose to

carry out an independent review of the primary curriculum in England in order to explore how to raise standards in reading, writing and numeracy. The interim report stated:

> Because ICT has the unique capacity and potential for developing and enlivening all domains of learning, including literacy and numeracy, it should also be taught both discretely to capture its essential knowledge and skills and through its applications across the whole curriculum to deepen understanding. The review has conducted a small scale survey, the indications from which are that ICT is not yet providing value for money in many schools. (Rose, 2008, p.43-44)

Rose adds that ICTs are not being employed appropriately to support students' learning. His critical statements suggest the need to review further studies on the impact of ICTs in the learning process. Have ICT investments in schools in different countries generated the expected impact concerning the development of students' skills and major improvement in their learning performance (OECD, 2004; Balanskat, 2005).

The research analysed in this section offers a broad perspective of how ICTs have influenced education. The documents were selected because they critically evaluate the impact of technologies in schools. They cover a span of eight years (2001-2009) and include the following geographic areas: four world-wide international comparative studies; six European sources; four studies based on the North American area; and one Israeli and one Colombian study. The five criteria used for the selection of the studies, presented in Table 1 are:

1. **Evaluating the impact of ICTs in education**: Investigations that assess how ICTs change or affect the learning performance of students at school;

2. **Critical studies**: Investigations that explore the problems, causes of failure or possible solutions to improve the impact of ICT in education;

3. **Current investigations**: Research or reports that were published after 2000.

4. **Credibility**: Studies developed or sponsored by institutions such as the OECD, the World Bank, the European Commission, etc, which have been constantly dealing with this field; and

5. **Comparative information**: Studies which report information related to one or more of the following categories:

- Relationship between '*access*' to ICTs at school and '*learning performance*' of students.

- '*Use*' of ICTs at school.

- Relationship between '*use*' of ICTs and '*access*' to ICTs at school[7].

- Relationship between '*use*' of ICTs and '*learning performance*' of students.

It is important to note that the selected studies (16 in total) are not necessarily statistically representative of the countries where those studies were developed. The reviewing of these results from *national* (USA, Israel and Colombia) or *international* research (EU, OECD, World Bank, IEA) was considered a useful approach to identify trends related to the impact of ICTs at school.

1.1   Analysis of the results in the category: 'Access and Learning Performance'

The research included in Table 2 refers to the correlation between 'access to ICT' and 'learning performance' and shows that there is no consistent relation between the mere availability of ICTs in schools ('access') and students' learning. Furthermore, these studies suggest that the impact of the acquisition of ICTs in education is not as evident as was expected.

At the same time, the refereed studies remark on the methodological challenge related to finding the appropriate technique and instrument to assess students' performance in order to identify a correlation between 'access to ICT' and the 'learning' of the students. On the other hand, it is interesting to observe that even recent studies (2005), which were developed more than ten years after the expansion of the Internet and the incorporation of computers in the classroom, still declare that it is 'too early' to identify the impact of ICTs on students' performance.

Two ideas are, therefore, noteworthy. The first one has to do with the *temporal* dimension. These studies emphasise the idea that the impact of ICTs on the learning process could generate medium-term effects. This factor could increase the complexity of identifying impacts through short-time studies. Nevertheless, the *length* dimension seems to be linked to the difficulty of finding a significant impact. The second dimension has to do with the *subjects* that are evaluated. The challenge is to identify whether students acquire new skills, proficiencies and abilities due to the support of ICTs. These achievements can hardly be evaluated by standardised assessments (e.g. 'compositional effect'). In this sense, it is necessary to consider the

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[7] '*Access*' is considered by this study as a *macro indicator* related with the *outcome* of ICT and education policies (e.g. number of computers, students per computer, average Internet connection). Meanwhile, '*use*' is considered as a micro indicator related to the impact of ICT and ICT and education policies (e.g. type of use of ICT, learning outcomes, place where ICT is used).

design of new instruments (tests) to evaluate *other* outcomes related to the learning process (e.g. 'soft skills'). These are some of the major methodological challenges that the research identifies.

To summarise, the reviewed sources find a lack of evident correlation between 'access to ITC' in the school and the 'students' learning outcomes'. At least based on these studies it is possible to identify that the continuous investments in technology have not necessarily translated into the required solutions to improve the largely unresolved problems of ICT in education.

1.2 Analysis of the results in the category 'Use'

The international parametric world-wide study conducted by the OECD (2005) indicates the relevance of the location where the ICTs are used during the learning process. Interestingly, Table 3 shows how the physical location of the computers is an important factor in a student's performance. Particularly the student's use at *home* is correlated positively with their ICT deployment and their learning achievement.

On the other hand, it is important to consider that the students' use of ICTs at home could be linked with complementary approaches to the learning process (e.g. informal learning, learning by doing and peer-learning). In addition it is interesting that students in Denmark, for instance, lead the acquisition of ICT skills through self-study and informal learning (friends, colleagues and/or relatives) but also have a lower position in relation to the acquisition of ICT skills through formal training (in comparison with the situation in Britain).

In terms of the amount of time the technology is used it is interesting to see that the Nordic countries (also called *frontrunners* for their advanced position in the knowledge economy[8]) register higher numbers of teachers who hardly use ICTs in the classroom (less than 5% of their lessons). Also, the percentage of teachers who use ICTs for more than 50% of their lessons is lower than in other countries. These results refer to the way in which ICTs are used in the classroom. It seems to be more relevant *how* the ICTs are used rather than the *amount of time* spent using them. This trend is particularly relevant in countries like Denmark and Sweden. In other words, some of

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[8] The classification 'most advanced countries' is based on the results of the Knowledge Economic Index (2008) set by the World Bank to measures the level of development of a country or region towards the Knowledge Economy. From the 12 variables required to measure that index, 8 of them are related with technology, education and innovation. The highest ranked countries are: Denmark, Sweden and Finland; UK is placed in the eighth position and USA one place below. (www.worldbank.org/kam)

the most networked countries in Europe are among the lowest users of ICTs in the classroom.

These results lead to the hypothesis that rather than the amount of time using the technology in the classroom what seems to be strategic is the *effective* use of ICTs. Summarising these studies the identified aspects that affect an *effective* use of ICTs in the schools are: teachers' lack of skills in using computers for instructional purposes; insufficient time to prepare lessons; inadequate pedagogic strategies to incorporate the technologies in the classroom; not enough organisational preparation, insufficient maintenance and staff support. The lack of confidence and motivation of educators leads to an underexploited use of ICTs during their teaching.

Furthermore, the successful adoption of ICTs through teachers' and students' performance will lead to new and different ways of using the technology. This trend reflects a shift in focus from the *tool* to the *content*. This can be described as a transformation of the students' and teachers' roles, which shift from *ICT user* to *e-competent user*. This means that the technology is not as relevant as the *knowledge* and the *information* that can be accessed, understood, created and/or communicated. The most proficient use of the technologies will depend on the development of complex abilities, skills and competence that surpasses the mere technical use of ICTs (Tapscott, 2008).

1.3 Analysis of the results in category: 'Use and Access'

The studies, summarised in Table 4, indicate that there is no consistent correlation between ICT access and the percentage of teachers who report having used ICTs in class. Unlike the expectation generated by policymakers and promoters, the reports point out that the incorporation of technology in schools (over the past two decades) has *not* resulted in a transformation of teaching and learning methods. Interestingly, teachers are using ICTs mainly for administrative tasks rather than for their teaching activities.

As was previously mentioned, teachers in *advanced countries*[9] like Sweden, Finland and Denmark are not necessarily intensive ICT users (particularly in the formal environment of learning). It seems that in these countries where the use of the

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[9] Knowledge Economic Index (2008). www.worldbank.org/kam

ICTs and connectivity is very high[10], there is no evidence that it is necessary to encourage the intensive use of computers at school. A possible interpretation of this result is that Internet access in the Nordic countries is increasingly ubiquitous and that students have several other locations available to access ICTs than at school. Consequently, the learning environment expands to *other places* beyond the school in ICT use.

There is a manifest challenge to be faced to move from the technical use of ICTs to the development of a complex set of abilities and competencies, which are linked to aspects such as the informal development of ICT abilities, e-maturity[11], access, willingness, pedagogic strategies, organisational monitoring, physical and social environment, among others.

1.4   Analysis of the results in the category: 'Use and Learning Performance'

Considering that the use of ICT in education has been a priority in most European countries for at least a decade, the impact has been irregular and inconsistent. If the relationship described in Table 5 between 'use of ICT' and 'learning performance' is not clear enough, it is necessary to identify the causes that affect the accomplishment of higher learning achievements. The lack of evident correlation does not prove that a relationship exists at all. It could not be confirmed that students' learning through technologies was nil or minimal. However the collected results do not seem to be clear enough to identify which aspects relating to the adoption and use of the technologies contributes to improvement in the learning process.

The impact-evaluation studies find that the time spent using the computer at school is not associated with better performance of the learners. However, one of the successful practices mentioned in the research identifies that the impact of ICT use is highly dependent on the teaching approaches. A recommendation made in these studies is: better ICT training for teachers in order to improve their pedagogical strategies and methods to embed the technology. In addition, a successful incorporation of ICTs demands a sound transformation in the educational organisation; a change in the workplace, a new learning environment and the incorporation of informal learning settings are some of the things that need to be

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[10] In Denmark, Finland and Sweden the average population with access to the internet is higher than 80% (Internet World Stats, 2008). Internet Usage in Europe. Internet World Stats. http://www.internetworldstats.com/stats4.htm# europe

[11] See Durando, Blamire, Balanskat, and Joyce 2007

strengthened. Interestingly, the self-learning and informal peer-learning are described as one of the most significant approaches for obtaining ICT skills.

Despite the increasing adoption and demand for ICTs in education, there are very few *systematic* studies and 'hard data' about the impact of technologies on learning achievement. The reasons for this lack of information could be due to the methodological challenge that these sort of evaluations imply. Some of the causes that constitute this methodological challenge include: the significant *length* of the learning process, the diversity of the *learning outcomes*, the variety of *locations* where the learning process takes place and a proficient comprehension of the *role of ICT* in the classroom.

Considering that the positive impact of ICT use in education has not been proven consistently, the question of future impact still remains open. More nationwide micro-studies are needed to explore the extent to which, for individual students, certain kinds of computer usage raise performance, and which kinds are most effective. What seems to be clear is the necessity of designing better strategies in terms of public policy and pedagogical approach, as well as a different understanding of the impact of ICTs and use of ICTs in order to train a more e-competent generation of students and teachers.

1.5   Discussion of findings

The fact there is no *technological determinism* (Pedersen, 2001) represents one of the main conclusions of this comparative analysis. Despite the adoption of ICTs in education and training during the last decade, progress has been extremely uneven. The comparative review based on 16 recent studies and surveys carried out at national, European and international level, confirms the challenges in relation to the adoption of technology in the classroom. The following statements are a summary of this review:

1. *Advanced countries*[12] are not (very) intensive ICT users in class;

2. There is no correlation between the level of ICT access and the percentage of ICT use;

3. The frequency of ICT use among students does not determine their academic performance;

4. The impact on education and training has not been as great as expected;

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[12] Knowledge Economic Index (2008). www.worldbank.org/kam

5. There are no clear advances over the last decade that can be confidently attributed to broader access to PCs;

6. There is very little scientifically based research to gauge the effectiveness of ICT;

7. Students of the most *advanced countries* developed their ICT skills (mostly) through self and informal learning;

8. Educators use technologies regularly at school for administrative tasks, but substantially fewer for instruction-related tasks;

9. Assessing the impact of ICT in the learning experience demands new instruments, methodologies and surveys; and

10. There is a lack of coordination between the adoption of technology in the classroom and the embracing of flexible and innovative teaching-learning strategies.

The students' understanding of ICT is beyond the traditional idea of *technologies*. These devices are used by the youngest generation in versatile and changing ways, as tools to communicate, to share, to create, etc. These digital devices are 'invisible' for young students, because what really matters to them is what they can do with these instruments (Tapscott, 2008). In this sense, an increasing challenge that the education sector faces is the necessity to update the knowledge of teachers, their pedagogical strategies and also their competencies in the use of and also in the understanding of ICT. In other words, the education system needs educators who are able to create, connect, enrich and transfer knowledge among people. For years technological infrastructure has been one of the priority strategies of education policies (OECD, 2004). However, a review of these studies indicates that the education sector needs to give more priority to the development of ICT competencies alongside other soft skills.

Table 1: List of studies included in the comparative analysis

ID	Scope of the Research	Kind of Study	Author/Year	Name of the Study	Institution (author's affiliation)
Int.1	EU Member States	Evaluation of Impact	Korte & Hüsing (2006)	'Benchmarking Access and Use of ICT in European Schools. Report from Head Teacher and Classroom Teacher'	Empirica (Germany)
Int.2	41 Countries	Evaluation of Impact	OECD (2005)	'Are Students Ready for a Technology-Rich World?'	OECD
Int.3	EU Member States, Australia, N. Zealand, Canada, USA and Korea	Indicators and benchmarks	Commission of the European Communities (2008a)	'Progress Towards The Lisbon Objectives In Education and Training Indicators and benchmarks'	European Commission
Int.4	EU Member States	Indicators and benchmarks	European Commission (2008d)	'The use of ICT to support innovation and lifelong learning for all - A report on progress'	European Commission
Int.5	22 Countries	Indicators and benchmarks	Law, Pelgrum & Plomp (eds) (2006)	'Pedagogy and ICT use in school around the world'	International Association for the Evaluation of Educational Achievement
Int.6	15 Countries	Indicators and benchmarks	OECD (2004)	'Completing the Foundation for Lifelong Learning. An OECD survey of upper secondary schools'	OECD
Int.7	EU Member States	Indicators and benchmarks	Eurostat (2005)	'Evaluation of education, training and skills data sources (ISOC_SK_HOW_I)'	Eurostat, EU
Int.8	Developing Countries	Evaluation of ICT for education impact	Kozma (2005)	'Monitoring and Evaluation of ICT in Education Projects: A Handbook for Developing Countries' (InfoDev)	The World Bank
Int.9	EU Member States and Australia	Evaluation of implementation by comparing outcomes	Rosado & Bélisle (2006)	'Analysing Digital Literacy Frameworks'	(European Framework for Digital Literacy) European Commission
Int.10	EU Member States	Review of ICT impact on learning outcomes	Balanskat, Blamire & Kefala (2007)	'The ICT Impact Report. A review of studies of ICT impact on schools in Europe'	European Schoolnet (European Commission)
Usa.11	USA	Controlled evaluation study	Kulik (2003)	'Effects of Using Instructional Technology in Elementary and Secondary Schools: What Controlled Evaluation Studies Say'	SRI International (USA)
Usa.12	USA	Case studies	Cuban (2001)	'Oversold and Underused Computers In The Classroom'	University of Stanford (USA)
Usa.13	USA	Monitoring and evaluation of ICT for education impact	Goolsbee & Guryan (2005)	'The Impact of Internet Subsidies in Public Schools'	University of Chicago (USA)
Usa.14	USA	Survey applied to 1,934 educators	National Education Association (2008)	'Access, Adequacy, and Equity in Education Technology: Results of a Survey of America's Teachers and Support Professionals on Technology in Public Schools and Classrooms'	NEA & The American Federation of Teachers (USA)
Col.15	Colombia	Monitoring and evaluation of ICT for education impact	Barrera-Osorio & Linden (2009)	'The Use and Misuse of Computers in Education: Evidence from a Randomised Experiment in Colombia'	The World Bank, Human Development Network
Isr.16	Israel	Evaluation of impact	Angrist & Lavy (2002)	'New evidence on classroom computers and pupil learning'	MIT and NBER, Hebrew University

Table 2: Category - Relationship between 'access' to ICTs in the school and 'learning performance' of the students

Excerpt	Source	Country
(Usa.12) 'The contribution that school courses and experiences have made to computer literacy and competitiveness in the workplace remains, at best, murky'	Harvard University Press, 2001	USA
(Usa.12) 'As for enhanced efficiency in learning and teaching, there have been no advances (measured by higher academic achievement of urban, suburban, or rural students) over the last decade that can be confidently attributed to broader access to computers'	Harvard University Press, 2001	USA
(Usa.13) 'The results show no evidence that Internet investment had any measurable effect on student achievement. None of the estimates reported in the table are statistically different from zero […] It is possible that it is too early to evaluate long-term investments in information technology or that the gains took place in areas other than test scores (better researched papers, for example), but thus far at least the increase of Internet investment appears to have not had a measurable impact on student achievement'	University of Chicago, 2005	USA
(Int.5) 'Increasing levels of computers access does not bring about more learning experiences conducive to the development of 21st-century learning outcomes for students'	IEA SITES, 2006	22 countries
(Usa.14) Yet, despite these significant investments of resources and time, the debate on education technology is still largely unresolved.	National Education Association, 2008	USA
(Int.8) 'The most pronounced finding of empirical studies on ICT impact is that there is no consistent relationship between the mere availability or use of ICT and student learning. Two major studies in the U.S. found a positive relationship between availability of computers in schools and test scores. A study in Australia found no relationship between computer availability in schools and test scores. Two large studies, an international study by Fuchs and Woessmann involving 31 developed and emerging countries and another by Wenglinsky surveying U.S. schools , found a negative relationship between the availability of computers in the home and achievement scores'	The World Bank, 2005	Developing countries

Table 3: Category - 'Use' of ICT at school

Excerpt	Source	Country
(Int.2) 'The PISA evidence confirms previous studies showing the particularly strong association of performance with home access and usage'	OECD, 2005	41 countries
(Int.1) It seems to be relevant that the most advanced countries (Denmark - Sweden) have a higher number of teachers who use ICT in less than 5% of their class.	Empirica, 2006	EU
(Int.1) At the same time, the percentage of teachers who use the computer in more than 50% of lessons is lower in the most advanced countries.	Empirica, 2006	EU
(Int.1) The percentage of teachers who think that the students are more motivated and attentive when computers and the Internet are used in class is lower in the most advanced countries.	Empirica, 2006	EU
(Int.3) According to the Global Information Technology Report 2007-2008, Denmark is the most networked economy in the world, followed by Sweden […] It is interesting to see (PISA, 2006) Finland and Sweden among the lowest users of ICT in Europe.	EU Commission, 2008a	EU, USA, Australia, N. Zealand, Canada & Korea.
(Int.6) 'The question is not whether a school should or should not provide computers for teacher and student use but whether the present provision for student and teacher computers is adequate for using computers as media resources for (self-) instruction'.	OECD, 2004	15 Countries
(Int.6) 'Teachers' lack of skills in using computers for instructional purposes and insufficient time for teachers to prepare lessons in which computers are used are the problems most often mentioned as obstacles to integrating digital technology in the work of the school'	OECD, 2004	15 Countries
(Int.6) 'Principals reported that less than half of teachers use computer applications, about four teachers in ten use the Internet'	OECD, 2004	15 Countries
(Int.6) Obstacles related to teachers: 'Lack of teacher knowledge and skills is typically the second-most serious obstacles perceive by principals. […] There seems to be permanent teacher frustration and need for further training which is rarely calculated in teacher work time'	OECD, 2004	15 Countries
(Int.6) 'ICT technology requires a certain level of shared computer literacy of teachers. It also requires innovative approaches to teaching, professional development opportunities for teachers, organisation and planning to provide access time for teachers and students as required, provision for maintenance and support and educational software adequate to learning needs and teaching goals'	OECD, 2004	15 Countries
(Int.6) 'One can expect, however, that the focus of professional development activities in which ICT is involved will shift from the medium (technology) to content (education) [...] This may already be the case in Sweden, where only just over a third of teachers participate in development described as related to ICT but over 80 per cent, much more than in any other country, participate in other forms'.	OECD, 2004	15 Countries
(Int.6) 'Although Danish, Swedish and Norwegian schools stand out as making considerably more diverse usage of computers, on average, than other countries'	OECD, 2004	15 Countries
(Usa.14) Most educators in this study reported that the classroom was not the main location in school in which their students used computers.	NEA, 2008	USA
(Usa.15) Of the 48 USA states with technology standards, only 4 test students on their knowledge of technology. To be sure, the full integration of technology into teaching and learning will require a systematic and balanced approach that goes beyond just acquiring computer hardware and using limited technology skills.	NEA, 2008	USA
(Int.7) Danish students have been leading the acquisition of ICT skills based on informal assistance (2006-2007) helped by friends, colleagues or/and relatives. Meanwhile, this informal approach does not seem to be so relevant for British students. In fact, IT skills through informal learning have been decreasing for the British students, during that period (2005-2007). [...] Danish students lead the acquisition of ICT skills through self-study. In the meantime, British students reached the lowest positions in the acquisition of ICT skills through self-study (lowest positions in two of the three years, 2005-2007) [...] the British students acquire their IT skills mainly through formalised educational institution (school, college and university, etc.). Meanwhile, Danish and Swedish students reached lower positions in relation to the acquisition of IT skills through formal education, presumably because their strategies to develop their e-skills are closer to the self and formal learning approach.	Eurostat, 2007	EU
(Int.10) 'Teachers' use of ICT for communication with and between pupils is still in its infancy. ICT is underexploited to create learning environments where students are more actively engaged in the creation of knowledge rather than just being passive consumers'	European Schoolnet, 2007	EU
(Int.10) 'Teachers' poor ICT competence, low motivation and lack of confidence in using new technologies in teaching are significant determinants of their levels of engagement in ICT'	European Schoolnet, 2007	EU

Table 4: Category - Relationship between 'use' of ICTs and 'access' to ICTs at school

Excerpt	Source	Country
(Int.7) Interestingly, teachers in countries like Sweden, Finland, Denmark, the Netherlands etc. do not belong to the (very) intensive ICT users in class. Only around 10% or less of the teachers in these countries use computers in more than 50% of their lessons. One can only speculate about the reasons for this. It seems that in these countries the use of computers and the internet has become the norm for most of the teachers and pupils in all aspects of life and that there no longer is the need to put a special emphasis on this in the teaching processes at school. However, most European countries still seem to be in the phase of increasing the frequency and intensity of ICT usage for education in class.	Empirica, 2006	EU
(Int.7) 'One probably needs to consider that the use of computers and the internet by all citizens, including teachers, in these ICT frontrunner countries has for some time been part of daily life, whereas in other countries, which are at a lower level of penetration, motivation is of key importance and mentioned as such in the use of computers and the internet'.	Empirica, 2006	EU
(Int.5) Use of ICT in teaching and learning by mathematics and science teachers remained generally low and highly variable across countries, with reported adoption varying from 20% to 80%. Furthermore, there was no correlation between the level of ICT access (student-computer ratio) and the percentage of teachers reporting having used ICT in their teaching.	IEA SITES 2006	22 Countries
(Usa.12) 'The introduction of information technologies into schools over the past two decades has achieved neither the transformation of teaching and learning nor the productivity gains that a reform coalition of corporate executives, public officials, parents, academics, and educators have sought […] I have concluded that computers in classroom have been oversold by promoters and policymakers and underused by teachers and students'.	Harvard University Press, 2001	USA
(Usa.14) 'Most educators used technology regularly at school for administrative tasks, but substantially fewer used it for instruction-related tasks'.	NEA, 2008	USA
(Col.15) 'Despite receiving computers, training, and technical assistance, the teachers in the program simply failed to incorporate the new technology into their classroom teaching. This example provides an important lesson both for researchers and for policy makers. For policy makers it emphasizes the importance of program implementation and monitoring. In this case, the program simply assumed that once equipped and trained, teachers would voluntarily incorporate the provided technology into their classrooms. Mere training and equipment does not seem to be sufficient'.	The World Bank, 2009	Colombia
(Int.9) 'Sporadic measures such as implementing computers in classrooms, connecting schools to the Internet, providing courseware and access to digital resources, and training teachers have not brought about the pedagogical innovations, or the 'new teaching-learning methods and functions matching the possibilities of ICT'.	European Framework for Digital Literacy, 2006	EU & Australia
(Int.9) 'It seems almost impossible to go beyond getting computers and the Internet in the classroom, making digital resources and training teachers. The most frequent objective is getting teachers to use technology in their classroom. Often in the end, no real pedagogical change seems to have taken place, other than providing students with technological competencies to use digital tools'.	European Framework for Digital Literacy, 2006	EU & Australia
(Int.9) 'ICT or digital literacy frameworks have been developed in the last ten years, in the hope that they would empower educators to not only master technology and integrate it, but ultimately transform learning and teaching. However, experience has shown that using ICT is not enough to bring about significant changes. Very often, it has been assumed that if teachers are equipped and connected then using the tools will bring with it the know-how for using them'.	European Framework for Digital Literacy, 2006	EU & Australia

Table 5: - Category - Relationship between 'use' of ICTs and 'learning performance' of students

Excerpt	Source	Country
(Int.2)'Looking at the frequency with which students use computers for a range of purposes, the highest performances in PISA 2003 were seen among those students with a medium level of computer use rather than among those using computers the most'.	OECD, 2005	41 Countries
(Int.2) 'If high amounts of computer usage at school are not associated with the better performing students, teachers may need to look more closely at the manner of this usage. Stronger supervision and structured lessons, involving the setting of concrete tasks to be achieved using computers, may improve their impact on performance'.	OECD, 2005	41 Countries
(Int.3) 'Use of ICT in education and training has been a priority in most European countries over the past decade, but progress has been patchy'.	EU Commission, 2008a	EU, Australia, Korea, Canada, N Zealand, & USA
(Int.5) 'It was also found that higher levels of reported ICT use did not necessary go hand in hand with higher levels of perceived learning gains from ICT use'.	IEA SITES 2006	22 Countries
(Int.5) The impact of ICT use on students was highly dependent on the teaching approaches adopted when ICT is used.	IEA SITES 2006	22 Countries
(Int.5) Higher levels of reported ICT-use did not necessarily equate with higher levels of perceived learning gains from ICT-use. No significant correlation was found between using ICT in traditional instructional activities and perceived students' learning outcomes.	IEA SITES 2006	22 Countries
(Int.4) Embedding ICT in education and training systems require further changes across the technological, organisational, teaching and learning environments of classrooms, workplaces, and informal learning settings.	EU Commission, 2008b	EU
(Int.4) 'Although ICT has the potential to develop a 'learning continuum' that would support lifelong learning and embrace formal, informal and workplace learning, this has not yet been realised'.	EU Commission, 2008b	EU
(Int.4) 'One of ICT's main strengths is its capacity to support informal learning. Self-learning and informal peer-learning are by far the two most important mechanisms for obtaining skills and competences'.	EU Commission, 2008b	EU
(Isr.16) 'There is no evidence, however, that increased educational use of computers actually raised pupil test scores'.	MIT & NBER, Hebrew University, 2002	Israel
(Isr.16) 'Using a variety of estimation strategies, we find a consistently negative and marginally significant relationship between the programme-induced use of computers and 4th grade Maths scores. For other grades and subjects, the estimates are not significant, though also mostly negative'.	MIT & NBER, Hebrew University, 2002	Israel
(Isr.16) 'The computer-skills benefit may not be reflected in Maths and language scores'.	MIT & NBER, Hebrew University, 2002	Israel
(Isr.16) 'The question of future impacts remains open, but this significant and ongoing expenditure on education technology does not appear to be justified by pupil performance results to date'.	MIT & NBER, Hebrew University, 2002	Israel
(Usa.13) 'It is also possible that technology improves education but only with a lag so that it is too early to detect the impact on performance. Perhaps it takes time for the teachers to learn how to use the Internet in their classes […] Judged as a means of improving student performance, however, we fail to find strong evidence of success'.	University of Chicago, 2005	USA
(Col.15) 'Despite the growing adoption of and demand for ICTs in education, there is very little systematic research and hard data about how ICT is actually used in the classroom and even less about its impact on educational outcomes, social behaviour, or employment and worker productivity'.	The World Bank, 2009	Colombia
(Usa.11) 'It is not yet clear how much computer-based programs can contribute to the improvement of instruction in American schools. [...] For most technologies, results are available only at selected grade levels, in selected subjects, and on selected instructional outcomes. The literature is too uneven for sweeping conclusions about the effectiveness of instructional technology'.	SRI International, 2003	USA
(Int.10) 'The impact of ICT is highly dependent on how it is used. The impact of a specific ICT application or device depends on the capacity of the teacher to exploit it efficiently for pedagogical purposes'.	European Schoolnet, 2007	EU

Conceptualisation of E-competencies

One of the complexities of this field of study is the difficulty in finding a definition that could be suitable for different contexts and requirements. As the OECD (2005a) remarks, the often unclear terminology combined with the existence of a multiplicity of definitions (new economy, e-economy, ICT sector, …) means that these concepts change depending on the framework of use. Regarding the diversity of terminologies and definitions, this study follows the guidelines set by the European Centre for the Development of Vocational Training (CEDEFOP). During 2004, CEDEFOP published a European multilingual glossary in order to identify key terms that are essential for a common understanding of current vocational education and training (VET) policy in Europe. In this publication *skill* is defined as 'the knowledge and experience needed to perform a specific task or job'. At the same time, the term *competence* is described as the 'ability to apply knowledge, know-how and skills in a habitual or changing situation'. Performance in a changing situation is emphasised in the definition of the term competence which also embraces the concept *skill*. Thus it is important to highlight not just the expression *knowledge* (tacit or explicit) in this definition but also the capability to *apply* this knowledge in other situations. In this perspective, the students or workers need to be able to use their abilities 'in a new occupational or educational environment'.

The classification of skill proposed by CEDEFOP (Tissot, 2004) identifies *basic skills* as 'skills and competences needed to function in contemporary society (e.g. listening, speaking, reading, writing and mathematics)' and *new basic skills* which 'are information and communication technology (ICT) skills, foreign languages, technological culture, entrepreneurship and social skills'. Even though there is no unique, commonly adopted definition of ICT skills, it is important to note that efforts have been made to characterise various types of e-skills. In the following the definitions proposed by the OECD (2005a) and the European e-Skills Forum (2004) are presented. The OECD (2005a, p.6) distinguishes three categories of ICT competencies:

- **'ICT Specialists,** who have the ability to develop, operate and maintain ICT systems. ICTs constitute the main part of their job – they develop and put in place the ICT tools for others';
- '**Advanced Users:** competent users of advanced and often sector-specific, software tools. ICTs are not the main job but a tool';

- '**Basic Users:** competent users of generic tools (e.g. Word, Excel, Outlook, PowerPoint) needed for the information society, e-government and working life. Here too, ICTs are a tool, not the main job.'

Meanwhile the European e-Skills Forum (2004, p.5) proposes a definition of the term *e-skills* covering three main categories. This definition has been adopted and improved by the European Centre for the Development of Vocational Training (Cedefop, 2006, p.31) among other Europeans institutions:

1. **ICT practitioner skills**: the capabilities required for researching, developing, designing, strategic planning, managing, producing, consulting, marketing, selling, integrating, installing, administering, maintaining, supporting and servicing ICT systems, for the benefit of others.

2. **ICT user skills:** the capabilities required for the effective application of ICT systems and devices by the individual. ICT users apply systems as tools in support of their own work, which is, in many cases, not ICT. User skills cover basic digital (or ICT) literacy, the utilisation of common (generic) software tools in an office environment and the use of specialised tools supporting major business functions within a large number of user sectors.

3. **E-business skills**: the capabilities needed to exploit opportunities provided by ICT, notably the Internet for specific industry or societal sectors; to ensure more efficient and effective performance of different types of organisations; to explore possibilities for new ways of conducting business/ administrative and organisational processes; and/or to establish new businesses. E-business skills are strategic and innovation management skills, but not technology-management skills which are part of ICT practitioner skills. E-business skills contain elements of both ICT practitioner and end-user skills, but in addition they contain a significant element of generic (non-sector specific) non-ICT skills.

The term *users* (non-expert), which is particularly relevant to this study, is mentioned in both definitions (OECD and European e-Skills Forum). Nevertheless, in each one of these descriptions the understanding of *user* (as '*basic user*' or '*ICT user skills*') seems to be particularly limited in relation to the application of ICTs. Considering that the term *user* is characterised by one who has the skills 'needed for the information society' (OECD, 2005b) and who has the 'digital literacy' (European e-Skills Forum, 2004), a more precise description and understanding of the term 'ICT user skills' seems to be necessary.

1.6 Defining the meta-competencies

Based on the glossary of CEDEFOP (2004) the term *competence* ('ability to apply knowledge, know-how and skills in a habitual or changing situation') in relation to the

use of ICT and information, seems to offer a richer approach than the mere inclusion of skills ('experience needed to perform a specific task'). Relatedly, *The Key Competences for Lifelong Learning – A European Framework* (2007) identifies digital competence as one of the eight key competencies described in the programme 'Education and Training 2010' supported by the EU (European Commission, 2007; Education Council, 2006).

The review of the sources included in the benchmarking and the analysis of these broadly adopted terms (proposed by institutions like CEDEFOP, OECD, European e-Skills Forum, etc.) makes evident that there is a primary interest in proficient users of ICTs (business, practitioner, advance, specialist, etc.) but basic or non-expert ICT users have been oversimplified as evidenced by mentioning only capability to interact with generic ICT tools. However, the studies show that the profile of the current user of ICTs (non-expert) needs a more complex characterisation. Without doubt this profile will change over time, but for now it has to do with aspects such as people who combine the cognitive and the technical skills to create added value. Hence it is necessary to develop a new and operational definition suitable and functional for the educational framework.

For the purposes of this study, the term e-competent user is adopted, according to the CEDEFOP guidelines, which refers to a person who is able to complement the use of some specific technologies with other proficiencies and knowledge. The e-competencies are a set of capabilities, skills and abilities to exploit tacit and explicit knowledge, enhanced by the utilisation of digital technologies and the strategic use of information. E-competencies go beyond the use of any specific ICT, including the proficient use of information and the application of knowledge to work individually and collaboratively in changing contexts.

Due to the diversity of approaches related to the term *e-competencies*, a number of sources have been reviewed in order to propose a new conceptualisation of this term. For example: Ontario Ministry of Education and Training, 1989; Gilster, 1997; Educational Testing Service, 2003; CEDEFOP, 2004; OECD, 2007a; Hjørland, 2008; Jenkins, 2008; Pernia 2008; UNESCO, 2008b; Becta, 2009; Boles, 2009; Media Literacy, 2009 and Peña, 2009. Thus five underlying concepts that constitute the expression *e-competencies* have been elaborated: *e-awareness; technological literacy; informational literacy; digital literacy and media literacy*, just as the following image summarised.

Figure 1: E-competencies and the five underlying concepts
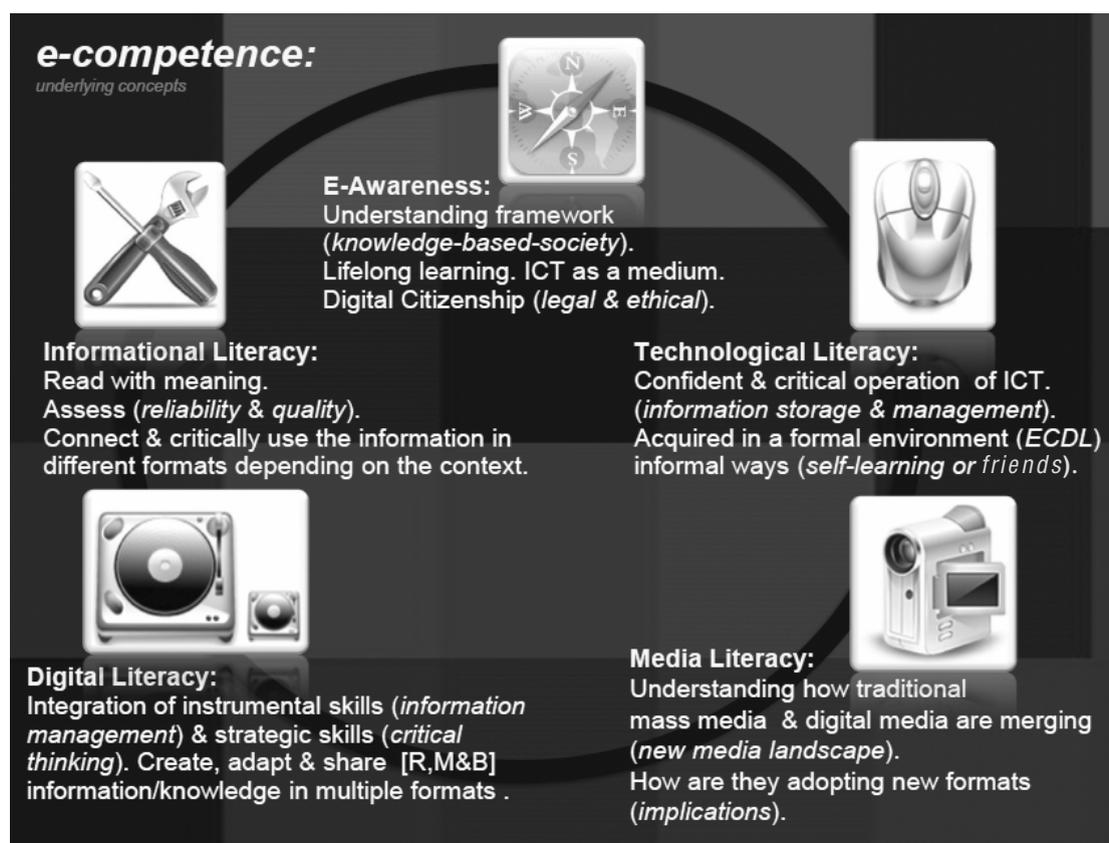
1.6.1   E-awareness

This cognitive (thinking) skill is characterised by a user's awareness of ICTs and appreciation of the relevance of these ICTs in the information based society. It embraces familiarity with the technologies and understanding of how these actually are, or can be potentially, beneficial or prejudicial for society. Fundamentally it is an act of cognition influenced by the use of information and knowledge and related technologies as tools to add more value and innovation to specific contexts. E-awareness is based on the understanding (comprehension and critique) of the information society's framework and its implications. From this perspective an e-competent user has the capability to understand and adopt the lifelong-learning paradigm and the use of ICTs as a medium to facilitate individual or collective development of knowledge, skills and new capabilities in both social and professional life. On the other hand, this understanding of the human, cultural and societal issues related to technology and their practice also includes legal and ethical behaviour (also called 'digital citizenship').

1.6.2 Technological literacy

The confident and critical use of electronic media for study, work, leisure and communication is represented by the ability to interact with hardware and software, as well as productivity applications, communication devices and management applications. This literacy includes the use of main computer resources such as word processing, spreadsheets, databases and tools for the storage and management of information. It embraces understanding of the opportunities and potential risks of the Internet and communications via electronic media for activities such as networking, sharing information, collaborating, etc. It also includes an ability to use Internet-based services (e.g. creating an account, composing an e-mail, attaching and downloading files, participating in an online discussion, using social networking sites, creating blogs, etc.). The technologies involved in this definition evolve according to technological transformation (currently this includes tools such as: mobile phones; computers; Internet; cameras, among other digital devices). The ability to use these tools can be acquired in a formal environment like schools (e.g., ECDL or EPICT[13]) or informal ways like home, trial and error, friends, manuals (self-learning or friends), etc.

1.6.3 Informational literacy

Informational literacy is the ability to understand, assess and interpret information from all kinds of sources. The concept goes beyond simply being able to read; it means the ability to read with meaning, to understand critically and - importantly - to evaluate, connect and integrate different information, data, knowledge and other sources. Acquiring informational literacy involves mastering a set of core competencies. It requires the ability to make informed judgement about what is found on or offline, identifying the sources, authors and their diverse approaches. Being able to evaluate the reliability and quality of information is a key aspect in deciding what and when information is needed for a specific audience, context or task. In an environment where users are overloaded with information being able to analyse, judge, evaluate and interpret information and placing it in context becomes a crucial skill.

Two very important abilities related to information literacy are *evaluation* (reflecting to make judgements about the quality, relevance, usefulness, efficiency,

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[13] European Pedagogical ICT Licence. http://www.epict.org

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authority and timeliness of the information) and *integration* (interpreting, summarising, drawing conclusions, comparing and contrasting information from multiple digital sources).

1.6.4 Digital literacy

The proficiency to build new knowledge, based on the strategic employment of ICTs is termed digital literacy. The main aspects related to digital literacy are how to get relevant information (*instrumental dimension*) and how to manage and produce new knowledge (*strategic dimension*). Being digitally literate means using technology for information and knowledge in order to access, retrieve, store, organise, manage, synthesise, integrate, present, share, exchange and communicate in multiple formats, either textual or multimedia. Critical, creative and innovative thinking is combined and empowered with information management skills. Digital literacy also means understanding that the management and sharing of new products of information could be enriched through networks of collaboration, just as open software communities do.

Some of the skills related to digital literacy are: *definition* (using ICT tools to search, find, identify and recognise the information need); *access* (knowing how to collect and/or retrieve information in digital environments and the ability to develop a search strategy to locate information from one or more sources); *management* (organising information into one or more classification schemes); *creation* (generating new information and knowledge by adapting, designing, editing, inventing, or representing information in ICT environments) and *communication* (conveying information and knowledge to various individuals and/or groups).

1.6.5 Media literacy

Media literacy has to do with understanding how the traditional mass media and the digital media are merging, combining and evolving towards a new media landscape. Some of the related skills and knowledge are based on the comprehension of how the media works, how it is organised, how it is evolving towards new formats, platforms and ways of communication and interaction and, finally, the understanding of how and why it produces meaning (constructs reality) as well as the social, legal, economic and political implications. This literacy is necessary to understand the phenomenon of the digital changeover.

This process of understanding and using the mass media in an assertive and non-passive way includes an informed and *critical viewing* or *critical analysis* of the media's nature. Also the skills related to media literacy include the capability to identify, judge and discriminate media content and services that may be unsolicited, offensive or harmful; as well as making effective use of media in the exercise of democratic rights and civic responsibilities.

1.7 Discussion of findings

This set of literacies can be defined broadly or narrowly. This review suggests understanding the term *e-competencies* as a meta-competency (Rosado and Bélisle, 2006) that denotes the interaction of different skills and knowledge (multiliteracies or hyper-literacies), which are constituted by five underlying concepts: e-awareness; technological literacy; informational literacy; digital literacy and media literacy. The relevance of one or more of the underlying concepts will depend on the context and the particular needs of each specific user.

The proposed definition embraces cognitive abilities and also technical proficiencies. It encapsulates the idea that the development of e-competencies is enriched by the continuous interaction (and connection) between knowledge and experience. As CEDEFOP and the European Commission (2007) suggest one of the distinctive characteristics of the competencies is their 'transferability' to one or another context. Considering the ubiquity of new technologies in modern life the acquisition of e-competencies becomes fundamental in our society.

Considering the abundance of documentation (e.g.: Bawden, 2001; Rodríguez Illera, 2004; Livingstone, Van Couvering and Thumim, 2005 and Guitert and Romeu, 2009) in this field and the references suggested by the international institutions quoted it is important to note Bawden's assessment:

> [T]he labels attached to these concepts do not matter; the concepts themselves, and their significance for practice, do [...] To deal with the complexities of the current information environment, a complex and broad from of literacy is required. It must subsume all the skill-based literacies, but cannot be restricted to them, nor can it be restricted to any particular technology or set of technologies. (2001, p.24)

In conclusion this meta-competency is a concept that needs to be constantly evolving as new technologies and the labour market evolve.

Best Practice, Trends and Recommendations

1.8 Description

Based on the revision of critical literature and expert interviews[14], this section describes a set of best practice initiatives and recommendations focused on the development of a future e-competent labour force. During the development of this research several recommendations and best practices were identified. As discussed earlier, the development of an e-competencies agenda[15] is a complex and multidimensional phenomenon which can be analysed from a broad range of perspectives. Therefore, the collected recommendations have been classified and structured by their degree of complexity. These recommendations are organised according to framework, principles and initiatives.

Figure 2: Diagram of dimensions
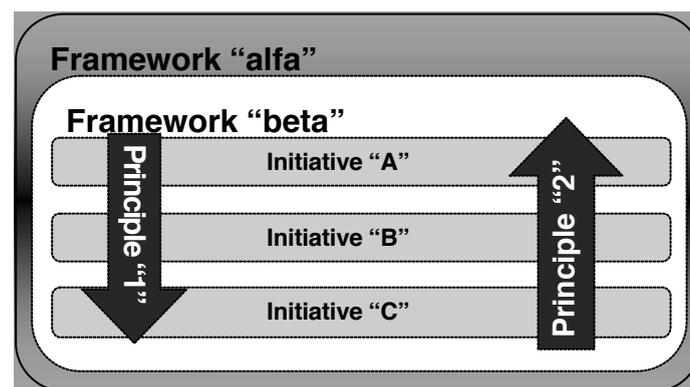
The degree of applicability of each one of the recommendations presented along this section is context-dependent. However it is important to add that most of the components recommended here are highly interdependent. Figure 2 is an abstract

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[14] These categories are the result of a revision of European experience, programmes, policies and research (each one of the references is quoted). Also they have been enriched by the contributions of expert interviews. The interviewees were: Peter Scott, the Knowledge Media Institute Open University (UK); Hilary Burgees, Centre for Research in Education and Educational Technology, Open University (UK); Yves Punie, Institute for Prospective Technological Studies (Spain); Jutta Bayer, European, e-competences Framework (Germany); Alfons Cornella, CEO of Infonomia (Spain); Udo Bleiman, Atlantic Project Darmstadt University of Applied Sciences (Germany); Liz Andersen, e-skills UK (UK), Barbara Kieslinger, Centre for Social Innovation – ZSI (Austria); Rebecca Eynon, Oxford Internet Institute (UK); Chris Davies, Department of Education, The University of Oxford (UK); Montse Guitert, Digital Literacy area, Open University of Catalonia (Spain), Bill Dutton, Oxford Internet Institute (UK); Ian Rowlands, University College London (UK) and Elena Silva, Education Sector (USA). However, the author assumes full responsibility for the content and views contained here.

[15] Set of articulated initiatives that promote and empower the development of e-competencies in the educational and in the professional sector.

illustration of how these recommendations can be organised. As shown, the dimensions of this figure are: framework, principles and initiatives. *Framework*, which is the general level, embeds *principles* and *initiatives*. Nevertheless, it is important to mention that the *principles* are transversal to the individual *initiatives*. In the following there is a brief description of each one of these dimensions:

- **Framework**: This is the more general dimension. It embeds the contextual conditions necessary to allow the coordination between sectors and the respective policies. This dimension constitutes the structure required to implement an e-competent agenda, including the articulation between national and transnational organisations. In other words, an appropriate framework includes educational, industrial and governmental co-ordination in order to facilitate the design of a common and consistent long-term agenda (2020-2030).

- **Principles:** This dimension refers to the relevant criteria for the implementation of a mid-long term agenda. The principles included in this dimension permit a more consistent e-competencies agenda, allowing its applicability either at national or transnational level. The values that constitute this dimension are supported by an inclusive and effective understanding of the information society.

- **Initiatives:** The seven initiatives recommended in this dimension are focused on the education sector. The scope of this dimension is the primary and lower secondary levels of formal education (from Key Stage 1 to 3 in UK). The initiatives presented are articulated under the premise that schools need major improvements to prepare the future workforce better. This dimension highlights and describes concrete actions, innovations, instruments and methods that could be implemented in schools in order to develop a better development of an e-competencies educational agenda.

A more detailed presentation of the three dimensions, including the specific recommendations for an e-competencies agenda, is illustrated in the next subsection.

1.9   E-competencies agenda: framework, principles and initiatives

The educational consequences of the full use of ICTs are far from clear and the impacts of new technologies in schools are highly dependent on aspects like the perspective of public policies, teaching approaches, the way ICTs are used and assessed, the school's organisation; teacher training and the design of the curriculum (Law, Pelgrum and Plomp, 2006; OECD, 2006; UNESCO, 2008c). The recommendations described below are not ready-to-use ideas because their applicability depends on the specifics of each context. On the other hand, they are presented and described in general terms, in order to simplify their application.

Figure 3 illustrates the components for an e-competencies agenda. It includes the three dimensions previously described as well as particular recommendations for each level. The tree is used metaphorically to describe the e-competencies agenda. A successful implementation of an e-competencies agenda requires external components or framework (in the illustration represented by the environment) and principles (illustrated by the bark). At a detailed level the principles of this agenda are embraced by specific initiatives (tree rings). In other words, the e-competencies agenda is the result of a suitable meeting of these dimensions.

Figure 3: E-competencies Agenda
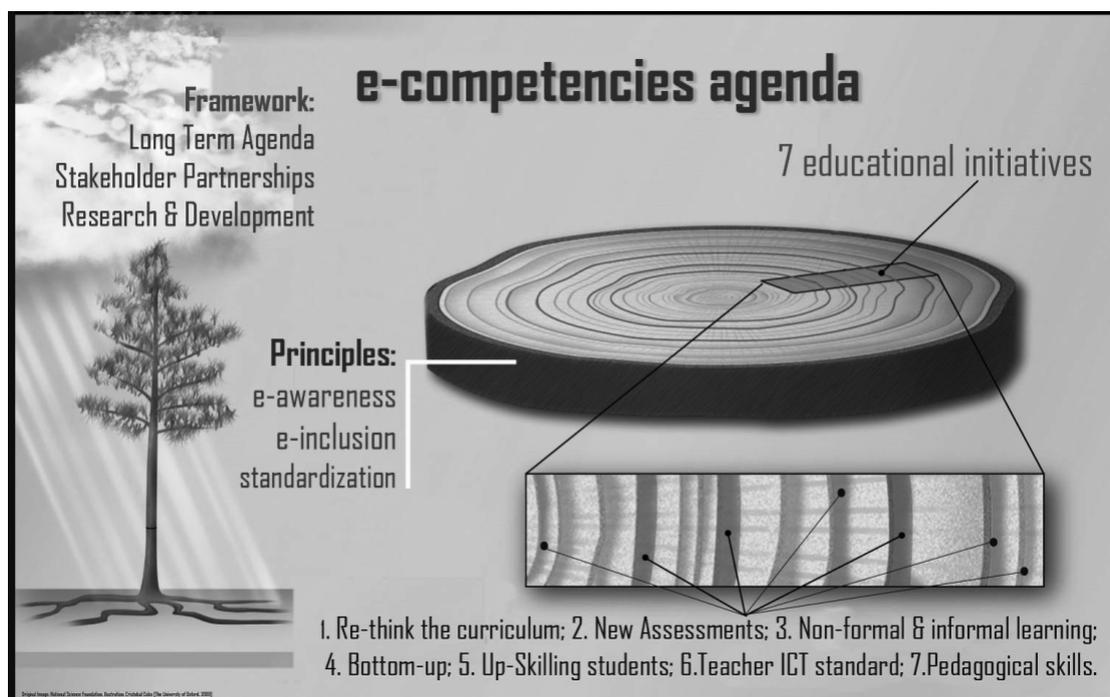
1.9.1 Framework

- Long-term agenda

The implementation of a long-term agenda (2020-2030), integrating a broad range of views, ideas and opinions, is necessary in order to reduce the e-competencies gap. After more than ten years of promoting the integration of technologies in the classroom there are enough experiences and studies to comprehend the necessity of re-designing or adapting dysfunctional ICT-skill strategies and policies. The establishment of a long-term agenda requires integration of the needs and goals of the national context, but at the same time must consider global trends and also the effective actions and initiatives implemented by other countries. Being aware of this

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context, experts from different sectors (public authorities and advisors from the private sector, educators, scholars, unions and associations) all around Europe need to continue setting and defining common strategies and standards to face the challenge of training a highly qualified workforce for the coming decades. Attention needs to be paid, not just to the ICT practitioners, but also to the e-competent users, particularly those who are still at the first level of their formal education[16].

Authorities of informal, industry-based education and formal, government-supported education need to collaborate and set common goals to promote the acquisition of ICT competencies for the workforce of the coming decade. It is recommended that these collective initiatives also suit the goals defined in the European mid-term agenda. Useful examples of this are the programme *Education and Training 2010* (*Lisbon Strategy*) and the *Bologna process.*

According to different reports[17] there is a mismatch between the skills taught (in the formal educational environment) and the skills demanded (e.g. employers, firms and industries). In that sense it is crucial to implement strategies to educate the future labour force according to the requirements of the modern labour markets (e.g. *National Occupational Standards* in UK) [e-skills UK, 2003]. Designing a long-term agenda needs to ensure that evidence-based policy does not repeat the mistakes and inaccuracies described in the Second Section of this paper. Moreover, it is important that the implementation of these policies and strategies is regularly reviewed and their impact assessed in order to constantly improve (among other aspects it will benefit the continuous updating of the *e-competencies* concept). The new approaches of the PISA test could also be a useful reference to evaluate the ICT skills of European students.

• Stakeholder partnerships

Stakeholders (e.g., education department, public and private educational/training institutions, ICT industries representatives, ICT service providers, business sector, etc.) must be identified, invited and involved to improve the dialogue between education, businesses and users. Collective initiatives are required in order to promote changes in the education sector but with particular focus on the recommendations and requirements supported by the business and technology sectors.

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[16] In the UK context Key Stage 1 (children from 5 to 7 years).
[17] e-Skills Competences Consortium, 2004; Fernandez, and Hayward, 2004; OECD, 2006.

Strong co-ordination across sectors in order to develop joint actions between policy-makers and the private sector is indispensable to promote the up-skilling and re-skilling of the current and future workforce. With regards to the existence of significant joint initiatives in the professional context (as in the 'European e-Competence Framework') it is important to include some of those common principles in the current training and development agenda in order to encourage the acquisition of 21st century skills in the education of the coming decade's professionals. Based on this idea schools, for instance, are encouraged not only to develop and teach the ICT skills that the future workforce will require, but also to facilitate co-operation between schools and other 'learning organisations' including private companies.

In order to ensure that the new generations of professionals will have the required ICT literacy competencies (i.e., foundation knowledge, technical skills and critical assessment skills) a broad spectrum of actions will need to be developed. Some examples of these initiatives are the continuous addressing and updating of e-competencies, setting standards, designing mechanisms for assessing competencies and promoting the acquisition of ICT competencies.

- Research and development

The adoption of continuous and consistent research and evaluation is necessary to ensure that the education and training experience relates to the complexities of the current knowledge-based-economy. Policy makers and educators require more evidence from critical studies of the actual use and impacts of ICTs on learning. It will help to understand what works and what does not and why some things work in some contexts and not in others. Empirical studies can provide information on the issues and priorities identified, such as: the features, benefits and risks of new learning paradigms, new networking opportunities from ICT-assisted learning; the potential for personalisation of the learning process and ways of using ICTs in education to bridge rather than reinforce economic and cultural divides (Nash, Dutton and Peltu, 2004).

The adoption of e-competencies strategies needs to be designed collaboratively by multi-institutional teams (composed of policy makers, employers, academic and expert views from different sectors). The recommendation for this panel is to systematically evaluate the effectiveness and impact of those initiatives orientated towards developing a future e-competent labour force.

The implementation of a longitudinal evaluation could provide critical information linked to the development of an e-competencies strategy, some examples are: evaluating the impact of ICT skills standards in the users' performances, exploring the existence of other skills stimulated by the use of ICTs, analysing the effectiveness of adaptive assessment, studying the performance of young professionals who have been trained with an e-competencies approach and evaluating the correlation between employability and e-competencies. The research and development construction is relevant not just in terms of *national* evaluation but also efforts should be made to support *trans-national* studies to ensure good coverage and that reliable results are supporting the policies and strategies of the new century.

1.9.2   *Principles*

• E-awareness

Promoting the development and continuous updating of ICT competencies in different learning environments (formal and informal) by providing concrete guidance and useful tools to the education sector is one of the ways to move towards an e-competent labour force. Stakeholders from different sectors need to collaborate in order to increase engagement with the use, training and adoption of digital competence.

The review of different studies and strategies shows the necessity to engage individuals from different sectors of society in the acquisition of e-competence. It is important that the main message of this engagement goes further than the acquisition of basic ICT skills. Current and future employees need to understand from a broader perspective the opportunities and challenges arising from ICT use in a knowledge-based-economy. In other words, it is important to realise that an increase in e-competencies is equivalent to a rise in the value of the workforce. The acquisition of e-competencies would raise the degree of employability of a potential employee (Card and DiNardo, 2002).

Another aspect necessary to include in this engagement strategy is that in a knowledge-based society the lifelong acquisition of e-competencies has to be comprehended as a continuous learning process. This means that students (tomorrow's workers) need to comprehend the necessity to update their competencies regularly (under formal and non-formal learning strategies) due to the fast evolution of ICTs. Nevertheless, it is worth considering the opinion of those who believe that

very generalised and traditional awareness campaigns are not very effective initiatives for increasing the population's e-competencies (Danish Technological Institute, 2007). From this point of view, it is recommended that efforts are made to promote the acquisition of these skills in the students' or workers' personal environment, where they may be better motivated to improve their capabilities. This has to do with endorsing the adoption of ICTs in daily life by formal and particularly informal approaches in order to relate to particular needs, contexts or motivations (Balanskat, Blamire and Kefala, 2006).

- E-Inclusion

In order to reach the Lisbon declaration: 'Europe should become the most competitive and dynamic knowledge-based economy in the world' (European Commission, 2008a) it is vital that a trans-national agenda of integration is developed which includes all those who are far away from the information society framework (phenomenon also known as *the digital divide*[18]). In this context it is important to include not just the ideal model of a 'knowledge worker' (young, professional, highly educated, ICT skilled, working in a middle or big urban area, etc.) but also other sectors of society (Eurostat, 2006). The e-inclusion approach considers the integration of *other targets* like low skilled workers, unemployed, educators, young students, senior workers, etc.[19]

Thirty-seven per cent of the EU population has no computer skills and more than sixty per cent of people not educated beyond lower secondary level have no basic e-skills (Eurostat, 2006). However, considering the three stages described in the European e-inclusion' report[20] (European Commission et al., 2008b), it is critical to continue promoting initiatives focused on facilitating access and connectivity to all sectors of society including training in the basic use of ICTs, but without ignoring the acquisition of more sophisticated and proficient digital skills (informational, media and technological literacy as well as e-awareness).

From a gender perspective, the e-inclusion agenda should also provide new actions encouraging women of all ages to use ICTs. Different studies show the need to

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[18] 'The term 'digital divide' refers to the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard to their opportunities to access information and communication technologies (ICTs) and their use of the Internet'. (OECD. 2008).

[19] Fastrack to Information Technology (Ireland) http://www.fit.ie/homepage.asp

[20] The first level represents the technical access to ICT. The second level is related to the acquisition of basic ICT skills. The third level describes the development of an advanced use of ICT.

reduce the gender gap that still exists in the exploitation of these tools (Eurostat, 2006; Turmo and Lie, 2006; DTI, 2007; OECD, 2007b; Ramb, 2008). It is important to move towards an inclusive comprehension of the knowledge-based society. Noteworthy are those up-skilling and re-skilling initiatives like: motivating non ICT-users, training workers (or teachers) with low ICT skills, subsidising ICT training in small and medium enterprises (SMEs) and promoting the use of low cost technologies, among others (European Commission, et al., 2008b). These initiatives should be encouraged by adopting flexible methods of acquiring ICT skills, such as informal learning, learning by doing or peer coaching.

- Standardisation

There is a general need to set ICT competencies standards and certifications. In this sense, it is important to consider the adoption of a broadly accepted and updated set of key e-competencies, acknowledged by both the education and the industrial sector. The common understanding of e-competencies should be nationally but also trans-nationally recognised in order to empower the mobility of the future workforce. Nevertheless, before adopting any specific standard it is necessary to define a common understanding of 'ICT literacy'. Concrete definitions of the key term and precise description of the underlying concepts of e-competencies have to be undertaken (see Section 3 of this paper).

Another strategic approach for defining the ICT competencies standards is to consider standards and international certifications that already exist. For example, the European e-Competence Framework which provides guidelines for the proficient use of ICT was created for supply companies, the public sector and social partners across Europe. A complementary initiative is the *European Computer Driving Licence Foundation,* a remarkable example of an international standard in end-user computer skills certification[21]. Both initiatives are focused on the generation of a framework, a standard and a certification that allows the common understanding of ICT performance in the European context. These programmes have been designed to promote and facilitate professional mobility through Europe. These experiences may be considered as best practices of measuring and standardising some of the proficiencies related to the previously described e-competencies.

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[21] ECDL learning material specific to education http://www.ecdl.co.uk

Another central aspect in relation to the definition and adoption of ICT standards, particularly considering the underlying e-competencies, is the necessity to update them continuously. It makes no sense to promote the adoption of any specific ICT competencies standard if it is not continuously updated and improved. It is recommended that an e-competence qualification framework be flexible in both content and approach in order to support the continuous formal and informal learning processes.

1.9.3 *Educational Initiatives*

The transformation of the future labour force demands a new paradigm of teaching which affects every learning environment including formal and informal learning contexts, individual and collective educational approaches, face-to-face and virtual learning and other places for in-depth knowledge experiences. The new paradigm should enable students to acquire knowledge and competencies in the classroom, the workplace or anywhere else, that increases their employability in the future, but it will require a whole new understanding of the usefulness and applicability of those new skills. To avoid any reductionist, ineffective or disappointing learning experiences in relation to the integration of ICTs in education it is important to complement the adoption of digital technologies with a new teaching and learning paradigm (OECD, 2004). The educational improvement needs much more than the acquisition of brand new computers or the simple adoption of any specific standard. 'The key word is transformation. If the organisational and institutional context does not support new working methods, educational practices will not change' (Balanskat, Blamire, Kefala, 2007, p.7).

In the documents reviewed in Section 2 of this paper, it was stated clearly that in many cases the integration of ICTs in schools has been primarily used to reinforce the existing teaching paradigm, rather than supporting a significant qualitative change in learning. If it is already known that the impact of a specific ICT depends on the capacity of the teacher to exploit it efficiently for pedagogical purposes, then the face-to-face teaching of ICT will require significant attention (Balanskat, Blamire and Kefala, 2006; Law, Pelgrum and Plomp, 2006).

Even considering that there is no one-size-fits-all strategy to embed the technology in the classroom (Kirschner, Sweller, Clark, 2006), there are several approaches that seem to improve the learning process through the use of technology.

Examples are project-based learning, real-world problems, self-learning activities, collaborative and interdisciplinary learning, constant acquisition of new competencies and knowledge transfer. According to previous works, encouraging informal and life-long learning in students are also significant initiatives to be considered (Eurostat, 2005; European Commission, et al., 2008b).

The development of e-competencies has to be complemented with flexible forms of training teachers, at different times, in different places, with different meanings. Teacher-training policies set ambitious general goals, but define less the specific skills required to integrate ICTs into pedagogical practices, the means of how to acquire these skills, or the kind of pedagogy that should be pursued (Balanskat, 2005). On the other hand, it is important to mention that the inclusion of technologies in the classroom can only be part of a deeper transformation if a different understanding of the acquisition of the critical and functional skills is embraced. These studies that show the uneven and patchy impacts of ICT adoption in the classroom make clear that it is necessary to reform not just the strategies to acquire knowledge but also the student's competencies. Undoubtedly, this is a multi-dimensional phenomenon (Cuban, 2001; Law, Pelgrum and Plomp, 2006) and the digital technologies will not provide all the answers (Daniel, 2002).

As UNESCO suggests the acquisition of ICTs in education has to do with policies, teacher training, pedagogy, curriculum, assessment, technology and school organisation, among others (UNESCO, 2008c). A description of aspects relevant to keep in mind during the integration of ICTs in the classroom follows.

• Re-think the curriculum

There is not enough data to state a clear correlation between the adoption of technology and a better learning performance (e.g. language or maths test). Also, there is research that specifies the non-correlation between the number of hours using a PC in the classroom and the student's performance (Korte and Hüsing, 2006). At the same time, other studies have found a strong association between the student's performance and the use of ICTs at home (OECD, 2005d), which highlights the role of parents and the family. Similarly, there is evidence that students feel more comfortable using their computers at home (Ba, Tally and Tsikalas, 2002).

Considering these findings the recommendation is to plan the integration of ICTs as a complex and flexible strategy[22] (OECD, 2005d), where it is essential to keep in mind that the performance is not only a matter of *quantitative use* of the PC but that there are other aspects like the *context of use* which also play a significant role (OECD, 2004). An e-competent curriculum should promote the development of meta-cognitive capacities in the students, empowering them to reflect on 'what we need to know, how we come to know and how we express our knowing' through life-long learning initiatives that stimulate personal higher-order thinking skills (e.g. e-awareness or information literacy) (Rosado and Bélisle, 2006). Finally, it is recommended to consider the use of digital devices to stimulate other 21st century literacies, for example *soft skills* to support creativity, innovation, experimentation, problem-solving, collaborative work and critical thinking.

- New assessments

E-competencies are uncovered by testing pupils' capability of employing these skills and knowledge in limited situations (e.g. use of word processor). Such meta-competencies cannot be tested using closed-ended questionnaires. The application of knowledge and skills in different situations will generate diverse outcomes. That is why the evaluation of e-competencies should be based on a flexible approach that considers the combination of different methods and instruments. It is important to mention that the combination of potential outcomes represents a pedagogical challenge for the educators, however pupils should be asked to solve a variety of tasks dealing with different information and technologies.

Based on the uneven impact of ICTs on education (see Section 2 of this paper) it is necessary to analyse whether teachers and researchers are looking at the wrong outcomes. Are policy-makers clear or realistic about what they expect the results of ICTs investment to be? The adoption of a new kind of assessment is still a subject to be discussed. There are points of view which suggest moving towards the adoption of e-assessment, virtual reality simulations, e-portfolios and other approaches, which even include computerised adaptive testing (QCA, 2007; Silva, 2008). Nevertheless the complexity of this aspect demands new studies in this area (Shapiro and Hilding-Hamann, 2008).

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[22] Partnership for 21st Century Skills. (2004) ICT Literacy Map. Partnership for 21st Century Skills in cooperation with the National Council of Teachers of English. http://www.21stcenturyskills.org/ images/stories/matrices/ictcover_english.pdf

- Non-formal and informal learning.

It is recommended that the learning process is valued in a broader perspective. The more attention that is given to the concept of life-long learning, the more relevant will be the informal[23] and non-formal learning and its certification (Council of the European Union, 2004). 'Schools and higher education are less and less the unique places for in-depth knowledge experiences' (Rosado and Bélisle, 2006, p.36). E-competencies are relevant irrespective of where or how these have been acquired. For instance, the *most advanced countries*[24] (World Bank, 2008) mention that in recent years their students increasingly obtained their digital competencies from self and informal learning (Eurostat, 2005) [see also *informal pedagogy of digital literacy*[25]]. It means guidance provided by friends and family or other methods of learning, such as trial and error or self-learning in a greater variety of locations beyond the school.

Other studies mention that the increasing relevance of ICTs as tools for everyday life is not restricted to the workplace or study place. In that sense, the challenges that education faces is identifying which ICT skills should be taught in the formal learning environment (school) and which ones should be developed in 'other' contexts (like home, free time, social networking or self-learning) [Finnish National Board of Education, the Swedish National Agency for School Improvement, the Norwegian Ministry of Education and Research, the Danish Ministry of Education and Ramboll Management, 2006; Vox, 2008].

Students learn competencies outside school. Unfortunately some of these competencies are not acknowledged and not certified in school. In that sense, the challenge is to design trustworthy strategies to identify and validate these learning outcomes that take place inside and outside formal education (European Commission, 2004). But, how well prepared is the educational system to asses and validate the acquisition of the e-competencies by non-formal approaches? That is something to be explored in future studies (see 'tacit knowledge' in Polanyi, 2002).

- Bottom-up

Most of the policies and strategies to promote and support the adoption of ICTs in education come from the government (BECTA, e-skills UK, SFIA Framework,

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[23] Informal Learning is learning that results from daily life activities related to work, family or leisure. (Miller, Shapiro, Hilding-Hamann, 2008)
[24] See Knowledge Economic Index (2008). www.worldbank.org/kam
[25] See Hartley, McWilliam, Burgess and Banks, 2008.

among others in the British context for example) as well as international organisations (the 'Education and Training 2010 Programme', European Commission, the UNESCO, the OECD, among others). Teachers, pupils and parents are not frequently part of the decision making of what kind of technology has to be bought for the classroom and how it should be adopted and used. In most cases, teachers and pupils regard ICT classes as *passive* subjects, where they receive the technology purchased by *others* (usually from a public initiative).

It seems to be relevant to consider other strategies for the integration of technology in the classroom. A more participatory approach (bottom-up), for instance, could be when teachers and students are asked what technology (hardware and software) they think they need to reach some specific goals or performance. Possibly this would bring richer outcomes and engage them in a better way in their relation to the adoption of ICTs. There are experiences that show how the changes in the organisational structure or in assessment procedures are still lagging behind (Balanskat, 2005).

• Up-skilling students.

Perhaps due to the novelty of new technologies and their attractiveness to the new generation, there is a popular perception of children's proficiency in using electronic resources. This apparent expertise emphasises that they are more multi-tasking users of ICT than their teachers. There is also colloquial terminology to distinguish between the young ICT savvy and all the old technologically illiterate people. In other words, it is the juxtaposition of *Digital Natives*: 'native speakers of the digital language of computers, video games and the Internet' and *Digital Immigrants*: 'those of us who were not born into the digital world' (Prensky, 2001). Even considering that these sorts of concepts are broadly adopted, 'there is no evidence in serious literature that young people are expert searchers, nor that the search skills of young people has improved with time' (Rowlands, et al, 2008).

Common understanding, therefore, does not necessarily match the studies findings. The same study mentions: 'The way young people evaluate - or rather fail to evaluate - information from electronic sources. Here, too, there is little evidence that this skill has improved over the last 10 to 15 years'. However their self-confidence in relation to their abilities is very high. Finally this document adds: 'There is a big gap

between their actual performance in information literacy tests and their self-estimation of information skill'.

Another critical analysis in relation to the students' lack of skills remarks the 'shallowness of their reading and TV viewing habits, a comparative lack of critical thinking skills, naïve views on intellectual property and the authenticity of information found on the Internet, as well as high expectations combined with low satisfaction levels' (Hartman, Moskal and Dziuban, 2005). Based on these sources it is interesting to see that students overrate their skills and expect that the computer will give them instant answers. Teachers, who also need to develop and certify some of the e-competencies previously described, have a big opportunity in terms of: 1) making learners understand the necessity to acquire other literacies, further than the technological one, as for example information literacy, e-awareness, ethical and legal behaviour, among others, 2) taking advantage of the students' enthusiasm for ICTs to embed their engagement in the classroom 3) encouraging peer learning and acquisition of e-competencies between friends, teacher-to-teacher, teacher-to-student, but also student-student and,-why not, student-to-teacher.

• Teacher ICT standard.

'There is some hope that if teachers are more comfortable and capable of using the new tools there will be a more effective integration into learning activities of the existing educational systems'[26]. It is recommended that educators are encouraged to reach teacher ICT standards in order to take the best of the technologies, but also to develop complementary abilities[27] (see Section 2 of this paper). It is highly desirable that the adoption of ICT skills standard (see UNESCO) will come as well as certification in order to offer concrete incentives to teachers after acquiring their qualification. ECDL programmes for teachers and students[28], for instance, can be considered as an instrument to certify 'technological literacy' (see Section 3 of this paper).

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[26] 'Dynamic evaluation systems, spanning the range from ranking and rating schemes in the hierarchical sphere to cross-referencing and semantic engines that help generate equivalences of sense across highly heterogeneous profiles.' (Miller, Shapiro, Hilding-Hamann, 2008).
[27] From the educational perspective this sort of standards further than improving the ICT performance of students and teachers, could simplify the comparability of countries along Europe, also called pan-European digital literacy framework (Drenoyianni, Stergioulas and Dagiene, 2008)
[28] ECDL learning material specific to Education http://www.ecdl.co.uk

CEN[29] (European Committee for Standardization) highlights some of the benefits that the standards could bring. The adoption of a standard-based policy, approved by a recognised body of experts could integrate the interest and expertise of different sectors (*e.g. governmental, educational or labour market*) and at the same time reflect a consensus about what is expected in relation to a specific performance (*e.g. e-competent use of the ICT in learning environments*). This organisation remarks that standards bring consistency which can facilitate trans-national recognition of certain practices or even professional mobility of those who adopt these criteria (*e.g. effective and efficient use of ICT to improve the learning outcomes, certification of e-competent teachers*). Finally CEN states that the idea of a standard is a useful approach to disseminate innovation and best practice (*e.g. knowledge transfer between educators, students, schools and other organisations*). A brief selection of international ICT competence standards for teachers is presented in Table 6. These guidelines for educators specify some of the competencies needed to improve teaching and learning through the effective use of technologies.

There are significant differences between these sources in terms of approach, levels of elaboration and complexities; even the targets are not all identical (a few of them are standards for ICT users, rather than educators). Interestingly most of these documents emphasise primarily what has been defined in this paper as 'informational literacy'. Consideration of the underlying dimension of the previously suggested e-competencies to adopt a wider perspective of this concept is therefore recommended (see Section 3 of this paper). The definition and adoption of any ICT competencies standard in the education sector necessarily affects the teaching-learning process so the implementation of the ICT skills standard requires an extensive range of changes in the learning environment (a summary of them are mentioned in *Educational Initiatives* of this paper).

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[29] See https://www.cen.eu

Table 6: ICT competencies standards for teachers

Document	Institution	Year	Country
Qualified teacher status (ICT QTS skills test)	Training and Development Agency for Schools[30]	2008	UK
Competència bàsica TIC	Generalitat de Catalunya Departament d'Ensenyament Direcció[31]	2000	Catalonia (Spain)
Digital competence: from ICT skills to digital 'bildung'	Ministry of Research and Education[32]	2003	Norway
National Occupational Standards for IT Users v3 (*)	e-skills UK Sector Skills Council[33]	2009	UK
ICT Competency Standards for Teachers	UNESCO, Cisco, Intel and Microsoft, International Society for Technology in Education (ISTE) and the Virginia Polytechnic Institute and State University[34]	2008	International
Raising the Standards. A Proposal for the Development of an ICT Competency Framework for Teachers.	Commonwealth Department of Education, Science and Training[35]	2002	Australia
Competence goals. Digital competence. (*)	Norwegian Institute for Adults Learning[36]	2008	Norway
European Pedagogical ICT Licence.	UNI-C, Lambrakis Foundation, Eötvös Lorand University; University of Genoa[37].	2008	Denmark, Greece, Hungary & Italy.
National Educational Technology Standards for Students.	International Society for Technology in Education[38]	2008	USA

(*) These are not guidelines that set standards particularly for educator, however they are focused on ICT standards for users and most of the areas of competencies referred are suitable for educators and learners at the schools.

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[30] TDA. (2008). ICT QTS skills test. UK. Training and Development Agency for Schools. http://www.tda.gov.uk/ skillstests/ict.aspx

[31] Generalitat de Catalunya. (2000). Competència bàsica TIC. Catalonia .Departament d'Ensenyament Direcció. http://www.xtec.es/escola/tec_inf/tic/eixtic.pdf

[32] Norwegian Ministry of Research and Education (2003). Digital competence: from ICT skills to digital 'bildung'. Norway. http://www.itu.no/filearchive/Dig_comp_eng.pdf

[33] e-skills UK. (2009) National Occupational Standards for IT Users v3. UK. http://www.e-skills.com/nvq/2541

[34] UNESCO, et al. (2008a). ICT Competency Standards for Teachers. UNESCO, Cisco, Intel and Microsoft, International Society for Technology in Education (ISTE) and Virginia Polytechnic Institute and State University. http://portal.unesco.org/ci/en/ev.php-URL_ID=25740&URL_DO=DO_TOPIC&URL_SECTION=201.html

[35] Australian Commonwealth Department of Education, Science and Training (2002).*Raising the Standards*. *A Proposal for the Development of an ICT Competency Framework for Teachers*. Australia. http://www.dest.gov.au/ sectors/school_education/publications_resources/profiles/raising_standards_ict_competency_framework.htm

[36] Norwegian Institute for Adults Learning. (2008).Competence goals. Digital competence. Norway. http://www.vox.no/upload/6429/Competence_goals_digital_competence_SEC.pdf

[37] European Pedagogical ICT Licence. http://www.epict.org

[38] ISTE (2008). National Educational Technology Standards for Students. International Society for Technology in Education USA. http://www.iste.org/Content/NavigationMenu/NETS/ForTeachers/2008Standards/NETS_T_Standards_Final.pdf

• Pedagogical skills.

The results of an OECD international survey of upper secondary schools report that 'less than half of the teachers use computer applications and about four teachers in ten use the Internet' (OECD, 2004). The main goal should not be to increase the number of hours that educators use ICTs, but to extend and enrich the use of information technology in a broad range of activities inside and outside of the school. Considering that the impact of ICTs on students is described as highly dependent on teaching approaches (Law, Pelgrum and Plomp, 2006) the role of the educator during the process of adoption of technology seems to be extremely strategic. As a result, teachers' training has to be rich in resources, best practices and information in order to provide them with the needed knowledge, skills and attitudes to encourage the acquisition of e-competencies in their students.

Some aspects that could be included during the training of teachers include e-competent teacher schemes to develop the proficiencies and techniques that provide the know-how to pedagogically embed the ICTs in classrooms, making the best use of the technologies to enrich the students' learning (Balanskat, 2005). It includes the development of higher levels of critical thinking and understanding of the relationship between technology and education. The casual use of ICTs also contributes to increasing teachers' pedagogical competencies (Balanskat, Blamire, Kefala, 2007), which should help to develop new learning material (e-content) and integrate successfully other resources to the student's (formal or informal) learning environment (Danish Ministry of Education, 2008). Recommendations also include the promotion of sharing of best practice and other experiences between colleagues, like peer-coaching[39].

In this field, the British Qualifications and Curriculum Authority (2008) report that some of the abilities required by teachers are: Identifying problems and defining tasks; Searching and selecting information; Organising and structuring information; Analysing and interpreting information; Combining and refining information; Modelling; Controlling events and devices; Exchanging information; Presenting information; Reviewing, testing and evaluating and assessing the impact of ICT. This approach develops complementary technological and pedagogical abilities as a way of delivering the skills required to successfully integrate ICTs in the classroom. In this

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[39] Peer Coaching Program (Microsoft Corporation)
http://pc.innovativeteachers.com/MPC_Web/peercoaching/pc_home.aspx

sense, it is essential to promote networking, exchanging thoughts and experiences between educators. The final result of this up-skilling approach would be much more than an ICT 'savvy' educator. As Siemens (2005) suggests, 'learning is a process of connecting specialised nodes or information sources'. In that sense the technology should be understood as tools to enrich the connection of sources to create new knowledge.

Finally, the adoption of an e-competencies standard strategy in the education sector could also facilitate the implementation of a European credit transfer system. Nowadays, the absence of this system of in-service teacher training raises the question of mutual recognition of competencies acquired within continuous professional development of teachers (Balanskat, 2005). It can have a strong impact on the mobility of teachers to undergo a specific training in another country.

Conclusions

After ten years of consistent effort to improve educational achievements by infusing substantial amounts of capital into ICTs, current research constantly demonstrates that access to and the use of ICT are no guarantees of increased achievement of students. There are antecedents from different countries that show that there is no correlation between the level of ICT access and the percentage of ICT use. Further the access and the frequency of use of ICT, the review of international studies (Section 2 of this paper) shows that there is very little scientifically based research to gauge the effectiveness of technology in the learning achievement.

These results indicate the necessity of adopting a broad range of improvements in the educational system but also in terms of public policies, which should go far beyond the acquisition of ICT. *E-maturity* (maturity in the use of ICT) will not arrive without major changes and improvements. The lack of co-ordination between the adoption of ICT and the embracing of flexible and innovative teaching-learning strategies will demand collective effort between policy makers, educators and employers.

Innovation starts with people and new ways of thinking not only with powerful technologies. This work has presented evidence that those public policies, which were expected to bring considerable improvements in education achievement through adoption of ICT, were erroneous or at least patchy. The labour market of the 21st

century demands a creative rethink of the way that individuals learn and deal daily with information and knowledge. A lucid example of the flexible adoption of ICTs in the learning process comes from the Nordic countries. These nations, which reach high positions in international rankings, such as the Knowledge Economic Index (World Bank) or the Education Index (UNDP[40]), are not necessarily intensive ICT users in the classroom.

> As many as 69 per cent of the [Norwegian] users have acquired their ICT skills by independent trial and error. Approximately half emphasise guidance received from friends and family as a prominent method for learning ICT skills. (Vox, 2008, p.21)

The works presented show that in the Nordic countries there are signals indicating that the students' ICT skills are significantly acquired through self, informal and personalised learning. These countries register a high rate of Internet penetration (their populations register over 80% of connectivity[41]) and their innovative understanding and use of ICT is also remarkable. As an example, Tapscott (2008: p.28-29) highlights:

> Consider the changing relationship between students and teachers in Finland. The government has chosen 5,000 Net Geners [people between 11-31 years old] to train the country's teachers in how to use computer. For the first time ever, in one domain, the students will be the teachers and the teachers will be the students.

The results presented offer a complementary perspective to those policies which evaluate the success of ICT programs only in terms of *output*, neglecting the relevance of *impact*. In other words 'output refers to the direct product of the activities that are carried out, such as number of new computers purchased, number of lessons using ICT, etc. Impact refers to the changes brought about by these activities, in terms of, for example, improved learning'. (Finnish National Board of Education, the Swedish National Agency for School Improvement, the Norwegian Ministry of Education and Research, the Danish Ministry of Education and Ramboll Management, 2006, p.7).

From this point of view, it is necessary to move from the *digital divide,* technology-centred, toward the *knowledge divide*, where the key difference is defined by the use and exploiting of knowledge. Computer visionary Alan Kay said that

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[40] Particularly Denmark, Finland, Norway and Sweden, which reach the highest position in the Knowledge Economic Index set by the World Bank, 2008 and also are placed in the in the first 14 world position in the Education index set by the 2007/2008 Human Development Report (http://hdrstats.undp.org/indicators/7.html).
[41] Source: http://www.internetworldstats.com/stats4.htm#europe

technology is 'technology only for people who are born before it was invented' (Tapscott, 2008, p. 19). An iPhone which is an astonishing break-through technology today, may simply be a communication gadget for those who grow up with it. It is important, therefore, not to reduce the term ICT to a rigid core of devices. The innovativeness of ICTs will always depend on the users' perspective (e.g. experience, age, type of use, level of interest, etc.). The nature of ICT is evolving intensively in a brief period of time and that is why it is so important to continue to update the definitions, understanding and strategies related to the use of the these 'technologies'.

In order to adopt a wider approach to *ICT skills* beyond the instrumental (and basic) use of technology, this study proposed the term *e-competent user*, which refers to a person who is able to complement the use of some specific technologies with other proficiencies and knowledge. E-competencies are a set of capabilities, skills and abilities to exploit tacit and explicit knowledge, enhanced by the utilisation of digital technologies and the strategic use of information. E-competencies go beyond the use of any specific ICT, including the proficient use of information and the application of knowledge to work individually and collaboratively in changing contexts. Five underlying concepts that constitute the term *e-competencies* have been identified: e-awareness; technological literacy; informational literacy; digital literacy and media literacy.

However, what really matters in terms of employability is understanding the critical importance of continuously developing new learning, skills and competencies. In that sense, new public policies, innovative pedagogical programmes (training teachers, new curriculum, e-assessments, etc.) ICT skills standards, among other strategies, will emerge only if e-competent policymakers, e-competent educators and e-competent employers work together.

Finally, this review of the evidence shows the necessity of developing further studies focused on empirical questions of how exactly students use ICT in the classroom, as well as at home among other informal-learning environments. The broad expansion of mobile and low-cost technology and the increasing relevance of the informal learning demand new studies in this field.

If the impact of ICT on the learning experience seems to be uneven it will be necessary to create new tools, methodologies and surveys. It is apparent that there is a significant need for new studies to critically evaluate the effectiveness of public policies and educational programmes. Further research and consistent trans-national

information (related to the *output* and *impact* of ICT) will allow consolidation of a theoretical framework to support the design of public policy in the coming decade.

Another challenge that is faced is how to test and certify informally acquired e-competencies. There are discussions and decisions to be made in relation to the criteria and methodologies of how to assess formal and informal acquisition of ICT competencies (European Commission, 2004). There is much research evidence pointing to the difficulty of evaluating the abilities and proficiencies of students[42], particularly in relation to those higher-level skills which can generate more complex and unpredictable outcomes. For example, when the use of ICT is combined and enriched with reasoning and judgements in complex tasks, problem solving abilities and distributed collaboration, among others, the assessment of those performances needs to be adaptable to the specifics of a particular context or situation.

If the transferability and the adaptability of the skills are what really stimulates formal and informal learning then the challenge will be in assessing the effective adoption of these capabilities in the context of performance. To avoid any reductionist perspective in relation to the integration of ICTs in education it will be necessary to have a flexible and dynamic approach in order to balance the adoption of the digital technologies with other critical competencies.

There is no such 'one-size-fits-all' strategy to embed innovation in the classroom from one day to another. However the current gaps in education demand innovation and new strategies to empower the teaching-learning process towards the development of e-competent students today who hopefully will become e-competent workers tomorrow.

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[42] Ehlers, 2005; New Technology High School, 2007; Learning and Skills Network, 2009.

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