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A European Framework for Digital Literacy

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ANALYSING DIGITAL LITERACY FRAMEWORKS

by

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Abstract: This paper presents the comparative analysis of ten frameworks for ICT and Education. These frameworks have been selected as representative of the different policies and strategies deployed by governments from the turn of the century to 2005 to address the digital literacy educational challenge. The analysis focuses on the characteristics of these frameworks, and on the ultimate results that have been attributed to them. A more detailed description of each one can be found in the accompanying information files that make up the annexes.

Résumé : Ce document comporte une analyse comparative de dix programmes-cadres pour l'intégration des technologies de l'information et de la communication dans l'éducation. Ces programmes ont été sélectionnés en tant que représentatifs des différentes politiques et stratégies d'éducation mises en oeuvre par les gouvernements ces dix dernières années pour répondre au défi de la litéracie numérique. Cette analyse porte principalement sur les caractéristiques de ces programmes et sur les résultats qui leur ont été attribués. Une description plus complète de chaque programme est accessible dans le document annexe.

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Introduction: Addressing the digital literacy challenge

Frameworks are important relays than can transform policies into actions. During the last ten years, governments, education ministries and university boards have been developing frameworks for dealing with information and communication technology and education. Although computers have been present in classrooms for the last twenty five years, it is only with the generalised user friendly access to the Internet, in the mid '90s, that the majority of schools and universities have begun, not only to feel the pressure to use ICT, but more importantly to develop specific, innovative and productive educational uses of ICT.

Ten "Digital Literacy" frameworks have been studied and form the basis of the reflection presented here. "Digital Literacy" or "Framework" are not always the wordings used by the different approaches that have been selected, but their contents cover what has become known as such. Digital literacy is a recent concept popularized by Gilster's book (1997), *Digital literacy*. Gilster provided both an extensive definition: digital literacy as "the ability to access networked computer resources and use them"; and an in-depth one: digital literacy as context-dependent critical thinking, or "the ability to make informed judgments about online information", to enjoy emerging "mind-amplifying tools" with "the awareness of other people" and our expanded ability to discuss issues with them. There were already present in this seminal work the two basic dimensions that justify the need for digital literacy and that gave rise to the frameworks studied: the growing pervasiveness of mind empowering digital tools and the evolving relation to information, knowledge and learning.

- **The invasion/penetration of digital tools:**

The last twenty years have been a period of unprecedented technological evolution, both in terms of the extent and of the acceleration of the changes brought about. The effective and potential impact of converging information and communication digital technologies has permeated every sector of society: economic, social, political and cultural. Computers are becoming widespread in homes after having been integrated in the workplace and broadband connections are allowing truly interactive multimedia communication. New technology such as mobile telephones, a worldwide consumer attraction, bring new services, increase mobility, and spearhead unprecedented liberalization and competition. Furthermore, the impact of ICT extends well beyond the economic domain. With broadband access and wireless connections, Internet is becoming a "cultural crossroad of work, play and social interaction" (Marriott, 2006).

Three technologies, the personal computer, the cell phone and Internet, although unknown thirty years ago, have brought about significant transformations not only in supply and demand chains, in consumption and spending habits, but also in administrative and industrial organisational structures and in the access to cultural assets and resources. Digital technology is overcoming barriers of time and space in ways no other technology had made possible before. The very texture of social life and cultural identities is being re-woven by those who have access to the technology. As communication behaviours evolve, as information access widens and e-democracy is implemented with IC technologies, new perspectives on information and knowledge are disrupting traditional academic perspectives.

The evolving relation to information, knowledge and learning

There are two recognized monopolies on knowledge: that of educational institutions and that of books. Are these strongholds being threatened with the coming of digital technology? Schools and universities have been setting up special programs to train people in the use of information and communication technologies or to integrate these technologies in teaching and learning activities. The main reason is that important changes have inevitably and profoundly altered the nature and the role of both information and knowledge in society.

As more and more aspects of daily life involve information transactions, as companies develop knowledge management and databases, it becomes apparent that schools do not have an exclusive hold on information or on knowledge. Information overload has replaced information scarcity. Schools and universities had developed as the main, and often only, providers of access to information, and to knowledge building competencies. However, with the on-going socio-economic and technological transformation, "knowledge is reproduced, created and recombined in fast cycle-times and in problem contexts that are difficult to imitate in educational institutions". (Tuomi, 2005)

For centuries, knowledge has been associated primarily with academic institutions. Schools were recognized as the obligatory and unique access to organised knowledge. Universities with their research units were the main producers and distributors of knowledge. With the universal access to online cultural heritage and convivial editing and publishing tools, the Internet is becoming a real challenge to academic strongholds. The mastery of these new digital tools is taking place more and more outside schools and universities. Young people seem to be born with a cell phone in one hand and a mouse in the other. Although training can greatly expand one's use of the computer, most people start using one with only a minimum of help.

Another important evolution is the fact that information and knowledge are becoming more and more sought for their efficiency and economic value than for their justified truth value. As the French philosopher Lyotard[1] wrote as early as 1979 in his seminal work on the postmodern condition and the fate of knowledge, are teachers being asked today to "Be operational, that is measurable, or disappear"? As efficiency and practicality become dominant values, the criteria for appreciating knowledge are changing as well as expectations concerning the role of schools and universities in transmitting this knowledge and developing 'knowers'. Educationalists and teachers are loosing ground in setting the standards for learning and knowledge validation. Critical changes characteristic of the knowledge society are being identified more and more, and a different relation to knowledge is emerging from "changes in 'the world (objects, phenomena) to be known', changes in conceptions of knowledge and processes of 'coming to know', changes in the constitution of 'knowers", changes in the relative significance of, and balance among, different forms and modes of knowing, which are associated with the impact of digitization," changes diagnosed by Lankshear & Knobel (2003), two educational researchers.

Within academic circles, knowledge is seen as the result, in a human mind, of understanding information and integrating it meaningfully with pre-existent knowledge. However this educational conception of knowledge, as an individual psychological act, does not account for a widening notion of knowledge used to designate strategic information selected and processed within specific contexts, such as professional practices, industrial operations or global marketplace behaviours. Knowledge societies base their development mainly on scientific knowledge and measurable or quantitative information. For example,

[1] Jean-François Lyotard's *La Condition Postmoderne. Rapport sur le savoir*, was translated in 1984.

knowing what are the likes and dislikes of each age group as regards a cell phone interface, can be obtained through a classic survey but can be considered “confidential and priority knowledge”. It is this strategic conception that is referred to when companies talk of knowledge management, knowledge sharing and knowledge production.

By relationship to knowledge is meant here the organised set of relations that a subject has with all that relates to learning and knowledge. Thus the relationship to information and knowledge is changing and it is this evolving relationship that needs to be mastered through education. Schools and universities need to develop in learners not only cognitive and critical thinking skills, but also a discerning capacity to interact with different types of knowledge, humanist knowledge and scientific knowledge, descriptive knowledge (facts and figures) and explanatory knowledge (the why? questions), within a lifelong learning endeavour encompassing personal and cultural development, political awareness raising and professional maturing.

The three main changes in knowledge can be located in accessing information, in processing information, and developing information and knowledge. The use of technological tools to access information (such as databases, digital libraries, or simply the Web) has resulted in the need to cope with information of immeasurable quantities, with great levels of complexity, accessible at unconceivable speeds. This needs to be done with data dispatched in picoseconds and gigabits. Knowledge skills needed include knowing how to be able to gather vast amounts of information from varied sources, knowing how to select and synthesize it, how to interpret it and evaluate it taking into account diverse cultural context and formatting. Because the human mind cannot deal with great quantities of symbols simultaneously, technological tools become absolutely necessary to organise such complex information in readable patterns.

Digital knowledge

Digital knowledge refers to a new condition of knowledge that can be processed and transformed by technological tools. The first, most visible aspect is instantaneous access to outstanding sources of information. But a more important change is under way with the provision of tools capable of content categorizing, semantic marking, allowing knowledge foraging and mining by machines. What this implies is still debatable, but already standardization and tokenization of knowledge are developing rapidly. Knowledge processes, such are searching texts for words, summarizing texts and pictures, customizing information, translating within specific contexts, clustering large quantities of information, searching for labelled contents, are being taken over by technological tools. Important quantities of knowledge can be handled, taking into consideration not only the way knowledge is produced and its epistemological context (for example scientific or religious knowledge) but also the way it is structured and represented. Knowledge can be managed through the descriptors of its semantic content as well as its form. This implies a machine interpretable description of the knowledge units that correspond to the information needed to apply specific processes to it.

The main conclusion is that with the general availability of information and the digital tools to manage and process it, it is becoming more and more obvious that the kind of information and knowledge that schools are familiar with and are usually presenting to young people most often does not reflect the information and knowledge that is transforming our lives.

These changes, which will be discussed later as part of the emerging information/knowledge society, did not happen haphazardly, but resulted from choices in technological developments and uses, and social policy preferences. One such important

government action line, to which education was rallied, was overcoming the digital divide.

- **Bridging the digital divide.**

One of the first instances of a global awareness of the important changes brought about by the development of IC technology is the digital divide issue. Because "bridging the digital divide", is one of the strong arguments that have been brought forth by governments to accelerate the integration of ICT in education, it is important to look into its rationale. The "digital divide" is but one amongst a host of controversial issues that have emerged, such as peer to peer network distribution and legal accountability, spyware, surveillance and personal security, spamming and viruses, but it is the oldest[2], and probably the most consequential up to date. Initially understood as inequality in access to IT technology it has turned out to be much more problematic than the initial statistical approach suggested. Looking into the digital divide issue has been at the roots of debates on social exclusion, economic investment in deprived areas, and the role of technology in solving social ills or in amplifying them.

The question has arisen as to whether fighting the "digital divide" is being used to implement more social equality, better public education, in-depth cultural values, or are the different programmes and policies using social inequality and hierarchy as an opportunity to develop and diffuse profit-reaping technologies? Some studies have shown that big business and capital are dictating who has access to the new technologies and broadband and who does not (Graham, 2002). Other studies have stressed the marginalizing and patronizing tone, focussing on issues of race and gender, with people described as "on the wrong side of the divide" and '"information have-nots". (Kvasny, Sayer & Purao, 2004) This was particularly evident in the first four reports (1995, 1998, 1999, 2000) of the U.S. Department of Commerce, which popularized the expression "digital divide", the first one being entitled "Falling through the net", and stressing the need for disadvantaged groups to "catch up" or "risk falling further behind". [3]

But most important is the technological bias that the approach entails: the "digital divide" framing tends to suggest "digital solutions", that "computers and telecommunications" are the answer, without a need to consider beforehand the context into which that hardware would be put (Warschauer, 2003). This line of thinking, with a "narrow focus on provision of equipment" has often resulted in providing access to IC technology without "an analysis of the people's social and economic needs", and therefore failing to address the complex social problems that have to be solved. This *technological determinism* has also penetrated education, as it has often been observed. Stakeholders tend to overemphasise hardware

[2] "According to the Benton Foundation, the term was first used in discussions of the National Information Infrastructure (NII) Advisory Council by former President William Jefferson Clinton circa 1993." Excerpt from "Who Coined the Term? Origin of 'Digital Divide' escapes even the experts.", web page by Sharon Forster and Adrianna Borkowski. (Page accessed on the 24th of April, 2006: http://www1.soc.american.edu/students/ij/co_3/digitaldivide/history.htm.

[3] The expression "digital divide" does not appear in the first 1995 U.S. Department of Commerce Report, "Falling through the Net: A Survey of the 'Have Nots' in Rural and Urban America", but in the 1998, "Falling Through The Net II: New Data on the Digital Divide". It is only in the third Report, "Falling through the Net: Defining the Digital Divide", that the digital divide is presented. "This is our third report examining which American households have access to telephones, computers, and the Internet, and which do not. The "digital divide"-- the divide between those with access to new technologies and those without -- is now one of America's leading economic and civil rights issues. This report will help clarify which Americans are falling further behind, so that we can take concrete steps to redress this gap." NTIA (National Telecommunications and Information Administration), U.S. Department of Commerce, November 1999.

which gets their prime attention and only after acquisition of equipment, attend to pedagogical training and curricular frameworks, even though it is these two factors that should determine what is needed and how it is to be used.

Is the digital divide a problem of technology or of social priorities? There have been, and still are, many conflicting stances within the educational community, with dominant technophiles riding on the persuasive strength of the discourses about the need to train for the information/knowledge society. In their literature review of community informatics initiatives, Loader and Keeble (2004) commented on the competing beliefs concerning technology, social behaviour and social relations. They portray the "techno enthusiasts who believe that the empowering capabilities inherent in the ICTs will enrich people's lives as soon as they come into contact with them", and for whom "all we need to do is show people the potential of the media, train them in computer skills and provide them with access to the Internet, and the 'information age' is born". An alternative view to this technological determinism, which they identify as the 'social shaping of technology' perspective, is "that the technology is of secondary importance to the social, political, economic or cultural objectives of a programme." A comment, made by Tara L. McPherson, an assistant professor of cinema and television at the University of Southern California, during the 2001 MIT conference "Race in digital Space", remains very relevant: "Obviously there is a digital divide -- the idea of challenging the digital divide is not about denying its existence. But it is to ensure that the focus on the digital divide doesn't naturalize a kind of exclusion of investment in the communities we are speaking about here."[4] From this latter point of view, fighting the digital divide at the technological level is senseless as it is the deeper social barriers and inequalities that organise social life. If people do not have the experience, the know how, the incentive and the self-confidence that these technologies require, then they will find no relevance to using them to answer their daily needs.

Bridging the "digital divide" is now generally perceived, by policymakers and educationalists, as a challenge of multiple dimensions, the main ones being technological cost and affordability, public access, content, social networks and communities, mediating institutions and literacy. Awareness of these issues in educational research has therefore moved from the earlier OCDE (2001) definition of digital divide as "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 for a wide variety of activities", to a much more socio-technical stance such as that of Warschauer (in press), associate professor of education and informatics at UCI who defines the digital divide as "a *social stratification due to unequal ability to access, adapt, and create knowledge via use of information and communication technologies (ICT)".*

This definition is interesting at several levels. First of all, it identifies the digital divide as a social problem linked with technology and not as a technical problem having social consequences. Secondly, three different situations are considered with the words "access, adapt and create". "Access" refers to the physical possibilities of entering in contact and having an operational know how of digital tools. This is a first level of situations in which a "digital divide" can be found. But it is the most simple to address. "Adapt" means being able to use, to include in one's activity, to adapt to the new possibilities, but also to adapt the tools to the goals pursue by the user. The situations concerned here are much more difficult to assess and entail the social and personal development of the user if he is to master and use

[4] Quoted by J.R. Young in "Does 'Digital Divide' Rhetoric Do More Harm Than Good?", in *The Chronicle of Higher Education*, Nov 9, 2001. http://chronicle.com/free/v48/i11/11a05101.htm (Accessed June 6th, 2006).

digital technology. “Create” implies much more complex capacities, cultural and social know how and awareness of how these tools can help transform society or education.

Schools and universities are expected to play a crucial role in fighting the digital divide. This implies not only in preparing young people for employment by facilitating mastery of technological tools, but more significantly by developing reflective awareness of the values and ethical choices – both in terms of new potentials and disappearing excellence - that are at stake when endorsing the digital universe. Integration of IC technology in education needs to build on this new awareness that the “digital divide” issue has brought about and thus overcome the rampant technological determinism too often that pervades educational implementation of ICT.

After having acknowledged, in this introduction, the changes that justify the need for digital literacy, we will now explain, in a first part, why it is important to reflect upon the frameworks that have been set up to cope with ICT in education. Then, in a second part, the analytical grid, used to analyse the different frameworks, will be explained followed by a presentation, in a third part, of the results of the investigation work. Additional observations on each of the ten frameworks can be found in the annexes.

1. Frameworks, ICT and education

It has progressively become obvious that integrating information and communication tools within educational settings cannot be considered as a simple classroom problem, but that school systems and school cultures are deeply concerned. Local and limited solutions, relying on good will and pioneer work, have proven inadequate or insufficient. 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”[5]. Most educators will agree that it is culture that must transform technology, but that is not what they have been witnessing.

1) Taming the future of education with ICT frameworks

And it is because this was not happening, and because education has become the main hope for many people, that school authorities, policy makers and government administrators have had to find more global approaches, broader concepts and deeper solutions. Frameworks have thus been developed to go beyond local and ad hoc solutions and cope with the growth of available and more and more easily accessed digital tools and information. Frameworks have to do with visions, rational planning and strategic organisation. Basically an educational framework is a rational structure that organizes institutional assumptions, curriculum objectives, educational concepts, ethical values, technologies, pedagogical goals and constraints, and professional practices, in order to implement educational policies. Typically lasting from two to five years, frameworks provide

[5] Carlos Frade, of the Tavistock Institute, wrote in 1998: “The area which clearly appears as lagging behind is the very core of pedagogics, i.e. the teaching-learning process itself, as innovation efforts have not been very successful in bringing about new teaching-learning methods and functions matching the possibilities of ICT.” *Looking at Innovations in Education and Training, Framework, Results, and Policy Implications of the DELILAH project,* TSER - DELILAH CONSORTIUM, Deliverable 15, Final Report.

orientations, establish priorities, organise processes and technologies, and imply investment and personnel to ensure attainment of intended goals.

Frameworks have thus been developed to bring about in education the kind of results that the growing use of digital tools was producing in economy, work or leisure. Frameworks are usually organisational instruments not familiar to teachers. The frameworks considered here concern policies that address the integration of information and communication technology into education. It is important to note the absence in most of the frameworks of the information literacy tools, reference schemas and guidelines that have been produced to enable teachers and students to research intelligently information sources. There is almost no trace of this work, on more fundamental approaches to information research, in the frameworks that have been developed to cope with ICT integration.

This analysis has looked at what is being implemented by each of these frameworks, what are the issues addressed and partly what can be observed when going from the framework to the classroom. It is important to understand what was sought with the framework as compared to schools as they exist. Should school develop competences instead of knowledge? Intellectual higher order thinking processes linked to practical ICT? Learn to learn, to process information, to interact critically with the information?

2) Why analyse frameworks?

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. The ICT or digital literacy frameworks that have been deployed in education usually come after many efforts that have usually begun by acquiring equipment, hardware and netware, than providing teachers with educational resources, and finally training of teachers. The awareness that the training should be the initial step comes unfortunately at the end, when it is much harder to make the right decisions because equipment and resources are already there.

Most of the frameworks, implementing a global approach to educational change, should have resulted in a transformed pedagogical scene. Yet this has not been happening, or at a very small scale. It has thus become necessary to try to understand why these frameworks have not brought about a generalised integration of digital culture within school and university settings and whether recent ones have a better chance of achieving it. The integration of ICT is obliging schools to critically reflect on their practices of educational ICT.

The analysis that follows is focused on the characteristics of ten frameworks, of their underlying conceptual grid and, when available, on the ultimate results that have been attributed to them. As there is, to our knowledge, no standard approach of digital literacy frameworks, and as there are many conflicting and diverging understandings of the expression, this reflection on digital literacy frameworks begins by defining the main issues addressed by digital literacy frameworks.

2. Presentation of the main framework themes or issues addressed

Frameworks rest on visions of society and education and of the problems to be addressed and solved, but also on different approaches, models and understandings of the

basic components of educational actions, that is learning and teaching. Within an ICT framework there is also an acknowledgement of the new context of the information/knowledge society and a particular perspective on what kind of digital or ICT literacy is to be generated, possibly seen in terms of academic outcomes and specific competences.

1) Context, scope and intended audience of the framework

Frameworks have varying extension and can address a large panoramic educational landscape or focus on particular groups or address specific issues. They can aim at developing the educational understanding of ICT of teachers, of decision and policymakers or of the whole educational community. The frameworks can give general directions for transforming teaching and learning or can focus on specific teacher training outcomes in terms of professional standards to be attained.

Context

Frameworks have begun to appear rather regularly since the end of the ’90 when it had become obvious that computers and networks were here to stay. Computer literacy gradually converged with information literacy as the use of the web developed. More and more teachers became aware of the need of specific skills, knowledge and fluency for navigating on the web. Mostly students, but sometimes also teachers were deemed to lack critical discernment, selective appreciation and basic ethical values and attitudes in their interaction with the web.

The technological development of the web has led to digital solutions being integrated more or less in schools through hardware and software investment schemes, resources development. More pedagogically focused teacher training began to be offered in order to stimulate a more massive use than the pioneer level of integration that had been attained.

Frameworks were thus developed in the hope of bringing about in education the transformation that were being observed in other fields of society such as leisure, economy, industry and services. Frameworks started presenting ICT as a transforming power for education, beyond facilitating, improving and empowering learning and teaching. However, very few frameworks have given content to the transformative rhetoric and more importantly, most have not yet produced any changes that would provide evidence of the transformative power of ICT in education.

Scope

The scope of the framework refers to the operational boundaries, what the framework takes into account and what it does not take. It defines the extent of the actions to be undertaken and the reach that they can be expected to attain. The scope will be determine in terms of duration, geographical coverage, school levels concerned, type of intervention in teaching and learning activities.

Intended Audience

Finally we will look at whom the frameworks are addressed. Are there specific target groups or is the framework a general approach to integrating ICT in education and society? The way the targets groups are selected, or not specified, also informs of the expectations that the frameworks will meet and on the goals it can attain.

The frameworks typically address a very broad audience, all educational actors, stakeholders and policy makers. They provide guidance and recommendations usually for teachers but sometimes also for school leaders. The intended end audience, where the

changes are to take place, is mostly student, with the aim to prepare them for a digital information society. There are also often specific recommendations for teacher training and more rarely for school system organisations.

2) Visions and objectives

Visions: Where is it heading? The vision is what the rationale of the framework is built on. Frameworks are more likely to be implemented successfully if they draw their strength from a clear, engaging and shared educational vision of learning and teaching. Building on acknowledged needs and expectations, a shared vision of a possible and desirable future helps focus attention on aims, motivates staff and students, and brings together ideas and commitments that are needed to successfully implement the process of change.

ICT or digital technology are only means for goals that need to be phrased as an ongoing educational vision or as the evolution of this vision with the changes brought about by digital culture. The vision can be grasped through the aims, intentions and goals present in the framework. With the vision can be identified the underlying values and goals that shape action and that justify the framework that will be implemented. However frameworks do not all embody a vision with values identified and recognized as the leading thrust behind the intended integration of ICT. A first step will therefore be identifying what part of the landscape is covered by the framework.

An educational vision is about tomorrow's education. Usually tomorrow's reality is imagined by starting from the present situation and by extending identified trends, extrapolating them into the future. More pertinent than this futurist and often delusive approach, is the prospective approach which consists in imagining a completely different future and trying to look at the present situation from this perspective. In both instances, what is needed is a clear idea of what is happening today

Objectives: **what does the framework plan to accomplish?** Objectives are operational statements linked to one or more program goals. They can be presented in attainable and quantifiable results to be achieved by a program. They describe the future state that is to be achieved, and the series of action needed to attain this desirable future. The objectives need to be part of economic, social, cultural and educational rationales. Often, the values that underlie decisions are not clearly established. For each framework, it will therefore be necessary to examine what are the main focuses: strengthen citizenship and democracy? Foster academic excellence? Fight the digital divide? Train students professionally for the knowledge economy?

Change and innovation are often words used to describe the goals aimed at. However innovative change is not sufficient as an objective for education, notr is 'better', 'improved', 'enriched' learning. Even improvement needs a direction, a purpose or an aim to attain, described in terms of what this future state will be. Education actors would generally agree that they aim at developing critical actors capable of challenging dominant ideologies, mastering technological tools and developing life long learning. Often the reference to such shared values remains implicit and it is not obvious how such goals will be attained.

Furthermore, whatever the explicit objectives, there is usually a hidden agenda to ICT which can correspond to one or more of the following objectives:

1) Re-establish the foundational legitimacy of an institution to initiate to reflexive and critical knowledge.
2) Reframe the role and objective of education in an information society.

3) Rethink and transform teaching and learning for the 21st century context.

However, there can be an important gap between the very ambitious set of objectives of a framework, which can be expressed in terms of transforming education, and the actual activities that are organised, which can deal only with mastering tools to cope with digitally based information.

3) Basic components of digital educational practices

In order to address the conceptual basis of the different ICT frameworks, three basic components will be considered as structuring the frameworks: learning, teaching, and digital literacy. Not all frameworks state clearly what their understanding of each of these components is, but all frameworks refer to these different structural elements in the way they address the integration of ICT.

Why is it important to become aware of the different teaching and learning theories that are ingrained in pedagogical practices?

1) Because educational systems are extremely difficult to change. It is necessary to have a clear understanding of the premises on which are built the teaching and learning activities, if one does not want to become trapped in repetitive behaviours.

2) Because there are several prominent theories that developed different approaches to important aspects of the pedagogical practices. It is important to understand how learning occurs if one wants to improve or change learning. Coherence can only be achieved through awareness of the strategic choices involved in order to succeed. A knowledge society cannot function without a clear understanding of the different learning models that are constantly activated by the different contexts or the demands for competence.

3) Because each theory of learning leads to specific classroom practices. Introducing changes with IC technology can only succeed if the concerned actors have a reflective understanding of their actions, their goals and their underlying processes. “Any purposeful action is governed by theory. Everyone who teaches or professes to teach has a theory of learning“ (Bigge, 1976). Theories have a tendency to organise our actions without our knowing it. If a teacher is strongly committed to teaching, then chances are that this teacher’s activity is based on a theory of learning.

• Theories and models

When looking at learning and teaching, one is immediately confronted with a plethoric assembly of theories and models. Theories are formulations of apparent relationships or underlying principles of certain observed phenomena that have been verified to some degree. Learning theories are based on psychological or social theories that explain the functioning of human being and human groups and institutions. For example, the classical conditioning or learning by association theory of learning is based on behaviourism, a psychological theory which states that behaviour is always a response to a stimuli coming from the environment.

Models are general hypothetical descriptions, often based on an analogy, used in analysing or explaining a phenomena and generally conducive to prediction or applied action. For example, teaching models are formal representations of the different teaching techniques based on a particular vision of the learner and aiming to develop specific aspects.

One such model of teaching is “instructional design”, which is the systematic process of translating general principles of learning and instruction into plans for instructional materials and learning, and which relates specified events of instruction to learning processes and learning outcomes that have been set by the instructor.

Most frameworks do not explain clearly what are the underlying teaching models and learning theories that form the basis of the strategies deployed to integrate ICT. However, the training of teachers, which is an important component of frameworks, requires a clarification of such issues. As states Loveless (1995), “It is not possible to consider the use of IT in classrooms without reflecting upon one’s beliefs about learning and teaching. IT capability can be seen as having much more to do with an approach to ways of learning and working than as the development of a set of skills”. In that sense any IT training of teachers needs to be a truly professional development, that involves, beyond skills training, changes in teachers’ approaches to learning, in their attitudes, values, beliefs and meta-cognitive understanding. It is only when teachers have understood the importance of lifelong empowering learning strategies that they will engage students in self directed and lifelong computer learning, and in self appraisal and self management.

Learning

A knowledge society based on lifelong learning cannot function without a clear awareness of the different learning models that are constantly activated by the different contexts or the demands for competence. Learning is a composite concept that can refer to many different theories and models. While there is agreement on a broad definition of what is learning, generally understood as the acquisition of knowledge, competences, skills and attitudes that lead to long-term change in behavioural patterns, cognitive structures, or personal identity, *how learning happens* is a controversial matter. When integrating ICT, some learning models may seem more appropriate than others and there is usually an explicit reference to some theory. But it is only when looking at the big picture, at what is happening over a long period, that the implicit theories and models organising the concrete activity can be identified. Learning theories are embedded both within learning systems and processes and within teaching practices.

Theories and models, or how learning happens

How does learning come about? Many schools of thought have developed theories of learning. As already explained, a learning theory is a coherent and systematic explanation of how learning happens, based on interrelated concepts, definitions and propositions, offering a well-substantiated explanation of some aspect of the learning process. A theory of learning will therefore need to address the following questions:

- What are the role and activities of the learner in the learning process?
- What corresponding teaching emphasis and activities does it require?
- How are the learning outcomes described?

Main learning theories

For the purpose of this study, four main learning theories that come up in relation with educational ICT are:

1° Learning as a conditioned response or the **behaviourist theory of learning**, based on the S-R stimulus-response paradigm (behaviourism: Watson and Skinner): to learn is to

integrate lasting changes in one's behaviour, in response to environmental and contextual changes. The behaviourist approach develops an objective, empirical and quantitative approach to teaching with specific goals and adapted instructional strategies. Behaviourist focus on student's behaviour which they try to shape by adjusting situations such that the students are encouraged to behave in ways that gradually conform to a fixed goal. Learning outcomes are measured changes in the overt behaviour of the individual. Teaching is based on directed instruction, with the breaking down of the instruction process into steps, with drill and practice, with exams to measure results, with the use of rewards and punishments. ICT is appreciated because it allows a greater individuation of the whole process.

2° Learning as the processing of information - **computational theory of learning** (cognitivism: Ausubel, Gagné) To learn is to acquire information and new representations. Here the focus is on the mental processes of the learner during the learning process, based on the information processing theory. The learner processes information, linking new to old knowledge, schema and scripts. Learning is organized by a systematic analysis of the sequence of learning events, of the hierarchy of skills in relation to the five major categories of learning: 1) Verbal information 2) Intellectual skills, 3) Cognitive strategies, 4) Motor skills and 5) Attitudes (Gagné, 1987). Learning consists in constructing new symbolic, mental representations to be encoded in the mind. Teaching strategies will organize instruction to make optimal use of encoding processes taking into account the limitations and specificities of the human memory.

3° Learning as the construction of new understanding and knowledge – **the constructivist theory of learning** (cognitive development paradigm: Piaget & Bruner) To learn is to integrate new cognitive schemas through assimilation and accommodation in order to construct new knowledge, that is meaningful entities. Teachers focus on active problem solving and on connections between facts and fostering new understanding in students, facilitating the construction by each one of his or her personal perspective of the world. They tailor their teaching strategies to student responses, encouraging students to analyze, interpret, and predict information. Teachers also rely heavily on open-ended questions and promote extensive dialogue among students. Constructivism calls for the elimination of grades and standardized testing. Instead, assessment becomes part of the learning process so that students play the larger role in appreciating and judging their own progress.

4° Learning as a social and experiential process – **the socio-cultural theory of learning.** Learning is a process of change by which a subject transforms himself and produces a conduct adapted to these internal changes and to external solicitations. Humanistic theories of learning, very much value-driven, focussed on personal development are the basis for a development of the learner as the actor and author of his own becoming through social interaction. Learners need to be empowered and to have control over the learning process which takes place within a group, the teacher being more a facilitator (Rogers) of critical reflection (Schön), of conscientization (Freire) and of transformative learning (Mezirow). It is a similar approach to learning that explores the use of collaborative software in the light of Wenger's community of practice approach.

• Teaching

Teaching is a communication process aimed at activating learning. There are much less specific teaching theories referred to in the pedagogical literature, as compared to learning theories, but there are many teaching models. However, underlying these models are the different theories that teachers adhere to and that constitute their basic knowledge and beliefs about their professional activity, but these are usually not explicit beliefs.

Theories and models or how teaching generates learning

The different theories that teachers endorse come from their personal and social background and their personal experiences, and they are also, as formal teacher training develops, more and more coming from academic grounding. There are three main types of theories that teachers rely on:

- *disciplinary theories* (for example, theories that account for what understanding and knowing mean in mathematics) and *epistemology* (for what is knowledge);

- *didactics* (for example, theories that account for how one brings about learning in geography) and *pedagogical theories* (for how one brings about learning in a classroom, for how one organises group work, for how one uses IC technology to bring about learning);

- *psychological and sociological theories* (for example, theories that explain the impact on learning of interpersonal relationships, authority, organisation, human desire and human suffering, relationship to knowledge and emotions, etc).

Main teaching models

There are four main types of teaching models that are based on one or more of the above theories, whether explicitly or implicitly.

1) the *lecture model*, or the transmission model, involves general communication strategies, an organised or structured syllabus, varied formats (expository lecture, case based presentation, demonstrations and stories, short format, interactive lecture, question and answer) perhaps validation exercises;

2) the prescriptive or instructional design model, is based on instructional methods and specified outcomes, principles of good course design, a structured sequence of different learning activities, and reliable and objective assessments;

3) the transactional model, or discursive model, based on a continuing dialogue between teacher and students, with explanations, clarifications, descriptions, mappings provided by the teacher to stimulate understanding, feedback, problem solving, reflection and knowledge building;

4) the transformative model, based on humanist, social and clinical psychology, with the teacher providing the means for, on the part of the learners, developing awareness of the socio-cultural reality in which they live, critical reflection on students' character, self-consciousness and social development, personal commitment and engagement to transform this reality.

Each model leads to different expectations in terms of learning results. Yet it is only if the teachers share the underlying theory that they can obtain the expected results. For example, using a transactional model, based on constructivist theory, does not allow for outcomes measurable through quiz and tests. If such assessment measures are nevertheless set up, then the teacher's practice is in fact probably more transmissive and more prescriptive that it appears or wants to be. Teachers often have the impression that they work intuitively taking into account the immediate context – school, classroom, social, political and economic – but close study of these practices have shown that there is a definite underlying set of beliefs that explain the overall pattern of a teacher's practice.

Integrating ICT in classrooms in itself does not change this basic pedagogical reality.

Often stakeholders believe that the use of the technology will bring about change. They expect teachers to spontaneously reflect on their activity with ICT and that this will bring about the desired changes, as if innovation and evolution were inherent to ICT technology. This overwhelming belief in the transformative power of technology is nowhere as important as it is in the curriculum content of training for ICT or digital competency and/or literacy.

Digital literacy[6]

Since all frameworks want to implement the use of IC or digital technology, they have goals expressed in terms of what it means to be ICT or digital literate. These objectives are sometimes relayed through curriculum content. In some cases, ICT or digital knowledge, skills and competences have been identified as such.

Digital literacy is an evolving concept. Digital literacy had initially been understood as equivalent to technological literacy, in a technologically centred approach. The implicit assumption was that technology is introducing change in society and that individuals need to master the technological tools in order to be able to adjust to these changes. All schools today include, or plan to include, training for the basic understanding of digital literacy, that is having mastered the use of a personal computer and of the key tools that allow word processing, online navigating and email. However, digital literacy can also refer to an in-depth understanding of literacy in a knowledge society, with what it implies in terms of competences, empowerment and critical reflection. “Literacy is underpinned by critical thinking and the ability to challenge dominant ideologies. All literacy practices are integrated within the social context. The objectives of literacy are holistic. They are not limited to individual and/or vocational outcomes, and they include the building of capacity for communities. » Lina Markauskaite (2005) It will therefore matter if literacy is understood as a set of social practices rather than a narrow cognitive skill.

As aptly formulated in inquiring whether the knowledge society provides for the obsolescence of human values or new horizons for creativity, a UNESCO (2005) report states: “Closing the digital divide will not suffice to close the knowledge divide, for access to useful, relevant knowledge is more than simply a matter of infrastructure – it depends on training, cognitive skills and regulatory frameworks geared towards access to contents.“ What is at stake here is the learner’s relation to knowledge and literacy and the role of the learner in constructing his or her knowledge. It is such an involvement of the learner that Warschauer stresses to overcome the digital divide: “Paolo Freire (1994) and others have shown that literacy instruction is most effective when it involves content that speaks to the needs and social conditions of the learners. And, as with ICT-related material, this content is often best developed by the learners themselves.” (Warschauer, 2002)

Furthermore, digital literacy goes beyond the culture of print, with its basically stabilised and structured representations of reality. It implies the mastery of ICT tools, but also the competences and understanding to cope with the significant changes that the information/knowledge society brings. The main changes that characterise this society are

- the cognitive processing and reception of knowledge are more and more computer assisted and dependent on collective technological codification;
- technologies that externalize cognitive functions are more and more used interactively for the elaboration and construction of knowledge;

[6] Digital literacy is used here as a “general label”, but many frameworks have developed different and specific understandings for these terms.

- the role of memory is changing and increasingly understood as external, material and of almost unlimited range;
- seeking information and interacting with knowledge is expected more and more is be a real pleasure experience that stimulates interests and thinking.

Whether in the training of teachers or of students, it is interesting to look at the c**urriculum content** that is presented in terms of skills, competences, understandings, higher order thinking skills, or meta-cognitive processes. For example, what types of information management competences are favoured? Are the different types of interaction with information considered: researching, communicating, modelling and evaluating information? Does the digital literacy or ICT literacy curriculum include autonomous learning, which implies self-organizing processes/systems capable of maintaining oneself by adapting, and accomplishing functional actions in a changing environment? What is said about ethical and social issues? Are the pedagogical competencies more developed than the technological operational competencies?

4) Strategies

Strategies are systematic plans of action, with prioritized steps to achieve specific outcomes. Usually, frameworks include such plans to implement the goals and objectives pursued. Strategic thinking is necessary in a framework, as practical and acceptable solutions have to be found to implement the framework's good ideas. With strategic planning, the frameworks promoters have the opportunity to focus on the important rather than the urgent.

Strategies can be top-down approaches or bottom-up or a combination of collaborative participation with periodic re-assessment of future actions to be taken.

Here, the analysis will be looking at the following questions: What approaches or plans have been selected within a framework to accomplish the desired goals and objectives? How have the different known dimensions of integrating ICT in education been attended to? What plans and procedures has proven difficult to achieve and what has brought about the desired results.

School have more and more to cope with the demands for measurable outcomes and results. Yet it is becoming more and more obvious that learners need to develop complex thinking capacities, for in-depth analysis, for high-level comparisons, for multiple level planning. These learning objectives imply a new relationship to knowledge, a change in the conception of learning and knowledge. It will be very difficult to find strategies that attend to both dimension, measurable outcomes and high level thinking skills and knowledge.

5) Evaluation of the framework: assessment procedures, indicators and criteria

Since the '90, it has become customary to assess government work and to apply to non-profit organisations the same expectations in terms of accountability and results as those applied to private endeavours. These procedures are being more and more applied to education. Evaluations and assessments provide stakeholders and decision makers with information, preferably quantitative, on the impact of their policies and on the state of the education system. Here, we will investigate if the frameworks included evaluation measures. If they do, what is the time frame, the indicators and criteria used as well as the procedures. It is also interesting, when the information is available, to look at who is doing the evaluation

and who is asking for the evaluation.

The evaluation of what has been realised can be done with two different approaches. One is evaluating the implementation by comparing the outcomes of the actions with a fixed set of measurable desired outcomes, such as amount of equipment, number of teachers trained, number of students trained, number of hours of training, number of class-hour equivalent courseware produced, changes in weekly schedule, new courses created, etc. This quantitative information gives rather limited but easily manageable information.

An alternative approach is to organize a formative evaluation with the participating actors, the teachers and students involved, and have them reflect on the changes that have been implemented, on what they have learned and what they have discovered. This phase can also include identifying what is still missing compared to the initial aims and objectives and what continuation they would propose for the future.

3. Framework list

The following ten frameworks have been chosen as representative of the different endeavours that have taken place in educational ICT. The “documents” were chosen because they cover a wide range of different approaches that have been developed in the integration of ICT in education. They cover a span of seven years, and concern varying geographical areas, from local to European dimension, and from different countries, as fas as Australia.

1) Raising the Standards. A Proposal for the Development of an ICT Competency Framework for Teachers.

The ICT Competency Framework for Teachers is the final report of a three-step national project which took place in Australia in 2001 and which is focused on producing standards for ICT in teaching and learning. The first step was a literature review summarizing current research in learning with ICT and mapping work on teacher ICT performance measures. The results were gathered in a document comprising three sections: two sections which map teacher professional standards developments in Australia and overseas; and the third section, which analyses the significant issues relevant to ICT competence in teaching and learning. This document was discussed at a two-day national workshop of key stakeholders (60-70). The third phase was “an analysis of the main findings of the Literature Review and Mapping document, discussions at the forum and the generation of a draft ICT Competency Framework proposal.” A final report in web-ready format summarised the project work and presented proposals for a teacher ICT Competency Framework and for ways the work could be supported and shared at a national level. It is this last framework proposal that has been analysed here.

A project undertaken by UWS, ACSA, ACCE and TEFA on behalf of the Commonwealth Department of Education, Science and Training, Canberra, Australia. http://www.dest.gov.au/sectors/school_education/publications_resources/other_publications/raising_the_standards.htm Raising the Standards, PDF Document (242.24 KB, 44 pages) Appendices PDF Document (393.94 KB, 92 pages) (Accessed May 28th 2006).

2) Digital Transformation. A Framework for ICT Literacy, in the U.S.A.

Digital Transformation, A Framework for ICT Literacy, is presented in a Report of the

International ICT Literacy Panel (2002), set up by ETS, Educational Testing Service[7]. ETS brought together, during one year, eighteen experts from Australia, Brazil, Canada, France and the United States, on two major themes: 1) answer the crucial need of large-scale global assessments and smaller diagnostic tests to help governments, schools and private sector organizations, understand the breadth and gaps in ICT literacy across the world; 2) develop a workable Framework for ICT Literacy, that would provide the foundation for the design of assessment instruments. It is this framework, and its basic aim to lead to a clearer understanding of ICT literacy and ways to improve it, that is reflected upon here.

http://www.ets.org/Media/Research/pdf/ICTREPORT.pdf (Accessed on the 2nd of May 2006.)

3) ICT in Teacher Education. UNESCO.

The two documents analysed were produced in 2002 by the Division of Higher Education of the UNESCO Education Programme. *A Planning Guide* provides a framework for ICTs in teacher education. It describes the essential conditions that teacher educators, administrators, and policy-makers must meet if they are to successfully infuse, integrate, or embed ICTs into teacher education. *A Curriculum for Schools and Programme of Teacher Development*, also known as the Andersen and Weert Report, stems from an IFIP[8] Working Party and proposes both a curriculum in ICT for secondary schools and a programme of professional development for teachers. While the first document develops a "new view of the learning process" and provides a rationale, a framework and a strategic technology plan for integrating ICTs into teacher education programmes, the Curriculum document proposes a four stage ICT development for schools, going from an approach where ICT is emerging as a separate component becoming available, to a transforming approach where the school has evolved into an open learning centred resource environment based on an intensive integration of ICTs.

http://unesdoc.unesco.org/images/0012/001295/129538e.pdf (05/01/2006) – Curriculum)

http://unesdoc.unesco.org/images/0012/001295/129533e.pdf (05/01/2006 - Planning Guide)

4) Digital Competence: from ICT skills to digital "bildung", in Norway

The Norwegian Ministry of Research and Education (UFD) commissioned ITU (Network for IT-Research and Competence in Education), than a research community, and since January 2004, a permanent national academic unit at the University of Oslo, to develop a report on the concepts of *ICT as the fourth basic skill* and *digital competence*. The basis for this request was the need expressed by the Ministry to acquire greater knowledge of this topic. The report, which came out in June 2003, was written by Morten Soby, Researcher at the University of Oslo, presently Network Leader of ITU. Although this paper was not initially a formal framework, its considerable impact within the educational community justifies its choice in this research corpus. http://folk.uio.no/mortenso/Dig.comp.html (Accessed on May 3rd, 2006) Also available on the DigEuLit website: http://www.digeulit.ec/docs/public.asp

[7] ETS, founded in 1947 with headquarters in Princeton, New Jersey, is an independent, non profit organization, devoted to educational research and assessment. It brings together, mostly in the USA, over one thousand experts in research and assessment to help educators around the world find new ways to advance learning through innovative assessments.

[8] IFIP is the International Federation for Information Processing, a non-governmental, non-profit umbrella organization for national societies working in the field of information processing. It was established in 1960 under the auspices of UNESCO.

5) I-Curriculum: The knowledge and Information Skills needed for Living in the Digital Age. Minerva Action implemented in Greece, Spain and UK.

The I-Curriculum Framework results from a European project, funded by the EUROPEAN COMMISSION within the SOCRATES-MINERVA Programme, 2002-2004 (100783-CP-1-2002-1-GR-MINERVA-M). Its development is based on « an analysis of current curriculum requirements for teaching digital technologies, relevant literature, and case studies involving innovative teaching ». The objective of the project was to establish a European framework for defining the key meta-skills and meta-knowledge needed for living in the digital age.

"An underlying tenet within the I-Curriculum project is that there are new ways of knowing and being in the world. It is not sufficient that a curriculum just adopts the simple operations of the tools that make those new ways of knowing and being possible. For example a student is not truly digitally literate if they are only taught the mechanics of a modelling tool like how to enter formulae into a spreadsheet. New ways of knowing mean that there are new things to know, new ways of organising knowledge and new ways of classifying knowledge." (*Policies and Planning*, p. 6)

The analysis presented here is based on the deliverables produced by the project, which include the study of national implementation of the project's output. http://promitheas.iacm.forth.gr/i-curriculum/outputs.html (page accessed on 21.02.2006)

6) European Pedagogical ICT Licence in Denmark

EPICT is the European Pedagogical ICT Licence, launched in 1999 in Denmark. Its focus is the continued professional development of teachers in the pedagogical use of ICT in education. The training combines the acquisition of ICT skills with purposeful integration of ICT in classroom pedagogy using small teams working in their familiar school environments and takes about eight months to complete. In Denmark, there exist ten different and specially designed courses covering the entire range of education settings where teachers intervene. There is an export version that is widely used in Norway and pilot versions that exist in Hungary, Greece, Italy, Iceland and Tasmania (Australia), and specific African pilots in Ghana, Uganda and Cameroon. http://www.epict.org (Accessed May 2nd 2006.)

http://www.uni-c.dk/generelt/english/education/ict-licence.html,

7) AUSPICT The Pedagogical ICT Licence in Australia

AUSPICT, or The Pedagogical ICT Licence in Australia, is a methodology, developed in Denmark in the late 1990s by teachers, for teachers. It combines the acquisition of ICT skills with purposeful integration of ICT in classroom pedagogies using small teams working in their familiar school environments and takes about eight months to complete. This approach was transposed into the Australian context, translated and adapted to the Australian educational environment. Thirty-five staff members experimented this new training with six facilitators in 2005. http://www.ausipict.com (Accessed May 2nd, 2006)

8) Common European Framework for Teachers' Professional profile in ICT for Education. uTeacher project outcome (eLearning Initiative and Action Plan)

The CEF is a Common European Framework on teachers' profile in ICT for Education in Initial Teacher Education (ITE) and in the Continuing Professional Development (CPD).

The main aim of the framework is to help educational administrators, course designers, teachers, examining bodies, etc. to reflect on their current practice, coordinate their efforts and ensure that they meet the real needs of school in the knowledge society, within the European context. It is the outcome of a European Commission eLearning Initiative project, *uTeacher* carried out between December 2003 and June 2005.

http://www.univirtual.it/uteacher/devepro/framework_books.htm (Accessed on the 2nd of May 2006)

9) TICE Framework in France.

The French Ministry of Education and Research (MENESR) is in charge since November 2002, within the French government, of the development of information and communication technologies in education (TICE). The policies and programmes concerning education (schools and higher education) have been made public on a specific website (http://tice.education.fr/educnet/Public/plan/). Five important programmes implement the ICT policies in education. The other are 1) infrastructure and services, 2) digital resources, 3) uses of ICT in teaching, 4) "Training for ICT and accompanying support and measures" and 5) Quality, technology monitoring and diffusion. The analysis will focus mainly on programmes 2, 3 and 4. These three programmes cover all levels of schooling and higher education as well as the training of teachers. Mastering the basic information and communication technology is now included in the core knowledge and skills considered as absolutely essential during French compulsory schooling (up to age 16). Building on existing ICT knowledge and skills frameworks, the French Ministry of education has developed its own certifications for students and teachers. ICT Certification in primary and secondary schools is obligatory and more and more integrated within existing curriculum.

10) Techno-pedagogical competence framework for teachers. (Référentiel de competences technopédagogiques pour le personnel enseignant.) Québec, Canada.

This framework was produced by two educational researchers and counsellors for a network of college teachers. The main objectives were:

- ◊ To ensure broad guidance for reflection and training in terms of competence, allowing teachers to improve the pedagogical use of ICTs. More a source of inspiration that for prescription;
- ◊ Facilitate the analysis of needs in professional development and provide training in four domains: communication, information, design, production;
- ◊ Produce a tool for reflection and exchange on an articulated problematic of pedagogy and ICTs that goes beyond simply providing a curriculum.

The content of the framework results from the study of the existing ICT competence framework, interviews of ICT teacher trainers and the study of course scenarios. The French word "Référentiel" is based on the idea of a structured system that will serve as guide in the integration of ICTs in a conscious pedagogical practice.

http://site.profweb.qc.ca/index.php?id=96 (Accessed May 2nd 2006)

http://ntic.org/guider/referentiel.pdf (Accessed May 2nd 2006)

4. Analysis of frameworks

1) Context, scope and intended audience of the framework.

If the sample of frameworks analysed are considered as a "hole continuous movement of the society facing the ICT's challenges" it is possible to detect a gradual shifting from different central subjects. Even if in general the main aim presented/identified in these frameworks is to upgrade the citizens to function in the information/knowledge society, the majority of them focus on the **educational system** and ICT integration in education. In these frameworks, the school is seen as the priority locus to ensure the social transformations needed by the information society. Nevertheless, and perhaps because of the growing importance given to the educational system (especially the teacher, seen as an actor of change) to face this challenge, the educational system gradually became a focus itself as an institution which must be deeply transformed, in order to face the problems brought by the information society.

Different subjects are highlighted throughout this reflection: the incongruous role played by the school in terms of issues ensured: preparing (or not sufficiently preparing) the students for the work world; the nature of the learning-process' paradigm employed by the school and the kind of the students' competencies that this paradigm allows them to acquire if related with that they really would need to function in this society; the teachers professional identity, not adapted if related with their new missions as an educator in the new social configuration where ICT are everywhere; the educational structure commitments ensuring/not ensuring the transformations needed by the knowledge society. Thus, in the frameworks, gaps between the school's missions and objectives and the other social institution needs are often criticized, sometimes just as basic arguments (and the school is called to "modernise" its didactics and pedagogical methods, which means, include ICT as a didactic tool), sometimes the educational system is scrutinized more closely in order to integrate consciously and pertinently ICT into the learning process.

The trends identified in the frameworks point to different directions:

a) *By pointing the gaps between the school's objectives and society's needs*: *remediation* can be found by focusing on ways to upgrade the actors' (teachers, students) technical and operational skills/competencies, giving them the knowledge necessary to function in this new context. This is done in parallel to the existing educational system, in terms of training, courses, certifications, etc., without any querying of the educational system itself, in terms of its objectives, values, paradigms, curriculum, etc;

b) *By taking into account the gaps between school's objectives and society's needs*, actions introduce *in schools change towards modernity*, usually centred on *didactics and pedagogical activities including ICT as a tool*. In these cases, the teacher sees his/her role and tasks as a challenge: change the system by changing his/her owns' practices, by changing his/her points of view about ICT and education and by creating the conditions for improving the students' skills and competencies. Here, the ICT's tools are not only the knowledge to be learnt (technical skills to be acquired), but they create a particular situation that must foster the development of others competencies, presented as absolutely necessary for the knowledgeable use of technology (critical thinking and other literacy like writing, reading, problem-solving, etc.). Therefore, the teacher must learn how to use ICT tools (in a technical way) and integrate them in his/her pedagogical practice (in a reflective way). So, these professionals must improve not only their own technical skills/competencies but also raise a higher level of critical thinking and understanding about the relationships between ICT and

education. Different frameworks/interventions situate the teachers' role at different levels:

- changing his/her didactical practice by including ICT in the activities without changing pedagogical paradigm;
- changing his/her vision of learning-process in order to integrate ICT into the pedagogical activities, by giving them a "pedagogical sense" that would support a certain level of pedagogical paradigm change;
- changing his/her vision of learning-process, in order to reflect more deeply on the contributions of ICT to new ways of learning, new knowledge organisation, new patterns to be employed for teaching (changing the pedagogical paradigm);
- querying his/her visions about what teaching means nowadays, and ICT tool applications (by using them) might lead the professionals to a further reflection about this subject that could go beyond the ICT integration's challenges.

c) *by recognising the gaps between the schools' objectives and society's needs*, the actions can focus directly on the educational system at the teachers' educational level. In this case, the school's legitimacy is recognized and the weaknesses of the institution are clearly pointed out. The teacher training curriculum and the pedagogical practices used to train teachers are called to be equally transformed. Here, it's the future teacher's mentality that is challenged, and ICT must be part of their future professional life from the beginning of their professional education.

2) Visions and objectives: the framework rationales

The rationales of the frameworks are rooted in the new information/knowledge society context, and propose to introduce innovative change in schools through the use of ICT. The goals are expressed in terms of modifying, enriching, or transforming student and teacher competence and literacy. In order to prepare these actors for the world of tomorrow, new skills, attitudes, knowledge, competence are needed and it is the schools' role to bring about the necessary changes through new ICT or digital curriculum.

The different frameworks originated from 1999 to 2005. During this time span, the understanding of how to cope with the changes that the information/knowledge society introduces in our relationship to knowledge evolved deeply. At the end of the '90s, there was still an important need, especially for teachers, to become computer literate, meaning to be operational with digital hardware and software. Although the frameworks aimed at pedagogical change, the implementation of the frameworks seems to have resulted very often in intensive and needed technological training. However, gradually, the pedagogical dimension became dominant, as evidenced with the development of the European Pedagogical ICT Licence. This shift probably became possible also because the spread of digital technology resulted in the shift from questioning what the impact of ICT on learning could be and how it could be assessed to exploring how ICT could help bring about an essential modernization of schools and educational professional practices. It rapidly became obvious that teachers needed very specific and focussed help in pedagogical integration and that simply training them to master technically the tools was obviously insufficient to empower them to innovate.

Some of the frameworks claim that there is a cultural determination to be taken into account, which means that the standards, the skills aimed at, the competencies needed,

might not be the same necessarily from one community to another. This composite context forced some authors to take the analysis to a more demanding level, towards *meta-skills*, *meta-competencies*, and new cognitive tools. Many frameworks have organised the integration of ICT in several levels, between three to five, and comprising a basic operational level with the mastery of digital tools and the acquisition of technical knowledge, an intermediate level focused on integrating within the daily classroom activities the digital tools, with the need to rethink the unfolding of the activities, and a third level with the transformation of learning and teaching.

These preliminary observations allow the regrouping of the frameworks into two main categories of rationales: 1) those that foster upgrading, adapting, enriching everyone to cope with the new demands of an information/knowledge society and the need to master technological information and communication tools (a, b, c); 2) those that built on the need for change and innovation in the educational system, and for higher level cognitive skills, meta-skills and critical reflection that all citizens must develop (d, e).

a) With the need to *ensure, equalise the "same level" of skills/competencies for every citizen (in the world)*, related to standard references, the rationale is to create the conditions (courses, trainings, certificates, etc.) that upgrade people to a common background of technical skills/competencies needed, selected and operationalized. The notion of "digital divide" here underlines the differences between individuals, focuses on the part of the population that doesn't have access to ICT and information/technical skills and the rationale will try to overcome this gap. Sometimes, the idea of non equal access to the skills is added by the idea of non equal access to the adequate education/training. The emphasis here is on the *technical abilities* to deal with computers and digital information.

b) With the need to assess and make a diagnostic about the level of persons who must receive a training, this rationale states as necessary a framework in order, on one hand, to create the best (the most appropriate) training program and, on other hand, to work within sound economic investments. In some frameworks, this rationale is clearly targeted, and the goal is to provide the foundations of an assessment tool; in others frameworks, the assessment is less formal but targeted too, made by the learner himself, at the end of the training process, when the trainee can realise his/her improvement and be more confident in keep using ICT's tools. Here, the differences between individuals are not excluded, but taken into account, with the provision that each one must go beyond his/her present level of competency.

c) A third rationale can be distinguished, even if this is not present in most frameworks: it is the insistence on the need for the teacher to keep using ICT tools in his/her professional practice after the training period is over. This is often justified for economic and institutional reasons. This third rational focused on this kind of action seems to be creating the conditions for each person, aware of his/her level of needed technical upgrading, to commit themselves to development/lifelong learning/ongoing practice with IC technology. The "assessment" could have a strong influence here and lead the person to an engagement towards his/her own ongoing development and use of the technology.

d) Another rationale identified is the development of complex cognitive thinking by using the ICT and/or for developing awareness with ICT in any activity/task (pedagogical, professional or leisure one). The use of ICT tools must improve different literacies, not only these referred to in " dealing with the digital" in a narrow sense but more in terms of cognitive skills and higher order and critical thinking. The competencies introduced, called *meta-skills and met-knowledge* are presented as a kind of "cognitive tools" that the citizen must acquire for functioning in a changing world that

imposes *new ways of working and knowing*. These competencies would enable the user to reflect, at first, about the tools and ways of using them, then about transforming uses and creating new ones. Beyond this, the new competencies would extend the professional/citizen's reflection about the structure of the technological world and of the social world in terms of a person's identity, a professional's identity, communication and community values/paths and challenges, the work world's structure and directions, education, culture, and others social concepts. There is here an ambitious political goal: underneath propositions that focus on the individual is the power of changing the environment. It's not difficult to see how many work has still to be done!

e) A last rationale extracted from the frameworks aims at changing the *educational system*, in terms of structure, curriculum, methodology, pedagogical paradigm, etc. In the framework directly driven by this rationale, the curriculum of the future teacher is focused on. But the majority of the frameworks does not touch directly this point, there's just the attempt to introduce the activities related with ICT (as a knowledge or pedagogical tool to teach other subjects) into the traditional curriculum. Reflections about a different knowledge organisation, the disciplines boundaries, etc., are so far only pointed at.

3) Basic components of the digital educational practices

Learning and teaching: theories, models and practices

As expected, there is very little explanation on the teaching and learning theories and models within the different frameworks. The UNESCO Planning guide provides perhaps the most explicit information in all the documents. A traditional view of the learning process, - learning is a tedious solitary and linear process, based on identifying deficiencies and weaknesses in students, based on information transfer and reproduction – is opposed to an emerging view – learning as an active social process, based on strengthening students abilities, interest and culture, an integrative, contextualized and versatile process. The framework states the need for a shift from a teacher-centred to a learner-centred instruction to acquire the new 21st century knowledge and skills. Then a series of theories, (from Vykisky's sociocultural theory of human learning to Bransford anchored instruction theory) of varying ecological validity, are presented as supporting the new view of the learning process.

In I-Curriculum, there is some reference to Cole & Engeström's "expansive learning", which is an adaptation of one of Bateson's logical levels of learning, that is "developing a change in our learning in order to make a new context for learning". This "learning about learning" underlies the notion of "transformational learning" – what learning has to look like in a world where the context is changing - that is developed in the framework. However transformational learning is presented in terms of new roles, new strategies and new activities, but the theories it builds on remain implicit. There is no exploration of how each learning theory relates the knowledge, to the underlying conception of knowledge that it activates in the learner.

Constructivism is the recurrent reference in several frameworks. However, there is usually insufficient information to grasp what is meant by this allusion to what is a very rich and complex set of theories. Constructivism and student-centred learning are often associated with ICT. In an important literature review on the impact of ICT on learning and teaching, Newhouse (2002) presents constructivism as "the pedagogical philosophy to which most 'Western" educational leaders and researchers subscribe". Markauskaite (2006) attests of this causal relationship between ICT and the shift from teaching to learning: "Access to new ICT tools and resources, such as CD-ROMs and on-line databases, modelling environments and other tools of computer-mediated learning, could change and even totally

reshape present instruction from behaviourist teacher-centred teaching to constructivist student-centred learning. ».

What is the rationale for linking a constructivist approach to learning and student centred or learner centred pedagogy? It is true that ICT introduces an important change, in accordance with what young people are experiencing today: the interactive experience of information. Learners want to be active, to react, to manage the situation and not be passive receivers. They want to work with tools that allow them to process multimedia information easily and rapidly. Therefore teachers, having understood that knowledge is constructed by each one through interaction with other people and external reality, want to organise learning situations where young people will actively construct their knowledge. Digital technology is fundamentally interactive and lends itself easily to such projects.

However, there is here a confusion that would need to be clarified. It appears that two dimensions of the educational situation are woven together when constructivism is referred to in the frameworks. These two dimensions are:

- the *epistemological dimension*: what conception of knowledge does the teacher have or is working with: there are several possibilities here, ranging from objectivist knowledge to constructivist knowledge

- the *pedagogical dimension*: who is the main actor, who triggers the events: from teaching activity to learning activity

It seems that the understanding of constructivism that is referred to when researchers and teachers speak of a constructivist student-centred pedagogy, is a more behaviourist reference to active learning. Teachers are challenged by learners to organise activities that allow students to construct their knowledge. Problem-based learning is thus associated in some frameworks with constructivist pedagogy, even though this structuring of learning activities is not focused on the learner's capacities and level of competence, but on a discovery and investigating approach, and on imitation and transposition of solutions. The behaviourist dimension, getting the learner to actively participate in learning, is present, but not the constructivist dimension understood as the learning based on linking what one does with questions to the learner about his activity, his way of accomplishing the work and his awareness of what is happening for him in this learning episode. Critical reflection thus results on becoming aware of oneself as a knower, within a socio-cultural knowledge production context.

Digital literacy

The frameworks present a variety of approaches of digital literacy, from a basic technological conception, close to computer literacy, to very complex understanding of high order thinking processes and meta competences. Digital literacy or more often ICT literacy is the goal to be attained. The frameworks present detailed and rich development of the content of training, with the basic assumption that every citizen needs to be trained in the mastery of these tools. However, the goal to be achieved is presented as a problem of acquiring more tools or skills or competencies. The approach does not seem to rise to the level of a knowledge or epistemological problematics. While it appears that with the changing information and knowledge context, with facilitated access and information in excess, students need to reflect on how they come to know, what kind of knowledge they have been constructing, how this knowing is changing them, and what kind of knowledge they need in this emerging society, the frameworks do not seem to be able to produce the adequate conditions for such maturing and awareness.

Even critical reflection can be conceived almost as a procedure to learn and to apply without sufficient attention being given to the self awareness that can result from a learning situation. Becoming aware is a fundamentally liberating experience because when one is aware, it becomes possible to look and appreciate at a distance. Distanciation means the

capacity to see the big picture, to better understand what is at stakes and to conceive alternatives to what exists. This gives results very different from those engaged in applying a procedure or doing repeatedly the same exercises, as some constructivist approaches tend to result in sometimes.

For example, in several frameworks that implement teacher training, teachers are asked to think about what they want their students to have learned in the course and then to create learning situations where the learning aimed at will be able to take place. This can result in a stimulating and interesting learning situation. However the teacher will probably not mature greatly, for lack of reflecting on the problem. If instead of thinking about the content of training, the teacher is instructed to begin by reflecting on what is learning, what does he/she consider as learning and only then, with this new awareness, to design the learning situation. The important changes here are that, as implemented in a framework like I-Curriculum, the teacher will be asked not only to be operational in setting up a learning situation, but can also be asked to reflect on how the learning goals can be integrated in other situations and how the learning situation can be associated with other goals (integrative dimension). Finally how can the teacher improve the situation and change it so as to better attain the pursued goals (transformational dimension).

4) Strategies.

The main strategies that are implemented in the different frameworks, with the exception of Digital Transformation aimed at facilitating assessments, is to provide teachers with a problem-solving approach and learn by doing implementation. Teachers are asked to solve a problem by producing a learning situation. This approach has the advantage of ensuring that teachers make connections between the information and communication technology that they are mastering and the pedagogical situations that they must manage. However, there is no assurance that the reflective thinking, key to change and innovative development, will happen.

Some frameworks focus also on the organizational and institutional context support needed to ensure that new working methods will allow changes in educational practices. New ways of generating learning are closely associated with critical reflection and distancing. In other words, what the teachers are asked to do, the questions that are addressed to them, the specific characteristics of the professional environment, the personal level of awareness of each one, all this tries to converge to a point where the teacher as a learner can hear what is asked of her/him and can reflect critically on the situation. The structure of the tasks seems to be based on constructivist theory, although this is not explicitated. Teachers are given the possibility of acquiring new knowledge and new tools, but they to do seem to be involved in a rethinking of what is knowledge. They are not led to asking themselves “what does learning consist of”, but they are asked to reflect on “what should students learn for the information/knowledge society”. They are asked to train for high level thinking capacities, but there is no explicit questioning of how these capacities relate to existing curriculum objectives and content.

It is not easy to create such conditions for reflection. Teachers are asked to adapt to their classroom activities the tools that they are learning to master, and to produce learning activities. It is difficult with such challenges to also question what is changing in the relationship to knowledge, if teachers are not helped and accompanied in this endeavour. Yet it seems impossible to achieve deep awareness, distanciation and creating capacity, all aspects essential to obtain change in a professional practice, without a teacher or trainer engaged in raising one’s awareness and consciousness. Only then will it be possible to go beyond existing competence and practices.

5) Evaluation

Evaluation is an important dimension in the implementation of frameworks. With these ICT frameworks, or assimilated documents, it appears that the implementations are still difficult to achieve and that the experimentations that have been done have required significant investment on the part of the researchers and stakeholders. The frameworks are not all intended for straight forward implementation and are presented more as proposals that as specific action plans. Some are meant to inspire and guide, and are not intended to be evaluated as such.

Some frameworks include validation procedures that have been done to ensure the content proposed satisfies a large number of intended users. The Franco-Canadian framework was tested within the network of teachers, in two different instances. The ePICT licence has trial essays and evaluation of pilots in several different countries. The I-Curriculum framework is being implemented in Spain, England and Greece. What can be highlighted is the great complexity of these implementations. The first level of acquiring the basic technological mastery of digital tools is intensive, but relatively easy to implement. The second level of having teachers integrate in their daily activities the digital tools is more of a challenge, and most frameworks seem to have attended successfully to it. However, where there is the intention to go beyond the mastery of IC digital tools and skills to deal with hypermedia, and cope with a profound transformation of the relation to knowledge and the development of higher level human thinking capacities (for example, Raising the standards, I-Curriculum, CEF), then there seems to be limitations or weaknesses in the proposed strategies. Bringing about change in education turns out to be a very complex matter.

Still it would be important to plan ahead and start gathering today significant data from the implementation of these frameworks for future studies. When implementing a framework, there is a lot of important information that does not necessarily get picked up. Information about the context, the individual purpose and rationale of the different participants, which would be needed to analyse the results obtain, would need to be gathered. This involves a great amount of work and stakeholders are not always convinced of the interest of such undertakings. There is a need for studies that carry over beyond the school year and can present data covering cycles and trends and allowing in-depth analysis;

5. Analytical grid

Frameworks	Main characteristics	Main strengths
1° Raising the standards	This Framework for Teachers is the final report of a three-step national project, which included an impressive literature review, a two-day workshop of key stakeholders and a framework proposal to be developed by the different institutions and school systems. It fosters a best practice approach	The framework articulates teacher professional standards in general and ICT Competency standards and is focused on producing standards for ICT in teaching and learning. The framework proposal was to be used by teacher education institutions, teacher employers and professional associations to develop ICT standards relevant to their purposes and contexts, based on the transformative power of ICT. It identifies four dimensions of ICT use from the tool approach to reforming the organisation and structure of schooling itself.

2° Digital Transformation	The framework has a clear assessment orientation. Its main goal is to provide a "foundation for the design of instruments including large-scale assessments intended to inform public policy and diagnostic measures to test individuals' skills associated with information and communication technology". The framework integrates the information literacy approach. There is a specific implementation process.	This framework synthesized in 2002 "what we already know about ICT literacy", defined "what we don't know" and provided a comprehensive definition of ICT Literacy that circulated widely within the educational and research community. It highlights the transformative power or capacity of ICT technology to change, to metamorphose, a novel dimension then, and that has since become one of the essential reasons for integrating ICT or digital literacy in education. The notion of digital divide is extensively explored in this framework, with the need to ensure *equitable technology access* as well as equitable *opportunities to learn how to use ICT,* despite cultural, economic, geographical, physical, linguistic and gender differences and barriers.
3° ICT in Teacher Education	This framework provides a global en in-depth approach of the issues, theories and existing (in 2002) standards in the integration of ICT in education. It provides rich information on case studies of ICT implementation and a detailed strategic technology plan, and multiple references.	This framework provides a very encompassing and in-depth approach of the transformation of the teaching-learning process through the use of ICT. It briefly presents several theories supporting a new view of the learning process and the shift to student-centred learning. It presents four clusters of competencies for teachers, an refers them to existing standards such as those of ISTE (International Society for Technology in Education). One of these clusters is social and health issues pertaining to the use of ICT: from intellectual property issues, legal and moral codes of practices to healthy use of ICTs, including seating, light, sound, and other related energy source implications.
4°Digital Competence	This "framework" is in fact a report to inform the Ministry on the decisive issues of digital competence. It contains specific recommendations for the government's education policy. The report insists on the need for a change and an active integration of digital technology and digital competence in education at all levels.	The focus on an encompassing digital "bildung" or competence: the sum of those fundamental skills required for the computer certificate combined with the interpretative and critical use of ICT. This "skill" specifically includes "communicative competence, critical thinking skills and enculturation processes". Hence this initiative brings forth a more dynamic and holistic view of the connection between basic and ICT skills and knowledge through the concept of digital "bildung" or competence.

5° I-Curriculum	This framework represents an important move from a key skills approach to a focus on high quality learning and comprehensive learning activities. It aims at developing meta cognitive capacities in students, empowering them to reflect on "what we need to know, how we come to know and how we express our knowing", so that they can, through life long learning capacities transform their own thinking. For teachers, the empowerment comes through for crucial activities that develop literacies (exchanging information, researching, model-ling, changing ways of living and working) that can be practiced at three levels of skills/ competences.	The framework is based on a "*learning-by-doing-and-reflecting-about-what-has-be-done*" principle. Teachers need to become aware of their own learning model/paradigm, change it if it doesn't correspond to the learner-centred approach by informing themselves, either by reading, or by looking at innovative practices of other teachers, or by taking part in network communication or personal communication to discuss innovative practices, etc. And, during this process, teachers reflect upon their own practice, transforming it gradually and evaluating the changes through reflection and critical thinking. The framework offers not only theoretical perspectives, but provides specific guidance for classroom use for each of the three levels of curriculum activity. Evaluation reports of experimental use are available on the web.
6° EPICT Licence	Initiated in 1999, EPICT now exists in ten different and specially designed courses covering the entire range of education settings where teachers intervene. The framework combines basic ICT training with pedagogical integration of ICT within classroom practice. This framework goes beyond mastering ICT tools by teachers and is focussed on the continued professional development of teachers in the pedagogical use of ICT in education. It has a growing audience and is being adopted by several countries.	The training is based on self-study through accessing Websites and pages related to each course. The teachers experience blended, flexible learning, process-oriented learning, problem-based learning, and participate in collaborative activities and team-based assessments. A "facilitator" is allocated and accompanies the work till the end through electronic conferences. Each project step must be the object of in-depth pedagogical reflection: the teachers explore and decide what they expect the students to acquire, what pedagogical meaning this will have for the students' development, and what kind of tasks, of pedagogical activities are most likely to ensure this achievement. *This is the strong articulation between ICT and the pedagogical point of view, proposed in the framework, and constituting the main characteristic of this framework.*
7° AUSPICT	This framework is an example of the adaptation of EPICT to a regional situation, Tasmania. The AUSPICT method is based on an "integrated" approach: teachers "learn ICT skills needed for their own teaching" and during their training, and are "encouraged to produce relevant work which they are able to take into their own classroom lessons". This method stresses personal involvement, collegiate approach and close monitoring of teachers' appropriation of the ICT tools, within a pedagogical scenario.	In other words, the teacher must reflect about the meaning of teaching and learning in the "information society" and the new social context. For achieving this goal, both teacher and students must learn how to use ICT, the mastery of tools being an essential step. The teachers need to plan pedagogical activities that will be concretised by using ICT. The challenge for the teachers is to change their point of view, putting aside the technical resource problems (usually the main focus in many frameworks) in order to reflect on the pedagogical issues concerning what students need to acquire in the coming years so that they will have the competencies needed to integrate the social world of work and this, with ICTs.

8° CEF uTeacher	The framework's innovative and stimulating structure for introducing change in classrooms is presented in a matrix form articulating an axis of communication in interaction with an axis of eight sectors of teachers' professional activities. In this way, the framework creates the conditions for systematic reflection by the teachers themselves, and conducted with peers, of their own pedagogical practice.	More than training teachers for a set of specific IT skills/abilities, technical abilities or even critical thinking skills, the program intends to bring about changes in attitudes, values, beliefs and an emotional commitment so as to empower teachers for their own professional development, for the welfare of the students, for dealing critically with the educational organisation where they work, and also with the educational system and the whole environment. Within the context of a knowledge society instead of an information society, the challenge becomes the evolution of teacher's personal and professional values. The inclusion of ethics as a specific theme brings to light in the daily professional practices of teachers many important issues that are usually left behind or put aside: ethical, cultural and societal issues related to technology, such as authors' rights, intellectual property and plagiarism, netiquette, the responsible use of technology systems or the development of a positive attitude towards technology uses for supporting life long learning, collaboration, personal pursuits and productivity.
9° TICE Framework	The actions analysed as "framework" concern for the major part students. The ICT training programmes and curriculum cover all levels of schooling and higher education and, more recently, the training of teachers. Mastering the basic information and communication technology is now included in the core knowledge and skills considered as absolutely essential during French compulsory schooling (up to age 16). The official strategy aims at providing everyone with a minimum level of digital literacy competence.	The focus is on endowing French students with the keys necessary for a critical understanding of the new digital culture. Students must have the opportunity to master ICT tools, which already form the basis of the economy, and which, through networking, are changing the social fabric by introducing new interconnection patterns. Building on existing ICT knowledge and skills frameworks, the French Ministry of education has developed its own certifications for students and teachers. ICT Certification in primary and secondary schools is obligatory and more and more integrated within existing curriculum, and is being implemented in regular curriculum in universities. Contents are available on the web.
10° Techno-pedagogical competence for teachers	The framework results from the study of seven different approaches to competences for ICT in education. Four broad domains of techno-pedagogical competences are derived and form the structure of the proposed framework: information processing, communication and collaboration, pedagogical design and production. The framework is focused on teaching practices, even if the ultimate aim is to prepare students for the information society.	Integration of ICTs in education is stated as an imperative in the evolution of professional practices. Going from "why integrate ICTs in education?", to "how?", the framework redefines the necessary competences, not from a technological point of view, but from within a pedagogical approach. It points to changes in the pedagogical role and to teachers' new, more specialised roles and tasks. Teachers need to personally engage in the development of the techno-pedagogical competences and thus have access to the new pedagogical possibilities that ICTs can offer.

Conclusion

This selective review of frameworks has been instructive in providing an insight on the difficulties of implementing changes in education and on the complexities of the teaching and learning activities.

Frameworks have been addressing, through the integration of ICT in education, the development of digital literacies and the evolving role of education in an information society. Policymakers tend to understand problems, or at least address them, in very short terms: skills, equipment, training, and resources. In doing so, they fail to develop, or communicate, fundamental visions and perspectives needed to really change the educational system. The important changes emerging in society and in the domain of information and knowledge would require that decision makers think in terms of projects that could go on for the next fifteen to twenty years. There is an important deficit of broad horizons needed for conceptualising the future of education in an information/knowledge society. Researchers, teachers and students need to urgently identify and communicate the problems and issues that they are coping with if education is to maintain its central role in the development of a knowledgeable nation. Some of these issues have been identified in the different frameworks, but others are emerging.

We will conclude this analysis by summarizing three main issues that stand out as not having been addressed, or having been addressed insufficiently.

1) Need for horizons

The horizons or directions, that these frameworks offer for education to-day, need to be deeply revisited. When looking closely at the vision of education, society and digital literacy that these frameworks refer to or explicitly promote, what stands out is an important belief in the capacity of digital technology to transform education, to facilitate, improve and empower teaching and learning. However, beyond the important statements, usually referred to no less important and official documents and research, there is little further explanation. What is the substance of this positive change, of these “raised standards”, that ICT can bring about? There is a crucial lack of information and one is left to wonder how innovation and change have become such absolute and magic values that they can suffice to justify important educational overhauls.

The frameworks bring forth a rationale for integrating ICT in education based on two arguments: 1) it is necessary and more and more urgent to prepare all citizens for an information/knowledge economy and society; 2) developing digital literacy is helping to fight the digital divide. In an information/knowledge society, educational institutions no longer have the monopoly in providing access to knowledge, in producing knowledge and in validating knowledge. They need to redefine what is their role in the development of informed, aware, concerned and engaged citizens. Teachers are aware that rote memorizing and repetitious reasoning cannot cope with the issues that citizens have to cope with from electing enlightened politicians to refusing thrash media. They are expected to move from a pedagogical model based on the accumulation by the learner of facts, data, laws and concepts to a model focused on developing the learner’s intellectual competencies for working on existing information, facts, data, laws and concepts, thus allowing the learner construct his or her own knowledge.

Although empowering visions have been expressed almost all along, there is little evidence of a learning effect in addressing the different issues involved. 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, which of course is an important achievement in itself.

2) A change of pedagogical model

It has therefore become necessary to define a direction for innovation, for improvement, for raising standards in education, in curriculum, or in teacher training. One such direction could be a change of pedagogical model. Teachers cannot improvise a new pedagogical model. Teaching students how to develop themselves and how to interact intelligently in a multicultural and multimedia world does not require the same preparation and competence as teaching students how to acquire existing knowledge. The change in pedagogical model is not required for training students in mastering ICT tools, but it is becoming essential in training students for the new knowledge scene that results from the generalized access to information and with the development of new knowledge production and legitimating spheres in society.

There is in the different frameworks frequent references to a constructivist, student centred pedagogy. However, as observed above, this is often only a reference to a behaviourist conception of learning activities, where the learner has to have ongoing active involvement. When looking at what is expected of teachers with the evolving place of knowledge and schools in giving access to knowledge in today's society, it becomes obvious that they have to gradually bring about a change in the relationship to knowledge, without accepting the very utilitarian approach of many students. What relationship to knowledge will foster personal growth, openness to others and society and relevant competence to intervene in the problems and issues of society? This is the challenge that teachers have to meet and for which a new pedagogical model is needed. This model will obviously result from reflective practice and an awareness of what is knowledge and what is learning. It is interesting to reflect on the lack of teaching theories as such and to be reminded that teaching models are build on an awareness of what is to be achieved with the learner and with the curriculum. A new pedagogical model is needed to attend to the transformation of learning and teaching that is affirmed by many frameworks as the new horizon in an information/knowledge society. What this horizon consists of depends precisely on one's epistemological understanding of what constitutes knowledge for learners today.

3) A new relationship to knowledge and information

The last dimension is the new relationship to information and knowledge, which refers to an epistemological understanding of knowledge. Schools have developed in a society where knowledge was scarce and available to chosen elites. Through formal education was achieved a sharing of knowledge and information. Digital technology is rapidly transforming not only the access conditions but the very nature of knowledge. Writing has become as accessible as reading, and the challenge today is not the have the knowledge but to know how to deal with great amounts of information, data and facts. Knowledge has thus become not the acquisition of information, data, facts and concepts, but the construction of a meaningful understanding of what make sense in this world. The digital knowledge revolution is happening within an important epistemological change in the meaning of what is knowledge.

Constructivism is basically an epistemological theory, which was explicitly formulated only in the XXth century. It asserts that knowledge is not the reflection of the outside world, nor the projection on reality of the innate structures of our mind. The physical world has to be modelled, re-invented (Watzlawich), constructed (Bachelard) through interactions during

which the knowing subject develops his knowing structures while producing his knowledge about the world (Piaget). Constructivism introduces a crucial change in the nature of knowledge. It represents a major shift from the logical positivism, the scientific objectivity and the empiricism that dominated Western thought from the Renaissance to the end of the nineteenth century, and that is known as modernism. This modern way of thinking is still very much present in current discourse and especially in school curriculum.

Constructivism opposes to the objectivist view of knowledge and science, the human participation in the elaboration of knowledge and the awareness that all knowledge results from a situated processing of perceptual information. Building on Piaget's work revealing the ongoing development of intelligence through interaction with the outside world, this approach proposes that human experience involves continuous active agency, that the knowing experience is more important that the results, that knowing is inherently a socially-embedded and situated meaningful experience.

Constructivism is therefore a conception of knowledge that de-legitimizes the "objectivist" view of human knowledge. It proposes a dynamic view of knowledge and learning, and weakens the curriculum approach of a fixed body of facts, data and knowledge that each one must acquire. It is not a question of denying the importance of a shared culture, but the accent is on the learning processes and on the development of active knowers. A constructivist approach to learning does not imply that learners have to be active so much as it sets a completely different landscape for learning.

An active approach to learning is not sufficient, if there is not, in the pedagogical environment that is set up, the elements that will trigger awareness of one's actions, of the personal maturing that is happening, and of the resulting 'distanciation' with the knowledge building activity that constructivism involves. That is why learning, even within a constructivist understanding of learning, needs to be organized by teaching. It is the teacher that will be able to select the kind of tasks that will allow the development of awareness; it is the teacher that will bring the adequate question, because he/she will know where the students are at, what are their interests, there previous knowledge, etc. All these aspects can be said to refer to Vygosky socio-cultural theory of learning. Only then can there be a true transformational learning.

The challenge for teachers today is to enter into a constructivist approach to learning and deploy a socio-cultural understanding of their activity. But if the information/knowledge society requires that they master these approaches, they also need to succeed in working with students who have entered into a fundamentally functional and utilitarian relation to knowledge and information. This is also one of the characteristics of an information/knowledge society. The relationship to information is changing, not only epistemologically, but also pragmatically. Students are less and less looking for a transformational experience in schools or academic settings. Scholarly knowledge does not attract or interest young people because of its great humanistic or scientific value, but more and more only if they need it for some specific pragmatic purpose. As teachers are beginning to shift towards a more meaningful and encompassing experience of learning – the constructivist epistemological approach - and are discovering that ICT greatly facilitates this approach, they are discovering that more and more young people are looking elsewhere for deep structuring and fulfilling experiences. Schools and higher education are less and less the unique places for in-depth knowledge experiences. Teachers and education stakeholders are therefore more and more challenged to provide unique self-fulfilling and enriching experiences, competing with the other media based knowledge experiences.

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