



**Is ICT-based Innovation in Educational Systems Truly
Important?
Overview of Key Development, Trends and Policies Shaping Education in
the 21st Century**

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Introduction

Educational systems of countries across the world are at the dawn of an age of change. Massive investments are already taking place, especially in the most advanced countries such as USA and UK. Educational achievement however has yet to show widespread positive results and most schools still show little sign of the promised radical pedagogical transformations. Indeed, it is common to contrast how much life for youngsters has changed in many areas (i.e., social communications, leisure and entertainment, work, etc.) while much of education and particularly, *learning processes, methods, content and evaluation in schools* have remained virtually the same as they have been for decades.¹ As Peter Senge has put it:

A simple question to ask is, 'How has the world of a child changed in the last 150 years?' And the answer is, 'It's hard to imagine any way in which it hasn't changed.' Children know more about what's going on in the world today than their teachers, often because of the media environment they grow up in. They're immersed in a media environment of all kinds of stuff that was unheard of 150 years ago, and yet if you look at school today versus 100 years ago, they are more similar than dissimilar. (Peter Senge, Quoted in Partnership for the 21st Century (2002), p.6.)²

The number of computers per students gives only a rough indication of computers installed however. It says little about the capacity of these computers in terms of multimedia or the Internet connectivity necessary to gain access to the reservoir of evolving digital educational materials as well as to e-learning. It also says little about the possession of other complementary digital equipment as scanners, digital cameras, data projectors, interactive whiteboards, and other technologies that have the potential to enhance the learning experience.

And it says nothing about the impact of the computers in the pedagogical processes of the adopting schools. For instance, a recent study on computers in UK schools³ – one of the countries with highest computer/student ration in Figure 1 - found that all types of schools (primary and secondary) reported ICT-related problems and issues. Amongst them problems related to the Internet, lack of funding (especially secondary schools), and a concern for the continuous need to update equipment - both as upgrades or acquisition of new equipment. An interesting finding that throws the spotlight on the characteristics of the available technology as a facilitating factor of its use was that: "primary and secondary schools identified 'using the most recent equipment' as the single factor that had really helped them in the last year [2002]. Other factors that helped were 'improving Internet access' (especially in the case of secondary schools), 'purchasing more computers' and 'improving the school's IT suite' (especially for primary schools)."⁴

¹ See *Newsweek*, Bionic Kids: How Technology is Altering the Next Generation of Humans, Special Report, 25 August / 1 September 2003.

² Partnership for 21st Century Skills, *Learning for the 21st Century. A Report and a Mile Guide for 21st Century Skills*, Washington, 2003.

³ BECTA, *The performance indICaTor*, BECTA, Coventry (UK), 2003, found in <http://www.ictadvice.org.uk/performance>.

⁴ Ibid.

Numbers of computers then tell us little apart from the obvious fact that those who have no computers at all are excluded from even the possibility of failing in their use. But, as recently noted: “there are four factors that need to be put in place, and a widespread infrastructure of interconnected computers is only one. The other three are teacher training, web-based content, and an institutional framework commensurate with such change”.⁵

On the whole the fact remains that the educational systems and schools around the world, even in the most advanced countries, have a long way to go to exploit fully the opportunities opened by the new technology. The reasons may be economic, social, technological, etc., or most likely a combination of them, but this does not alter the challenge: a massive and long-term process of change still lies in front of the educational systems and most schools across the world.

Would it not be desirable and easier not to change? Probably yes for those people who may be about to retire out of the system or those who believe that their present activities, subjects, knowledge, results may be performed just as well without an influx of new technology and the disruption of a process of change. And if an excellent teacher has always achieved excellent results, the question is legitimate, why change?

On the other hand, the world of schools is more and more immersed in an environment full of terms such as: innovation, ICTs, computers, software, internet, multimedia, e-learning, virtual networks, collaborative learning, educational CD-ROMs, virtual libraries, personalized learning, virtual schools and universities, asynchronous learning, edutainment, lecturing streaming and many others that concern the world of education. The legitimate question is then: can schools afford not to change?

1 Is ICT Innovation in Schools an Option?

Half century ago the classroom was a world of blackboard and chalk, students sitting on strings of benches, facing the lecturing teacher whose job was to instil “knowledge items” into the heads of largely passive students who knew that one day they would be examined on the knowledge acquired through this process.

Over the years this process may have added white board and ink pen, overhead projectors and some videos but the passive learning processes have hardly changed for most.⁶ Today few would be able to argue cogently in favour of the permanence of this system for the future in the face of the changes and possibilities opened by the new technology.

Indeed, arguments for no or little change in schools do not seem to exist, apart from ‘lack-of-resource’ reasons that tend to discourage people from starting innovation processes that may require substantial investments.

On the other hand, the reasons for ICT innovation in schools and the educational system are powerful, amongst them:

- ~~///~~ A world in constant change and need for learning
- ~~///~~ Opportunity to work for a better society and education system: not only a “learning society” – also a “better society.”

⁵ Apple Computer Inc., *Can we learn digitally? Technology to enhance learning*, IDG Global Solutions, 2002, found at http://a512.g.akamai.net/7/512/51/1fdb15b68a5920/www.apple.com/uk/education/learn_digitially/pdf/learn_digitially.pdf.

⁶ “Learning in schools is mostly organised in classroom settings where teachers are the primary agents for planning, pacing and monitoring learning.” OECD, *Education at a Glance*, 2002 ed., Paris, 2002, p.18.

- ✍ No class or even subject can desirably remain an “island of the past” (say in the next ten years) as long as students are immersed in new technology in other classes and subjects and, ultimately, in their lives.⁷
- ✍ Need for 21st century skills and for mechanisms to enhance learning for all.
- ✍ Good examples of ICT use in schools and educational systems are increasing and, in time, their lessons will spread as technology becomes cheaper and better and good practices are promoted, for instance, to help bridge theory and relevant practice in education.

Let us see some evidence for each of the first four statements. The last statement is the reason for the case studies to be reported later in the LEIPS project.

2 A world in constant change and learning

Today’s and future generations are growing in societies where the primacy of information and communications technologies (ICTs), networks, knowledge, and constant innovation in economic growth and society at large, has led many scholars to talk of “information society,” the “network society,” the “knowledge society,” the “learning society.” In addition, information and communications technologies are only one of the major elements that characterise this society. A number of other broad trends are simultaneously interacting with ICTs, creating a challenging world for all those living in the 21st century. Table 1 shows some of these interacting trends.

Table 1. Some Broad Trends Interacting with ICTs in the Emerging Knowledge Society
✍ Globalization - giving rise to unprecedented movements of capital, goods and services, mostly under the control of the most powerful economies.
✍ Increase in life expectancy - leading to the phenomenon known as ‘graying’ of the population.
✍ Fast pace of change and continued impact of science and technology on humanity and the world, for instance, through new technologies like genetic engineering, nano-technology, etc.
✍ Decline of jobs-for-life and consequent increase in employment insecurity and the need for “employability” (i.e., the ability to move easily from one employment to another)
✍ Increasing convergence between the worlds of work and learning/training facilitated by the penetration of ICTs into both industry and education/training.
✍ Increasing predominance of “mass-customization” in products and services accompanying the rise of more demanding and sophisticated customers.
✍ Increased awareness of environmental problems and the need for better use of natural resources.

Inevitably this conundrum of trends has its *educational* expression, for instance, in trends such as lifelong learning and the need for skills that prepare people to face successfully the fast-changing pace of the 21st century, including the disappearance of secure employment.⁸ Figure 2, for instance, illustrates how in the period of 8 years from 2002-2010, 65% of technology is expected to have changed while 85% of the workforce will be made up by the same people. The result is very much the need for lifelong learning and, in the long run, the “learning society.”

⁷ Excellence is not a static concept or ‘measure’ and it is unlikely that in the future it will be achieved without resort to new ICTs relative to achievement in other subjects

⁸ As a report from the European union put it: “The internationalisation of trade, the global context of technology and, above all, the arrival of the information society, have boosted the possibilities of access to information and knowledge for people, but at the same time have as a consequence changed work organization and the skills learned.” CEC, *Teaching and Learning: Towards the Learning Society*, White Paper on Education and Training, Brussels, 1996, p.2. Also, “globalisation implies not only increased investment levels but also a parallel reform process to increase the quality and relevance of school, university and adult education and vocational training curricula and the coherence of European education and training systems and to enhance their visibility and recognition abroad. In the light of such impacts of globalisation, and the accelerating pace of competition in education and training worldwide, the extent of the challenge at European level in terms of investment and reform is almost certainly widely underestimated.” CEC, *Investing efficiently in education and training: an imperative for Europe*, COM(2002) 779 final, Brussels, 2003, p.10.

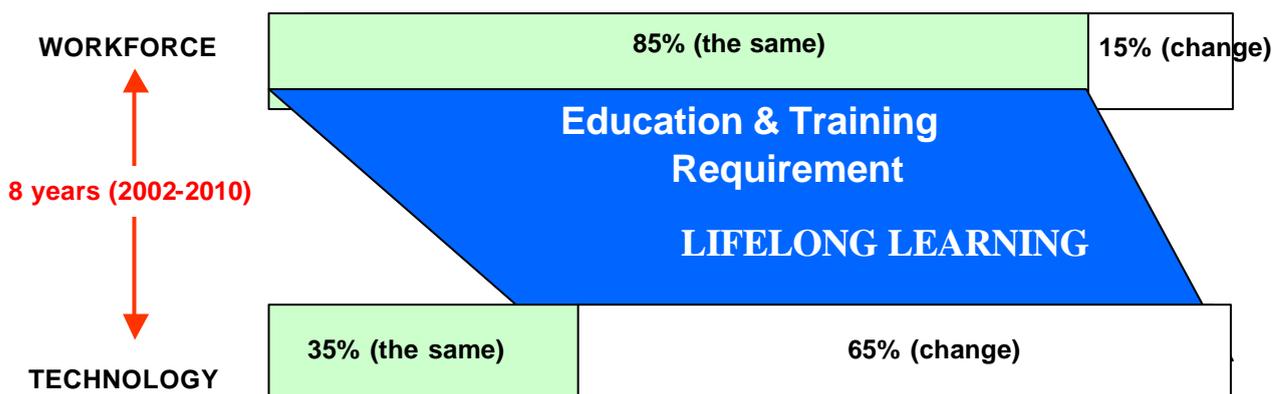


Figure 2. Needs for Lifelong Learning as a Result of Fast Pace of Technological Change

Source.- Hughes (2002).⁹

As a report from the European Union put it: “The future of the EU and its development will depend largely on its ability to manage the progress towards this new [learning] society. The objective is to make it into a just and progressive society based on its cultural wealth and diversity.”¹⁰ The latter is critical because terms such as the “learning society,” or the “knowledge society,” do not say much about the kind of values and aspirations people will realize in this new society of the 21st century.

3 Opportunity to work for a better society and education system: not only a “learning society” – also a “better society.”

For the first time in many years, humanity faces a challenge and an opportunity to work and influence the direction and shape of an emerging society: the knowledge or learning society. This process offers the possibility to advance with determination in the direction of the dreams of a better society for all in general, and a better educational system in particular. Times of broad change are precisely the times to re-think and re-engineer the specific ways and means of society in all fields, seeking to get closer to something better for all.

In Europe, many policy studies and statements have laid down the aspiration of an “information society for all,” or “inclusive information society.”¹¹ Policy-makers have also distinguished “the European way” to build a just and peaceful society - as contrasted particularly with the “American way.” Some of the key European aspirations regarding society and the education of its systems are

⁹ Hughes, G., “e-Learning and Social and Economic Development: Experience from Less Favoured Regions in Europe,” Presentation given at PACE Conference e-Citizenship for All: Challenges and the Way Forward, ERIS@, Brussels, 29-30 April 2002.

¹⁰ CEC, *Teaching and Learning: Towards the Learning Society*, White Paper on Education and Training, Brussels, 1996, p.2.

¹¹ CEC, *eEurope 2005: An Information Society for All*, Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions, found in http://europa.eu.int/information_society/eeurope/2002/news_library/documents/eeurope2005/eeurope2005_en.pdf. See also UNESCO, *Education for All: Is the World on Track*, Unesco Publishing, Paris, 2002, freely downloadable at http://portal.unesco.org/education/ev.php?URL_ID=13603&URL_DO=DO_TOPIC&URL_SECTION=201. UNESCO, *The Dakar Framework for Action*, Unesco Publishing, Paris, 2000, found in <http://unesdoc.unesco.org/images/0012/001211/121147e.pdf>. WSIS, *Draft Declaration of Principles*, PrepCom-3 for WSIS, Geneva 15-26 September 2003, found in http://www.itu.int/dms_pub/itu-s/md/03/wsispc3/td/030915/S03-WSISPC3-030915-TD-GEN-0001R2B!PDF-E.pdf.

listed in Table 2, whereas Table 3 identifies some of the most important areas in need of significant improvement in the educational systems of Europe.

Table 2. Strategic Societal and Educational Challenges to Achieve in the Evolution towards the New Europe of the Knowledge Society
<p>Societal Challenges</p> <ul style="list-style-type: none"> /// Sustainable democratic societies based on sustainable development and regard for the environment /// “most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion” (strategic target defined by the 2000 Lisbon Agreement for year 2010) /// Feeling of belonging to Europe and, ultimately, of European citizenship. /// Equal opportunities and social cohesion, particularly with regard to vulnerable and minority groups /// Spirit of enterprise and initiative, particularly socially responsible enterprise.
<p>Educational Challenges</p> <ul style="list-style-type: none"> /// Enhanced social, economic and democratic efficiency of the European educational systems, providing equal access, training and lifelong learning opportunities for all citizens, including access to ICTs and effectively tackling the problems of disadvantaged groups or regions. /// EU citizens’ freedom to learn, make full use of their qualifications, and work throughout Europe /// High quality and effective education and training systems in the EU: open to and interacting with the wider world, as well as learning from it (i.e., learning organizations themselves) /// High-quality and effective transformation of the teaching profession to its new role in the knowledge society /// Benefiting from Europe’s diversity by improving language learning, mobility, exchange and collaboration across Europe

Source. CEC, *Detailed Work Programme on the Follow-Up of the Objectives of Education and Training Systems in Europe*, Joint report by the Council (Education) and the Commission to the Barcelona European Council, Brussels, 2002.

Table 3. Some Educational Problems To Tackle for 21st Century Education
<p>Too high failure and dropout rates Around 30 % of pupils in the EU leave school without completing upper secondary and several countries also show high non-completion rates in higher education. Vocational education and training options also tend to be perceived as second-best to secondary and higher education.</p> <p>Comparatively high graduate unemployment in some countries In some countries curricula that are inflexible and ultimately non-relevant to employers' needs may contribute to a comparatively high rate of graduate unemployment - along with general economic factors.</p> <p>Unsatisfactory relative achievement levels In some countries educational performance per expenditure is low as compared with others. i.e., achievement levels are lower than in countries with comparable or lower level of expenditure.</p> <p>Educational dead-ends Lack of flexibility and permeability within and between the various parts of education and training systems – and sometimes between education/training and work leading people to educational dead-ends that prevent them from changing or resuming study/training at a higher level or a later in life.</p> <p>More efficient management of resources A positive relation exists between educational attainment and decentralisation, interpreted not just as deconcentration of central administration but, also, as the possibility to change and adapt curricula, methods and management. In addition resources must be targeted to needs given tighter education budgets.¹²</p> <p>Ensuring supply of sufficient number of skilled teachers Appropriate salaries and working conditions of teachers, including starting salaries and pay scales, compared with salaries and costs in other occupations. Teachers’ salaries are the largest single factor in the cost of providing education, so policy-makers must strike the best balance to maintain the quality of teaching and a balanced budget.</p>

Source. CEC, *Investing Efficiently in Education and Training: An Imperative for Europe*, COM(2002) 779 final, Brussels, 10.01.2003. Also OECD, *Education at a Glance*, 2002 ed., Paris, 2002.

Improvements in the educational system, in particular, can hardly be treated in isolation of efforts to improve the development of society and its citizens in general and, vice-versa, a great deal of social,

¹² This implies that responsible authorities need to be able to understand which schools are doing well, which less well or badly; and to direct resources in the directions needed. This basis for this understanding also needs to be transparent to the citizen, and understood by all concerned. (CEC, *The Concrete Future Objectives of Education Systems*, COM(2001) 59 final, Brussels, 31.01.2001, pp.11-12)

economic and cultural improvement of citizens passes through improvements in their education. Thus poor socio-economic conditions, inflexible systems, poor quality of courses and teaching, lack of appropriate guidance, and lack or inefficient allocation of resources tend to blend into cause-and-effect relations that result in badly-informed decisions, demotivation, higher failure rates, dropout, and potential social exclusion that may extend into other manifestations such crime, etc.

Often educational debates focus on lack of financial resources for improvements but, the changes required by the learning society are much more wholesale and demand a holistic and systematic approach to innovation. True investment remains a critical factor but it must go hand in hand with changes that ensure higher quality, relevance and lifelong learning opportunities for the generations of the 21st century. increased social, economic and democratic efficiency and/or improved access for all tackle the problems of disadvantaged groups or regions.

4 No class or even subject can desirably remain an “island of the past” as long as students are using new technology in other classes and subjects and, ultimately, in their lives.

New generations of youngsters and students are today growing in a world immerse in a new ubiquitous technology. A recent survey commissioned by Yahoo Inc. and Carat Interactive revealed that the time spent by teens and young adults (14-23) on the Internet has surpassed TV and the other media. Thus in an average week teens and young adults spend: (1) 16.7 hours online (excluding email), (2) 13.6 hours watching TV, (3) 12 hours listening to the radio, (4) 7.7 hours talking on the phone, (5) Six hours reading books and magazines (personal, not scholastic).¹³

The new technology is already penetrating the world of schools and education in an irreversible manner, although as noted there is still a long way to go to exploit all its pedagogical potential in most places. A recent Newsweek report wrote:

“The world that today’s kids inhabit is diverging sharply from the one their parent grew up in. Unlike other generation gaps this one doesn’t revolve around mores, fashions or pop culture so much as technology. Kids have never been more wired ... [T]hroughout the world, childhood relations are made up or broken with a few strokes of a cell-phone keypad. Skills are being acquired less from books than from videogames. And the senses are bombarded with information that flows from every direction at an ever-quickenning pace. ... Indeed, kids are not merely wired; they are also constantly being rewired, as information providers explore new ways of delivering information. ... They are growing adept at handling visual information and multitasking. And the messaging free-for-all may actually help some kids overcome childhood awkwardness in relation to their peers.” (pp.38-39)

¹³ Yahoo! Inc., Yahoo! and Carat Unveil Research Results Showing Teens are Truly "Born to Be Wired", July 24, 2003 found in http://biz.yahoo.com/bw/030724/245198_1.html.

Table 4 shows some other findings reported by the *Newsweek* (2003) report

<i>UK</i>	<i>Canada</i>	<i>Hong Kong</i>		
70% of 10 years old and older have Web access at home	Teenagers homework done online 30% (1999) and 40% (2003)	How teenagers spend their free time		
52% spend more than five hours online a week	Hours online per week researching for school: boys (2hr) and girls (3hr)	Internet	Boys 34%	Girls 31%
67% of children are more knowledgeable than their parents about computers		Watching TV	31	26
		Reading Newspapers and magazines	26	25
		Chatting online	24	45
		Listening to the radio	9	11

Source. Adapted from *Newsweek* (25 August – 1 September 2003), pp. 38 -39

The evidence clearly points to youngsters' high involvement with new information and communications technologies and this naturally extends to their processes of learning. Canada's data for instance show teenagers doing a substantial amount of their homework online. Of course, one development opens the door to another and, in this case, the increase in research speed facilitated by online access is also facilitating plagiarism with a potential decline rather than an improvement in learning standards.¹⁴ Indeed, without the ability to discriminate through appropriate research skills, decline is almost certain to occur given the large amount of low-quality material also available in the internet. This is a problem for schools and teachers regardless of how much ICT they may be using at school. They must simply respond to it and accept to live with the consequences of the youngsters' growth with ICTs. Otherwise, as the Partnership for 21st Century Skills put it: "Today's education system faces irrelevance unless we bridge the gap between how students live and how they learn."¹⁵ Buckingham (2003) is even more emphatic, arguing that the actual school system threatens to consolidate the *digital divide* between what happens outside and inside the school. Outside the school teenagers experience chat-rooms, instant messages, digital cameras, internet searches, music download, etc. Meanwhile, what they do in the school is just a fragment of their out-of-school experiences: they face restrictions and the use of technology is often confined to basic tools (word, power point and spread sheets). He concludes that teachers and the whole school system should start to recognize this *informal learning* and transform it into a resource for mainstream education.¹⁶

Some schools are at the forefront of the respond to this challenge both in the integration of ICTs into the classroom and even in the form of virtual schools. Most of them are doing something, for instance, teaching computing as a subject on its own, integrating computing into other subjects, participating in networks of schools and doing collaborative work, etc. Positive results are also reported, as shown in Table 5, depicting the findings of a Becta survey on ICT impact in the secondary schools in England and Wales.

¹⁴ "For all its benefits, the rise of technologies in the classroom has made it far easy for students to cheat- and get away with it. In the prewired days, plagiarism meant painstakingly copying paragraphs out of the encyclopedia; today kids can simply highlight the text, copy and insert. – a far more antiseptic process. The practice is rampant around the globe... Hastings, M., Pasting the Grade, *Newsweek* (25 August – 1 September 2003), p.55.

¹⁵ Partnership for 21st Century Skills, *Learning for the 21st Century. A Report and a Mile Guide for 21st Century Skills*, Washington, 2003, p.3.

¹⁶ Buckingham, D., The Value of Britney.com, *TES Online Magazine*, 25/04/2003, found in http://www.tes.co.uk/search/search_display.asp?id=378574. See also Buckingham, D. and Scanlon, M., *Education, Entertainment, and Learning in the Home*, Open University Press, Milton Keynes (UK), 2002.

Contribution of ICT by subject in English and Welsh secondary schools				
	Substantial	Some	Little	None
Business Studies	69	23	6	2
Design and technology	34	51	15	1
Music	17	39	33	11
English	9	59	31	1
Maths	7	55	36	2
Languages	7	38	50	6
Geography	6	53	38	3
Science	6	57	36	2
History	3	45	45	6
Percentage of secondary schools reporting contribution of ICT to be:				
	Substantial	Some	None	
Quality of teaching	22	63	15	
Quality of whole class or group learning activities	18	58	24	
Efficiency of school administration	36	46	17	

Table 5. Overall and Subject contribution of ICT in secondary schools in England and Wales in the opinion of Head Teachers
(Source: OECD, 2000¹⁷)

Clearly, none of the subjects remains untouched by ICTs, although the estimated contribution varies widely for the different subjects. Not clear from the Becta survey however is the exact pedagogical meaning of contribution of ICT in UK schools, especially as we focus on the following percentages: 78% of secondary schools reported “some” or “none” ICT contribution to “quality of teaching,” with only 22% reporting a “substantial” contribution. 82% of the same group of schools reported “some” or “none” contribution to “quality of whole class or group learning activity,” with only 18% reporting substantial contribution. Results that again highlight the fact that for most schools the processes of ICT-based innovation still lie very much ahead.

Other studies have concentrated more exclusively on the contribution of ICTs to attainment and the findings are not conclusive. MacBeath et al’s (1999) study of 101 secondary schools in 18 countries concludes that “The use of technology (email, video-conferencing, etc.) did not really stimulate the process.”¹⁸ While Angrist and Lavy’s (1999) study of 35,000 computers in 905 Israeli schools concludes that “There is no evidence ... that increased educational use of computers actually raised pupil test scores. In fact, the results show a statistically significant decline in test scores in fourth grade Math classes, where the new computers had the largest impact on instructional techniques.”¹⁹ On their part, Feinstein and Symons (1999) found that parental involvement has more effect on attainment than ICT, parents or class size.²⁰ In contrast, Fisher Family Trust’s 2002 survey on more than 190 pupils reported that the use of ICT in English (80% of schools gave it top-rating), maths, history and science lessons had a high impact on pupils’ learning and less effect in subjects such as music, RE and design and technology.²¹

¹⁷ See OECD, *UK Responses to BECTA Survey* (R11), OECD, Paris, 2000. Found in <http://bert.eds.udel.edu/oecd/quality/meetings/UKR11.pdf> and at <http://www.becta.org.uk>.

¹⁸ MacBeath, J., Meuret, D., Jackobsen, L., *Evaluating Quality in School Education*, Final Report for CEC/DGXXII-A1, Brussels, 1999.

¹⁹ Angrist, J. and Lavy, V., *New Evidence on Classroom Computers and Pupil Learning*, in *NBER Working Papers*, No. 7424. 1999.

²⁰ Feinstein, L. and Symons, J., *Attainment in Secondary School*, in *Oxford Economic Papers*, No. 51, 1999, pp. 300–321.

²¹ Fisher Family Trust, *High Impact ICT Resources – Primary*, 2002. Found at <http://www.fischertrust.org>. The survey also revealed that in those cases where teachers indicated a positive impact on learning, common present factors included access to sufficient, reliable ICT resources - often involving the development of an ICT suite, the use of interactive whiteboards and data projectors. In those cases where teachers identified a low impact, common issues included level of access to ICT equipment, reliability, pressures of time and the need for staff development in the use of

The lack of a clear message from the studies is not surprising. After all, attainment -as much as it is the result of learning- cannot depend only on variables such as computers or ICTs.²² Technologies are simply enablers, not positive determinants in the process of learning. True, they can play the role of a negative determinant in the sense that inappropriate, unreliable equipment will not enable certain desired developments to happen, or to put it more extreme, absence of ICTs certainly determines lack of e-learning in the learning process.

In short, whether or not causal relations have been established between ICT and students' attainment, the message is:

- /// Students' are using ICTs in their education process anyway
- /// Most schools have to a greater or lesser extent installed computers and other forms of ICTs
- /// Most schools are yet to make a substantial change in learning and pedagogical processes through the implementation of ICTs
- /// Most schools are yet to face major ICT-based innovation processes aimed at transforming pedagogical and educational processes.

5 Need for 21st century skills and for mechanisms to enhance learning for all

The thinking in European and US educational policy shows a great deal of consensus regarding the *type of skills* and *learning mechanisms* needed by citizens in the 21st century. The emphasis is on the preparation of individuals who will be able to understand complex and dynamic processes and circumstances made up of an increasing variety of tangible and intangible objects, as well as social, cultural and geographical contexts and situations. In the emerging information society, individuals and groups will have to succeed in critically discriminating accurate from inaccurate information, as well as analyzing, making sense and effectively using fragmentary information in the knowledge that others may have different interpretations. But "brain skills" are only part of the picture. "Life skills" in the form of positive flexible personal and inter-personal aptitudes to change, creativity and innovation, to others, to team work, to dependability and initiative, to trust-building and honesty (transparency), to curiosity and learning, are also part of the "competence set" that should equip people and communities to live in the challenging 21st century.²³ All citizens should have the opportunity to acquire these 21st century skills. Thus "The principle of equal rights in education is being applied increasingly in the context of equality of opportunity, including positive discrimination in favour of those at a disadvantage in order to prevent under-achievement at school."²⁴

Table 6 shows the type of educational skills that US and European educational policy-advisory bodies recommend as required for the 21st century. Table 7 shows the type of Institutional requirements and mechanisms identified by for the realization of ICT access and lifelong learning

ICT.

²² Major difficulties exist to establish clear causal links between ICT and attainment given the influence of many other variables. (Crook, C., *Computers and the Collaborative Experience of Learning*, Routledge, London, 1994)

²³ The report from the Round Table of European Industrialists (February 1995) advocated that, "the essential mission of education is to help everyone to develop their own potential and become a complete human being, as opposed to a tool at the service of the economy; the acquisition of knowledge and skills should go hand in hand with building up character, broadening outlook and accepting one's responsibility in society."

²⁴ CEC, *Teaching and Learning: Towards the Learning Society*, White Paper on Education and Training, Brussels, 1996, p.23.

for all in the European knowledge society.

Table 6. Type of Educational Skills Required for 21st Century

<i>US</i> ²⁵	<i>Europe</i> ²⁶
Core subjects beyond basic competency, reaching understanding of core academic content at much higher levels. Core subjects include English, reading or language arts, mathematics, science, foreign languages, civics, government, economics, arts, history and geography.	Literature, philosophy and scientific knowledge and awareness help individuals to develop their powers of discernment and critical analysis and to participate in an informed way in debates and decisions concerning critical environmental, ethical and societal issues. Better foreign language teaching is also essential for Europe's multilingual society to achieve its economic, social and cultural potential. The European Commission believes that it is necessary to make proficiency in at least two foreign languages at school a priority.
Learning skills to keep learning continually throughout life and comprising three broad categories of skills: information and communication skills, thinking and problem-solving skills, and interpersonal and self-directional skills.	Ability to learn – maintaining the curiosity and the interest in new issues and skills – without which lifelong learning cannot exist.
Learning ICT literacy, that is, “the interest, attitude and ability of individuals to appropriately use digital technology and communication tools to access, manage, integrate and evaluate information, construct new knowledge, and communicate with others in order to participate effectively in society.” ²⁷	Information technology across the board in curricula is a necessity.
Learning emerging content areas: global awareness; financial, economic and business literacy; and civic literacy. Educational and business leaders identify them as critical to success in communities and workplaces.	Learning European awareness, the feeling of belonging to Europe, and ultimately, European citizenship in a context of cultural diversity and broadening of experience and enhancement of skills, including foreign languages.
Teach and learn in context: need to learn academic content through real-world examples, applications and experiences both inside and outside of school.	Absorbing the intellectual and practical contributions of business, research and society as a whole, particularly spirit of enterprise and initiative by facilitating the understanding of the value of enterprise, risk-taking and innovation. Models of successful entrepreneurship should be promoted, particularly of socially responsible enterprises. ²⁸
Assessment measuring 21 st century skills: A balance of assessments — i.e., high-quality standardized testing for accountability purposes and classroom assessments for improved teaching and learning in the classroom. To be effective, sustainable and affordable, sophisticated assessment at all levels must use new ICTs.	Quality assurance systems are essential to an effective education and training system. They enable schools and training institutions to look critically at the value delivered people, identifying strength, weaknesses and hence areas of improvement. ²⁹

²⁵ Partnership for 21st Century Skills, *Learning for the 21st Century. A Report and a Mile Guide for 21st Century Skills*, Washington, 2003.

²⁶ CEC, *The Concrete Future Objectives of Education Systems*, COM(2001) 59 final, Brussels, 31.01.2001, Also, CEC, *Teaching and Learning: Towards the Learning Society*, White Paper on Education and Training, Brussels, 1996.

²⁷ Programme for International Student Assessment (PISA)

²⁸ Schools should also build on the contacts they have with businesses in their local environment to provide role models of successful businesses as part of their civic education curricula. (CEC, *The Concrete Future Objectives of Education Systems*, COM(2001) 59 final, Brussels, 31.01.2001, pp.11-12)

²⁹ Introduction of “quality assurance systems “requires an effort of training for teachers and school leaders; but their application leads to increases in quality not just in the administrative areas of school life, but in the quality of the learning experience provided to young people and thereby the overall impression that the local community has of a school. This in turn enables an increase in confidence in the capacity of the school to deliver, and to increased expectations of pupil attainment.” CEC, *The Concrete Future Objectives of Education Systems*, COM(2001) 59 final, Brussels, 31.01.2001)

Table 7. Institutional Requirements and Mechanisms to Realize ICT Access and Lifelong Learning for All in the European Knowledge Society³⁰

- ✂ Increased resource investment in education and training from all sources: public and private sector and by each individual.
- ✂ Careful attention and support to the changing role of the teaching profession through improvements in the education, training and support for teachers and trainers thus, helping attract the large numbers of well-qualified and motivated people required by ageing of the European teaching population. Learning must be made attractive and relevant to the individual.
- ✂ Appropriate ICT infrastructure and educational content and services in all schools, including equipment, broadband communication facilities, maintenance, high quality digital educational content, tutoring, guidance, adequate levels of teaching and managerial support.
- ✂ Development of specific networks for education and training to provide teachers with training and materials, classes with means and methods of cooperation both within and between schools, and individual learners with access to materials related to curricula.³¹
- ✂ Education and training institutions to become themselves learning organizations by opening to the outside world, strengthening their relations and cooperation with relevant actors, and absorbing the intellectual and practical contributions of business, research and society as a whole.³² Strengthening of the relations with business has particular importance for both training and employability. Local business can provide insights into future needs for skills and into the workings of the business world.³³
- ✂ Open learning environment through simpler and more democratic access to quality education and training for all, including easier movement from one part of the education and training system to another.
- ✂ Support for equal opportunities and social cohesion by positively taking care of the needs of vulnerable groups, particularly people with disabilities, with learning difficulties, those living in rural/remote areas or those with difficulties to reconcile work and family.
- ✂ Fostering increasing mobility and exchange by youngsters to promote European awareness, the feeling of belonging to Europe, and ultimately the emergence of European citizenship in a context of broadening of experience and enhancement of skills. Everybody should speak at least two foreign languages to benefit from Europe's diversity.³⁴
- ✂ Strengthening of European collaboration among higher education institutions and other educational authorities to enable citizens to learn and work across Europe, making full use of their qualifications. This in turn requires the development of more compatible systems of qualifications and a common European understanding of the minimum levels of quality accreditation.³⁵

³⁰ See CEC, *Detailed Work Programme on the Follow-up of the Objectives of Education and Training systems in Europe*, Joint report by the Council (Education) and the Commission to the Barcelona European Council, Brussels, 2002. Also, CEC, *Investing Efficiently in Education and Training: An Imperative for Europe*, COM(2002) 779 final, Brussels, 2003. Also, CEC, *The Concrete Future Objectives of Education Systems*, COM(2001) 59 final, Brussels, 31.01.2001.

³¹ CEC, *The Concrete Future Objectives of Education Systems*, COM(2001) 59 final, Brussels, 31.01.2001, p.9.

³² There is consensus about the need to open up education systems to the influences of other parts of society – both those close to schools (parents, local institutions, local businesses) and those more distant (exchanges, mobility, e-mail networks). This is necessary not just because of the increased mobility, both professional and geographical, that people undertake during their working lives, but also as part of the way in which Europe adapts to meet the challenges of a global economy. (CEC, *The Concrete Future Objectives of Education Systems*, COM(2001) 59 final, Brussels, 31.01.2001, pp.10-11)

³³ It is no longer possible to consider the company's role as solely that of recruiter of trained individuals or supplier of extra training. The enterprise is a major generator of knowledge and new know-how. CEC, *Teaching and Learning: Towards the Learning Society*, White Paper on Education and Training, Brussels, 1996, p.21.

³⁴ Over the last 10 years or so, not least because of interest sparked by the EU's own educational programmes Socrates, Leonardo or Youth, many schools have opened up to mobility and exchanges. ... Overall, they provide participants with a new view on the world – a practical use for foreign language learning, and show the positive sides to other people. They also provide a different perspective on the learning process, and the possibility for teachers to share good practice with their foreign colleagues, and to learn from each other in that context. (CEC, *The Concrete Future Objectives of Education Systems*, COM(2001) 59 final, Brussels, 31.01.2001, pp.11-12)

³⁵ Throughout Europe, there is a move towards local cooperation (in science and technology parks, urban multi-site technology zones, etc.), based on the exchange of information and training between research institutes, companies and teaching establishments. ... Local knowledge exchange networks are spreading across Europe, in France, Germany, Austria, Belgium, Spain, Switzerland, enabling people to share skills and train themselves by 'exchanging knowledge', everyone taking their turn to be first teacher, then pupil. CEC, *Teaching and Learning: Towards the Learning Society*, White Paper on Education and Training, Brussels, 1996, p.22.

As we can see, the processes of change facing the educational and training systems to be able to fulfill their purpose of preparing the citizens of the 21st century are extensive and very challenging indeed. Every individual or organization involved or having a stake in the educational and training system will be affected by the changes to come. The direction, quality and effectiveness of these changes will depend on the quality and effectiveness of the strategies and processes of innovation. Hence the critical importance to learn about the nature of innovation and, particularly, about those processes of innovation already pioneering the transformations of schools.

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