THE NEW MILLENNIUM LEARNERS:

Challenging our Views on ICT and Learning

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1.   Introduction

This paper is intended to synthesise available evidences on the emergence of a generational approach to learning and knowledge management strongly influenced by having always been living surrounded by and interacting continuously with information and communication technologies (ICT).

The main issues addressed here are the following:

a) Who are the New Millennium Learners (NML) and how can they be characterised?

b) Are NML a general phenomenon throughout OECD countries, and what factors can explain the differences among countries as well as within each country?

c) What are the educational challenges posed by NML, and to what extent will their emergence challenge prevailing schools views about inter-personal communication, knowledge management and learning?

d) How can the NML be duly accommodated into the requirements of the knowledge society and what kind of educational responses have been successful so far? What are the education policy implications of the NML in light of the needs of the knowledge society?

2.   The definition of NML

Who exactly are the NML? *Millennials* is a term widely used to designate those generations born from the 1980s onwards and who have been raised in a context where digital technologies form an inextricable part of daily life. The term was first used by generational historians and sociologists Howe and Strauss (2000) in their essay on *Millennials Rising: The Next Great Generation* to describe what they thought to be quite a different generation from the previous one, the so-called *Generation X*. In short, Millennials are the first generation to grow up surrounded by digital media, and most of their activities dealing with peer-to-peer communication and knowledge management, in the broadest sense, are mediated by these technologies.

Accordingly, Millennials are thought to be adept with computers, creative with technology and, above all, highly skilled at multitasking in a world where ubiquitous connections are taken for granted. This is why they are also often referred to as the *Net Generation* (Oblinger & Oblinger, 2005; Tapscott, 1999), the *IM Generation*, which stands for Instant-Message Generation (Lenhart, Rainie, & Lewis, 2001), the *Gamer Generation* (Carstens & Beck, 2005) for the obvious reference to video games, or even the *homo zappiens* (Veen, 2003) for their ability to control simultaneously different sources of digital information.

Typically their everyday lives are characterised by immediate communication, via instant messenger, cellular conversations or text messaging. They cannot be said to be passive at all regarding their use of digital media; for example, over two million American children aged 6-17 already have their own web sites (Grunwald, 2004), and the same applies to 31% of 14-to-21-year-olds in the UK (Gibson, 2005). The changing ways that members of this generation can learn, communicate and entertain themselves are the primary reasons behind the growing popularity of socially oriented technologies such as blogs, wikis, tagging and instant messaging. This popularity can help explain why today's teenagers are increasingly spending more time using home digital media (computer, games, the Internet) rather than watching TV - the figures for US show 13-to-17-year-olds spending 3.5 and 3.1 hours every day respectively (Grunwald, 2004). It should not be forgotten that *Millenials* usually take for granted that multitasking is the normal

approach to using digital media: being online while at the same time watching TV, talking on the phone, and doing homework. Undoubtedly, their recurrent activity with these technologies can be said to have fundamentally shaped their notions of communication, knowledge management, learning, and even their personal and social values. This is also likely to happen with adults who are heavy users of ICT, whether it be because of a professional need or a personal taste.

On the other hand, although the stereotype suggests that *Millennials* are all teenagers, the fact is that children begin their exposure to ICT at very young age. According to a recent US survey (V. J. Rideout, Vandewater, & Wartella, 2003), children aged six and under spend an average of two hours a day using screen media (1:58), about the same amount of time they spend playing outside (2:01), and well over the amount they spend reading or being read to (39 minutes). Half of the children in this age group have used a computer: among children aged 4 to 6, 27% spend over an hour a day at the keyboard. As it is stated in this report, "while earlier generations were introduced to information through print, this generation takes a digital path".

Throughout this document, the more specific reference to *New Millennium Learners* is intended to put an emphasis on the views, attitudes, expectations, and competences of Millennials in relation to learning and teaching, and, particularly, on the contradiction they can eventually perceive between what their daily practices involving communication and knowledge management are in and outside classrooms.

3. Comparative evidence on NML

A first question is whether the NML is a generation-wide phenomenon: can the term be applied to cover all members of the generation? A first indication can be seen in the percentage of young people currently using computers and connecting to the Internet. A report based on the PISA 2003 database (Wastlau-Schlüter, 2005) states that almost 100% of 15-year-old pupils in European countries have already used a computer and half of them use it on a daily basis at home and only a few times each week at school. Roughly, 80% say that they have a computer at home and 60% an Internet connection. The corresponding data for non-European OECD countries are, in some cases, even higher. And obviously, even in those countries where the ratio of pupils per school computer is low, it is always higher than the equivalent at home. Therefore in most, if not all, OECD countries today teenagers can find more opportunities to access a computer and to connect to the Internet at home than at their own schools.

Moreover, at home the three main activities developed by teenagers are playing games, looking up information via the Internet, and electronic communications via e-mail and instant messaging. Although any comparison between home and school uses has not been carried out yet, it seems to be that, leaving aside playing games, only the Internet search for information is a well-integrated school practice (OECD, 2004) while electronic communications do not seem to be recognised as a typical educational activity.

To complete this picture regarding the emergence of NML it would be necessary to supplement these data with evidence on the use of alternative ICT devices, such as cellular phones, for instance, the use of which is also growing very fast, and with more detailed information regarding time devoted to each activity. Again, data regarding cellular phone ownership among US high school pupils suggest a very fast yearly increase: from 2004 to 2005 the percentage owning a cellular phone rose from 51% to 62% (Horatio Alger Association, 2005). The proportion of British 14-to-21-year-olds owing one was 96% in 2005 (Gibson, 2005).

Accordingly, at least preliminarily, it can be said that NML seem to be a generation-wide phenomenon, growing steadily and already having a universal character in some OECD countries. Just to provide an

indication of the speed of growth, Table 1 compares the proportion of French high school pupils who use instant messaging for chatting according to age (Pasquier, 2005). If instant messaging is considered to be a quite good indicator of the development of NML, then an age difference in just a couple of years seems to be extremely significant: the lower the age, the higher the use.

Table 1.   Differences regarding the use of instant messaging for chatting among French high school pupils according to age

|	Total	Aged 15-17	Over 18
Never	41	38	51
Sometimes	29.5	30	22
Frequently	18	20	16

Source : Pasquier, 2005

3.1.   NML in OECD countries

There is scarce comparative evidence on the emergence of NML in different OECD countries, albeit some indications suggest that there could be vast differences among them. To begin with, although broadly speaking the NML generation is defined as being born from 1980 onwards, it may well be that in different countries its emergence has occurred later. Partly this could be due to the various rhythms of ICT penetration in society, particularly as regards the digital devices and services mostly related to NML habits and practices, such as cellular phones or free instant messaging. Thus it may happen that in a given country NML are already attending university courses while in another they are just ending primary education. For example, back in 2002 one-fifth of US college students began using computers between the ages of 5 and 8, which was not certainly the case for most students in OECD countries (Jones, 2002). And two years later 93% of US higher education students already owned a computer (Borreson Caruso, 2004).

Again, the only available comparative evidence comes from the PISA 2003 survey and thus refers to pupils aged 15. Figure 1 presents the country values of two variables that can be used as proxies for the measurement of the degree of maturity of the technological conditions most likely to be needed for the emergence of NML: the proportions of pupils having used a computer for the past five years and of those who have an internet connection at home. Both values could be said to reflect the level of ICT penetration in the homes of 15-year-old pupils and thus provide an indirect indication of the level of technology available to them.

Figure 1. Country variations regarding the proportions of 15-year-old pupils having used computers for the past 5 years and having an Internet connection at home


OECD country disparities in home access and use
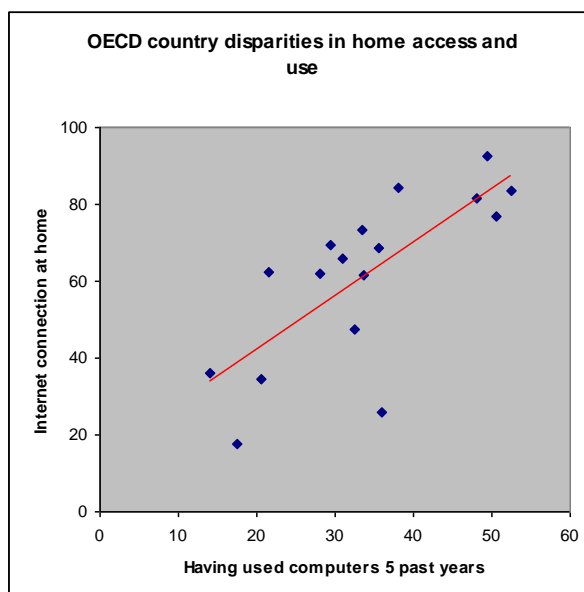
Source : PISA database, 2003

The range of values depicts a case of extreme variability among OECD countries: depending on country, between 20% and 90% of pupils aged 15 have been using a computer for at least the past five years, and from 15% to 55% have an internet connection at home. In general, it is clear that in OECD countries the higher the proportion of pupils having used computers for such a long period, the higher the proportion of them with home access to the internet. This is likely to be directly related with the variations in speed of general ICT development and accessibility in the OECD area. Although both values do not speak directly for themselves about the emergence of NML, the fact is that a similar level of variation can also be predicted to exist regarding the extension of the NML phenomenon.

Figure 2 completes this image of huge variations among OECD countries by providing data on the intensity of use of computers either at home or at school. These data refer to the percentage of 15–year-old pupils who claim to use a computer nearly every day either at home or at school. On the one hand, the graph is explicit about the differences in intensity of use in these two different settings: on average, the intensity of home use tends to be eight times the one at school –with the exceptions of Denmark and Scotland where the differences are reduced respectively to three and two times only. Leaving aside the issue of whether school use is too moderate or home use too intense, or both, the point is that these differences show that the two environments are quite diverse as far as the infrastructural conditions and the level of personal engagement are concerned, being both extremely related to the preferential uses and activities mostly carried out in each setting.

Figure 2. Country variations regarding the proportions of 15-year-old pupils using a computer nearly daily at home and at school
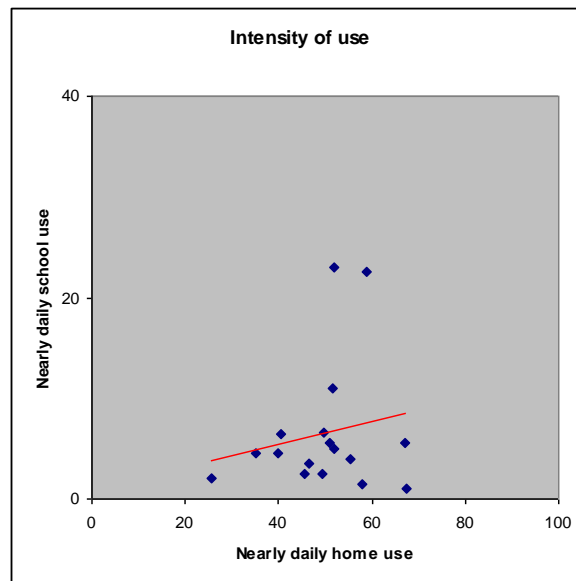
Source : PISA database, 2003

On the other hand, again vast differences appear among OECD countries, which, depending on the country, range from 25% to 70% of pupils aged 15 who have nearly daily use of computers at home and only from 1% to 25% at school – the average values being 50% and 8%, respectively. And finally, it is also worth noting that no significant association can be established between the corresponding country values for each variable, a fact that points to the existence of quite different reasons for the explanation of the actual levels of use in each environment. At home, where teenagers themselves can be said to act to some extent as prescriptors for the acquisition of ICT devices and services, the levels of daily use of computers are extremely high if compared to those of the school. And it can be also inferred that the pace of growth of the percentage of teenagers who actually perform ICT-related activities at home is much faster than the rhythm of ICT adoption and use at schools. Either because of the growing rate of home availability of ICT or of the contextual significance of the corresponding use, the conclusion is that in all OECD countries teenagers behave differently with ICT at home and at school.

What factors can explain the ample differences among countries? A number of reasons have to be explored. First of all, there is likely to be a connection between the emergence of NML and the degree of easiness by which youngsters can access a given ICT device or service. This degree in its turn depends very much on the national context of the ICT market, including the prices of both devices and connection services, when these are required – such as in cellular telephony. Thus an initial relationship could be established between the extension of NML and the level of ICT infrastructural development and markets at national level.

Secondly, on top of the availability of technological devices and services there is a societal attitude towards their use, which can be largely favourable or rather conservative. OECD countries vary greatly regarding the social predisposition and readiness to use ICT and it can be expected that this attitude has an influence on teenagers. The level of individual, corporative and governmental uses of ICT are indicative of this national attitudinal readiness to incorporate technological devices and services into daily life.

Thirdly, a closer look has to be paid to teenagers' own attitudes, cultural patterns and lifestyles, which again can be expected to vary to a certain extent across OECD countries. Here the point is to what extent the prevailing values and social attitudes among teenagers can encourage them to make an intensive use of ICT devices and services or rather prevent them doing so. Particular attention has to be paid to their cultural consumption habits and to their leisure patterns.

Finally, it can be expected that a certain level of association exists between classroom use of ICT and out-of-school practices by NML, both of them reinforcing each other. Lacking such an association in countries where NML appear to be a large phenomenon would clearly point to a divorce not only between NML and schools, as far as ICT uses are concerned, but between schools and society at large. Unfortunately, the available data seem to back this assumption and it may well be that in most OECD countries such a divorce is the prevailing situation.

3.2. *Gender issues*

Going deep into detail, when it comes to the degree of homogeneity inside the NML generation, *i.e.* to what extent all of its members show similar attitudes and behaviours regarding ICT use, the resulting analysis is likely to show a high degree of differentiation even in the context of common shared characteristics. For instance, it can be expected that the NML profile is connected with a combination of personal characteristics such as gender and socio-economic background. However, the existing evidences depict a rather confusing panorama.

On the one hand, it seems to be clear that boys and girls have different profiles of practices regarding the use of ICT and, at the same time, both show alternative preferences regarding the particular ICT devices they use more often. Why these differences occur, and whether they are common throughout OECD countries or not, are two issues that remain to be explored. Figure 3 shows gender differences in profile regarding past experience, frequency of use and main activities carried out with computers and the Internet among 15-year-old pupils. While country differences are also noteworthy, with just a very few showing no significant gender differences in some variables (like Ireland), overall it can be said that boys have significantly been using computers for a longer time than girls, that more boys than girls use computers nearly every day at home, and that boys use them primarily for playing games, while girls tend to do it basically for e-mail and chatting. Finally, both boys and girls show a similar level of use regarding the search for information.

Figure 3. Boys and girls profiles regarding past experience, frequency of use, and main activities regarding ICT in OECD countries

Time and main uses
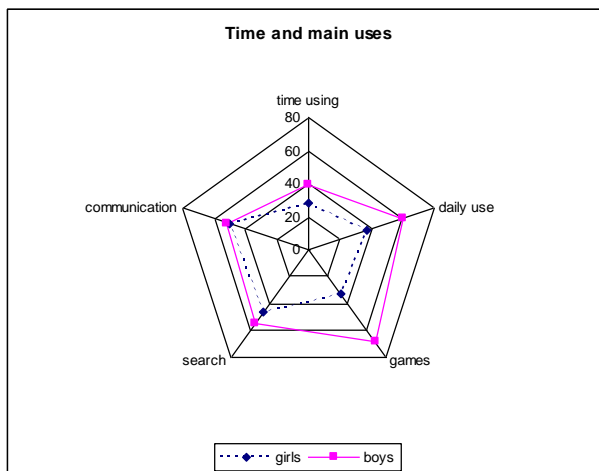
Source : PISA database, 2003

Figure 4 supplements these data with the level of expertise in several ICT-related skills. It shows the proportion of boys and girls who say they perform a number of ICT-related activities very well. It is worth noting that there is only one domain in which girls outperform boys, and that is e-mail. Another activity domain where there are no significant differences is file use, involving very basic operations with files. In the rest of activities, including complex file management, playing games, downloading files, advanced communications (sending attached files, for example), and advanced applications (such as programming), boys' declared performance appears to be higher than that of girls.

Figure 4. Boys and girls profiles regarding basic and complex ICT-related activities in OECD countries

ICT related skills
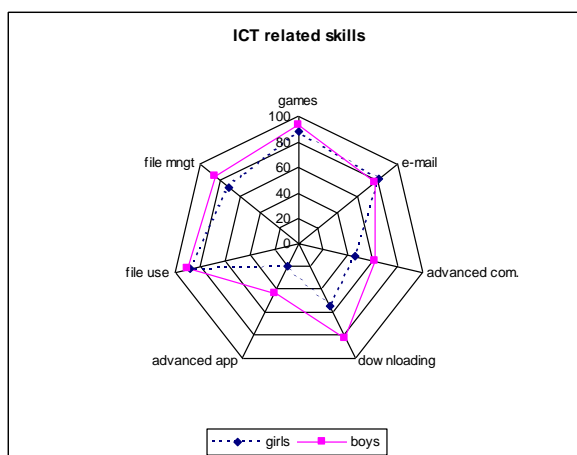
Source : PISA database, 2003

At least partly, gender differences seem to be based on different approaches to inter-personal communication. It has been widely documented that communicating at a distance, particularly using the phone, serves different purposes for boys and girls (Réseaux, 2000). The latter seem to count very much on

phone calls and e-mails, for instance, to organise their sociability and keep affective links alive. Merely as an indication, Table 2 presents data on gender differences among high school pupils in France regarding communication practices (Pasquier, 2005).

Table 2.   Gender differences in communication practices among French high school pupils

	Girls	Boys
Use daily a cellular phone	70	59
Call friends daily	49	34.5
Keep phone links with friends don't see anymore	72	30
Keep e-mail links with friends don't see anymore	47	41

Source : Pasquier, 2005

By all means, girls outperform boys in the use of all available technological devices to communicate or even to express themselves – just as an indication, US girls aged 6 to 17 are more likely to have their own web site than boys (12,2% versus 8,6%) (Grunwald, 2004). Therefore, girls seem to pay more attention to the communication opportunities that cellular phones or e-mail can open up than to more technologically-oriented activities such as playing games or sharing files (P2P). In other words, they rely more on the social uses of ICT as a means rather than on ICT themselves as a source of activity or entertainment. Unfortunately, no equivalent data exist on gender differences among teenagers regarding knowledge management-related activities.

3.3.   *The influence of socio-economic status*

The rather reasonably expected association between ICT usage and socio-economic status – the higher the status, the more intense and varied the use - cannot be sustained by available evidence. More precisely, it seems to be that socio-economic status either reinforces a certain number of practices while avoiding some others, thus suggesting a diversity of NML profiles following diverse needs for peer-to-peer communication and knowledge management. Should this be confirmed, then a serious concern about the differential benefits of the knowledge society in relation to socio-economic status could be raised.

Just as an indication, Table 3 provides the results of a survey with French high schools pupils on the socio-economic differences regarding the use of instant messaging for chatting (Pasquier, 2005). The relation that can be established between socio-economic background and instant messaging is rather the contrary to the one expected. Broadly speaking, the lower the socio-economic status, the higher the frequency of use. Thus, the reasonable assumptions relating socio-economic status and the millennial behaviour have to be contested. It can be argued that it is the status *per se* that imposes a given communication practice, and not the ability to buy more or less ICT devices or services.

Table 3.   Socio-economic differences among French high school pupils regarding the use of instant messaging for chatting

	Total	Higher SES	Medium SES	Lower SES
Never	41	51	39	30
Sometimes	29,5	31	27	31
Frequently	18	8	22	27

Source : Pasquier, 2005

Table 4, coming from the same source, shows the results obtained on the percentage of high school pupils who communicate via the Internet with people they have never met. Interestingly enough, the higher the socio-economic status, the lower the likelihood to keep corresponding with unknown people. Again, the status seems to impose strong differences in practices. Thus there seems to be enough evidence to confirm that the behaviours generally attributed to NML vary in fact greatly according to personal and social differences.

Table 4.   Socio-economic differences among French high school pupils regarding Internet-based communications with unknown people

Total	Higher SES	Medium SES	Lower SES
37	26	41	49

Source : Pasquier, 2005

4.   The educational challenges posed by NML

Is education challenged because of the emergence of NML? While some analysts would consider NML nothing but a manifestation of another vogue adopted by the youngest generation, they are likely to be a growing concern for educational institutions and policy makers in the years to come for three main reasons: the implications of NML intensive use of ICT over their intellectual and cognitive skills, the changes in cultural practices and lifestyles, and the eventual contradictions emerging from contrasting practices in and outside schools. Today's pupils are no longer the people traditional educational systems were designed to teach.

4.1.   Alternative cognitive skills

NML continuous use of ICT is thought to have important implications on the development of their intellectual competences and cognitive skills, up to the extent that some analysts think that they do really think differently (Prensky, 2001b). To begin with, the truth is that their inevitably short attention spans are the reason Seymour Papert (1994) coined the term "grasshopper mind", for the inclination to leap quickly from one topic to another, sometimes back and forth, instead of lingering over a subject. Such a repeated behaviour will result in NML being impatient if sources of information are not instantly at their fingertips, and rarely spend long hours thinking about the same thing. As well as changes in attention spans, the implications of an intensive use of ICT may also touch on a broad range of cognitive characteristics, from the need for instant responses to the habit of multitasking and the focus on multimedia content, just to mention a few. As a matter of fact, NML have grown up used to:

a)   Accessing information mainly on non-printed, digital sources.

b)   Giving priority to images, movement, and music over text.

c)   Feeling at ease with multi-tasking processes.

d)   Gaining knowledge by processing discontinued, non-linear information.

On the whole it may be that the resulting changes seriously defy traditionally expected behaviours and supported practices by formal education institutions – longer attention spans, reflective activities, and focusing intensely only on one activity typically involving some form of properly written text. As Prensky (2001a) has suggested, NML can be said to be "digital native," native speakers of the digital language of computers, video games, and the Internet, as opposed to their teachers who are mostly "digital immigrants" and have had to adapt to the new environment created by ICT. They have had to learn a new language and, because of this, their accents in speaking this digital language are still discernable.

For example, the enormous amount of time that NML seem to spend on video games – in the US 8-10-year-olds spend more than an hour a day with video games (V. Rideout, Roberts, & Foehr, 2005) - raises concerns not only about the competences being developed but also about the kind of expectations regarding learning being generated. Video games are expected to give immediate positive feedback for every correct choice, prompting direct learning. And because the learning is fast, focused and repetitive, games cause a great degree of limited learning in little time. In making the player adopt a role which forces constant decision-making, embedded into a particularly well-designed and exciting context, video games raise NML expectations about what is likely to happen when they are in front of a computer and, above all, transform them into real *gourmand* consumers of digital media. Nothing seems further from this than their daily school experiences with ICT.

However, it seems to be that not enough research has been carried out to test empirically the effects of ICT on cognitive development. As stated in a recent report on research on the effects of digital media on infants, "research has not come close to keeping up with the pace of new media development. Infants, toddlers and preschoolers today are developing in an environment saturated with media, and unanswered questions abound concerning their use of electronic media" (Center on Media and Child Health. Children's Hospital Boston, 2005).

4.2.   *Changes in cultural practices and social values*

As usual with intergenerational change, NML can be expected to show different cultural patterns and lifestyles when compared with those of any other previous generation. However, what makes NML unique is to what extent their lifestyles are pervaded by digital devices and services. Firstly, this is the first generation to have reduced the exposure time to television mainly due to the attention devoted to other digital media, particularly through the internet.

Secondly, under actual conditions NML consumption of digital media can be said to be less controllable by adults, be those parents or teachers, since NML are totally in command of what they want to see, download or upload. Broadly speaking, under these new consumption patterns:

a) Physical isolation tends to be reinforced, even if cyberspaces for social relationship emerge as alternative exchange fora.

b) Digital-related activity is extended longer and tends to cover time spans previously devoted to rest.

c) Immediate responses and quick reaction speeds are seen as the norm in personal communication.

d) Multimedia content is considered to be, by its very nature, of higher value than mere text.

e) Writing (although NML would probably say "talking" instead) becomes increasingly important due to the physical constraints imposed by the devices and services used, up to the extent of generating new languages.

The last point is particularly challenging for school culture and practices. Box 1, for instance, offers an excerpt of an essay actually submitted by a pupil to her teacher in a British school, and the corresponding translation. Needless to say, teachers need to reflect upon whether such a new universal way of spelling should or should not be accepted in school settings and if yes, then to what extent. A quick negative answer probably would not sufficiently take into account that these communication practices are increasingly used in corporate environments due to their higher efficiency (less time, lower cost) if compared to traditional writing – the same reasons for which use them.

Box 1. **NML writing**

My smmr hols wr CWOT. B4, we used 2go2 NY 2C my bro, his GF & thr 3 : kids FTF. ILNY, it's a gr8 plc.

Translation: My summer holidays were a complete waste of time. Before, we used to go to New York to see my brother, his girlfriend and their three screaming kids face to face. I love New York. It's a great place.

Taken from: Daily Telegraph, Sun Mar 2, 2003, British Girl Baffles Teacher with SMS Essay, as reprinted in (Veen, 2003)

But thirdly, and even most importantly, it might well be that a complete new set of social and personal values and attitudes appears to be linked to these emerging cultural practices, particularly when compared with immediate prior generations such as *Baby Boomers* or *Generation X* (Tapscott, 1999). According to some, besides being technology savvy, NML would be particularly hopeful, self-assured and determined, active even stressed, and close to their parents (Phalen, 2002). And following these values, their school performance would increasingly improve when compared to previous generations. Nevertheless, there seems to be no empirical evidence yet to support this kind of considerations.

4.3. *Expectations regarding teaching and learning*

It is also commonly stated that NML attitudes and expectations regarding learning, and teaching, have also evolved radically from previous generations. Some twenty years ago, when computers started to be seen as a tool that could potentially improve the quality of teaching, teachers began to experiment with the idea of supplementing traditional teaching and learning activities with educational applications and digital resources which later on, thanks to the Internet, became increasingly available. Up to then, teachers could be said to be in command of the opportunities for ICT-mediated educational innovations and for most pupils schools were the only place where they could access to a computer. But when both the computers and the Internet started to enter pupils' homes and increasingly became a standard commodity for most families, pupils' ICT-related competences grow exponentially, even by self-learning as the last PISA survey (2003) revealed, largely outperforming those of their teachers. Accordingly, it can be expected that a number of pupils' expectations could have changed dramatically and be completely different from the ones held by their teachers, particularly regarding:

a) The kind of ICT devices and services available at schools.

b) The frequency of their use.

c) The range of possible activities.

d) The opportunities for collaborative work and networking.

e) The communication skills involved (including a reinterpretation of written language).

f) The degree of learning personalisation.

g) The standards of digital quality, in terms of interactivity and use of multimedia resources.

Just to give an indication of the growing competences of NML in relation to potentially relevant educational uses, a recent study from Pew Internet and American Life found that in the United States more than half of the 12 million teens online create original material for the web, whether it's through a blog or a home page, with original artwork, photos or video (Lenhart & Madden, 2005). It can be reasonably expected that NML are more willing to use ICT in learning activities than schools allow them to do. To what extent this contrasting situation makes them feel disappointed with school practices, or even increasingly disaffected from school life, has not been thoroughly investigated yet, but some indications exist pointing to a growing gap between pupils and teachers perceptions regarding the quality of the school experience (BellSouth Foundation, 2003).

5. NML and the knowledge society: innovative responses and policy implications

Are there any innovative responses to respond to these educational challenges? ICT-based educational innovations are mainly the result of teachers' initiatives to improve teaching processes. Their number has increased following the growing availability of ICT at schools and increasing teachers' competence and confidence. But on the whole, these innovations in teaching processes and activities, although producing an impact on pupils' learning, do not seem to take into account the changes operated in pupils' views and expectations according to their increased dependence on ICT for their out-of-school daily activities. In short, not many educational innovations seem to have considered what would best suit NML characteristics, perhaps with the exception of a number of higher education institutions in some OECD countries.

5.1. Educational innovations

Therefore there is a need for finding and analysing innovative educational responses designed to better accommodate NML into educational settings, benefiting as much as possible from their enlarged ICT-related competences, taking into account the changes operated in their cognitive skills (from shorter attention spans to the need for immediate answers). In times when a lot of emphasis is put on the effectiveness of teaching, more attention should be devoted to the changes occurring in pupils as they increasingly become NML. Their emergence claims for a re-consideration of ICT-based educational innovations putting pupils' new attitudes and expectations, as well as transformed competences at the very centre.

It is likely that those innovative educational responses are going to be found around the following axes:

a) **Infrastructural**: aimed at increasing the number of ICT devices, resources and services available in educational settings (from wireless communications to lesson podcasts).

b) **Contextual**: designed to make functional resources (time and space) more flexible to allow room for alternative arrangements to traditional teaching and learning activities.

c) **Curricular**: intended to adjust curricular requirements or break their limits to welcome new cultural tools or contents typically related to NML (such as IMS writing language or personal websites for portfolio documenting).

d) **Process-focused**: proposed to better accommodate teaching and learning processes and activities to NML changes in cognitive and communication practices, including both inter-personal communication and knowledge management, as well as to benefit from their enlarged ICT-related competences, and most likely to be the hardest innovations to find.

5.2. *Policy responses*

Nevertheless, the challenges posed by NML can be said to go further than this, by questioning the prevailing design of the knowledge society and, indeed, by already putting into practice an alternative one. The rise of NML can also be seen as the emergence of an alternative approach to the knowledge society to the one usually supported by formal educational institutions, which relies more on a progressive adaptation of the traditional approaches to communication and knowledge management than on the severe breakthrough that NML practices seem to announce. While the first is more suited to the life rhythms and pace of evolution of educational institutions, the second would represent a true revolution which, as a matter of fact, will seriously contrast with the knowledge society designed not by true digital natives, but by adults. The critical issue is whether educators and policy makers should be paying more attention to NML or it should be taken for granted that they do not represent a serious challenge for the future, but just the expression of another, rather post-modern, generational conflict.

In short, what kind of knowledge society are schools currently preparing for? Up to now, broadly speaking (Eurydice, 2004; Plomp, Anderson, Law, & Quale, 2003) educational policies aimed at promoting the knowledge society have been mainly focused on:

a) Guaranteeing access to ICT in all educational institutions by, for instance, reducing students per computer ratios and providing schools with fast internet connections.

b) Investing in in-service teacher training.

c) Promoting the use of digital media as educational resources.

d) Setting incentives for fostering ICT-based educational innovations and experiments.

All these policy strands concentrate exclusively on the supply side by creating the conditions for ICT incorporation into regular teaching practices. Overall, there seems to be a growing concern on the results of the investments following those lines. It looks as if the promises of innovations which would radically improve both the quality and the results of school education, thanks to the availability of ICT coupled with well-trained teachers, still remain to be realised (Cuban, 2001; Kozma, 2003; Oppenheimer, 2004). Under present circumstances it would be hard to say that education systems are really preparing for the knowledge society.

From the demand side, it is clear that NML are currently experiencing what it is to live in a networked society without necessarily realising the potential of a true knowledge society. But to some extent their experiences stop when they cross the walls of educational institutions. What would then be the more appropriate policy responses to the emergence of NML in the light of the requirements of the knowledge society? At this stage a number of policies could be said to be potentially relevant if aimed at least at:

a) Bridging the gap between NML experiences of ICT-mediated inter-personal communication and knowledge management inside and outside classrooms by enriching schools' range of available ICT devices and services, and by allowing room for using them in a variety of educational experiments and innovative practices. There should be a focus in guaranteeing that there is a technological continuity between NML in and out of school lives and that their ICT-related competences are duly conveyed into educational activities thus make them feel at ease.

b) Making arrangements to better take into account NML voices regarding how education should be, paying particular attention to their expectations in relation to school applications of the digital devices and services they are currently using, by creating adequate direct and indirect channels of expression for them as well as observatories of their evolving practices and expectations, and assuring that their opinions are duly conveyed to teachers.

c) Considering NML practices involving ICT devices and services in relation to communication and knowledge management an area in urgent need for educational intervention, by coaching them within a framework of societal and personal values and, at the same time, by coping with existing imbalances in practices, like the ones based in gender or socio-economic background.

d) Creating incentives for the software industry to develop educational software for a vast range of devices (from computers to cellular phones) that try to apply the principles that make video-games so attractive and successful among NML.

e) Engaging initial and in-service teacher training institutions in all these processes, trying to ensure that they are at the forefront in the use of the digital devices and services that are already shaping their current and future pupils' communication and knowledge management activities.

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