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NEW MILLENNIUM LEARNERS IN HIGHER EDUCATION: EVIDENCE AND POLICY IMPLICATIONS

Purpose of this document

In the context of ongoing CERI work on higher education, this document addresses three questions. First, can the claim that today's higher education students are new millennium learners be sustained empirically? Second, is there research evidence demonstrating the effects of technology adoption on cognitive development, social values, and learning expectations? Third, how are higher education institutions coping with the widely assumed teaching and learning implications of the emergence of the new millennium learners?

This document is an excerpt of Chapter 5 in the upcoming CERI volume on ***Technology in Higher Education*** in the ***Higher Education to 2030*** series, which takes a forward-looking approach to analysing the impact of various contemporary trends on tertiary education systems..

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Introduction

Technology is an integral part of the lives of today's students in higher education. It is often claimed that the current cohorts of students are so adept at digital technologies that their lifestyles are, as a matter of fact, determined by the use they make of these technologies in areas such as personal communication, entertainment, and social interaction. In many OECD countries this is not so surprising as it applies also to a growing percentage of the adult population.

The discussions about the implications of this phenomenon for higher education have been already taking place for some time. Powerful and suggesting images, like the "new millennium learners", have emerged to evoke and summarise in an intuitive form a given set of expectations about today's learners. Whether or not this level of technology adoption or dependence is having an impact on the way students in higher education manage knowledge and learn, and therefore on their expectations about teaching and learning has been subject to discussion. Such a discussion has often derived into an irreconcilable confrontation between the advocates of educational change and those who look at technology in teaching merely as a tool to do better what higher education teachers have already being doing quite well for decades, if not centuries – and it works. The former see in the new generations of technology-adept students an opportunity to radically transform teaching and learning in higher education. The latter claim that technology should be used to enhance current practices and that the level of technology adoption should be a function of two criteria: convenience and productivity.

Nevertheless, rarely are these discussions backed by empirical evidence. There are many works about this topic, which can be seen as stimulating and challenging essays which expand the horizon of the debates. However, they often fail to provide the empirical evidence which could contribute to inform the policy debate at institutional level and even teachers' individual decisions about technology adoption in teaching.

To contribute to address this knowledge gap, three main questions are addressed here. First, can the claim that today's higher education students are new millennium learners be sustained empirically? Second, is there research evidence demonstrating the effects of technology adoption on cognitive development, social values, and learning expectations? Third, how are higher education institutions coping with the widely assumed teaching and learning implications of the emergence of the new millennium learners?

The responses found suggest a mixed and far more complex picture than it is often presented in most of the well-known essays about this topic. To begin with, although an increasing percentage of students can be said to be adept in technology, it is misleading to consider that all of them fit equally well into the image of new millennium learners. As it happens with learning styles, there are different student profiles regarding technology adoption and uses, and in many respects clear digital divides still exist. The use of concepts such as the new millennium learners can be helpful in so far as it evokes a clear and powerful image, but misleading if used as a cliché or stereotype. For the purposes of improving teaching and learning in higher education, the diversity of students and situations matters most.

Secondly, there is not enough empirical evidence yet to support that students' use of technology and digital media is transforming the way in which they learn, their social values and lifestyles, and finally their expectations about teaching and learning in higher education. In particular, students' attitudes towards technology use in teaching and learning appear to be far from what many would wish to emerge as the dominant patterns. Rather, students tend to be far more reluctant in this respect than the image of the new millennium learner would suggest. Most of them do not want technology to bring a radical transformation

in teaching and learning, but would like to benefit more from their added convenience and increased productivity gains in academic work. The reasons for such reluctance might be related to the uncertainty, disruptiveness and discomfort that discrete technology-based innovations may cause to them.

While higher education institutions and teachers are increasingly adopting technology in teaching, there is an urgent need to address this issue in a systemic way. This means to identify what policies and practices can best suit the objective of providing students with a rich learning environment while improving their satisfaction and boosting learning gains. More has to be done to improve the knowledge base about technology use in higher education so as to inform the debates. This requires not only more experimental research but also increased efforts to disseminate better existing findings and to avoid the reinvention of the wheel. Activities intended to train and support teachers for course adoption of technology should be based on validated effective practices.

Challenging the concept of the new millennium learners

The cornerstones and educational implications of the suggestive image of the new millennium learners are examined in this initial section. The new millennium learners and other equivalent concepts are often used as powerful images to evoke two well known assumptions. First, that the lives of today's learners are highly dependent on technology up to the extent that their social and cultural practices would not be as they are if digital media were not available anytime, anywhere to them. Second, that this has important implications for teaching and learning: students are not only accessing, managing, creating and sharing knowledge in dramatically different ways as their teachers often do, but also have radically new expectations regarding what a quality learning experience should be.

Because the image of the new millennium learners is so suggestive and powerful, it is often referred to as an important driver for educational change in higher education. But to estimate the real magnitude of this essentially generational phenomenon it is worth raising a number of questions regarding the empirical validity of the most commonly assumed views.

A powerful image

No matter how you name them, digital natives[1], new millennials[2] or new millennium learners, the first generations to grow up surrounded by digital media have reached the age of enrolment in higher education in many OECD countries. Most, if not all, of them carry a cellular phone and an mp3 player, have a personal computer connected to the Internet, and spend more time in front of its screen than watching television or reading books. This is why the new generations of university students are also often referred to as the "Net Generation" (D. Oblinger & Oblinger, 2005; Tapscott, 1999), the "IM Generation", which stands for Instant-Message Generation (Amanda 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.

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1 . A term coined by Mark Prensky (2001a) in his much quoted essay on *Digital natives, Digital Immigrants*. As he claims, "digital natives" are 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 technology. They have had to learn a new language and, because of this, their accents in speaking this digital language are still discernable.

2. This other 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.

Of course, it is not the first time in history when generational differences are in some ways enhanced by the emergence of new technologies such as television. But there is a big difference between digital technologies and the previous ones: they are personal and transform the way in which we communicate and actively manage information and knowledge, in a more interactive and instantaneous way, and with an expectation of ubiquitous access to networks.

Drawing on this assumption, media and technology firms tend to exploit the image[3] according to which today's higher education students could be expected to be adept with computers, creative with technology and, above all, highly skilled at doing several other things at the same time (multitasking) in a world where ubiquitous connections are taken for granted. Some authors have gone even farther and claim that today's students prefer receiving information quickly, be adept at processing information rapidly, in a non-linear way and often while multitasking, have a low tolerance for lectures, prefer active rather than passive learning, and rely heavily on communication technologies to carry out social and professional interactions (Frand, 2000; D. G. Oblinger, 2003; Prensky, 2001b).

What inevitably comes next, as Kennedy *et al.* (2008) have pointed out, is to question the ability of higher education teachers to deal with these new students' expectations, which some claim to be "the biggest single problem facing education today" (Prensky, 2001a, p. 2). And therefore the point is made that the lack of attention to the emergence of this new generation of learners is causing a number of educational problems such as a growing tendency to student disengagement and eventually disaffection, and consequently educational failure.

A research challenge

It is reasonable to expect that if digital media play such an important role in students' lives, it is bound to have an effect on the ways in which they face their own education and the role that technology should have in it. The attractiveness of this reasoning could be hardly denied, but does reality confirm and validate the assumptions about the new millennium learners?

Hence the importance to back up with hard data these hypothetical assumptions and to address research questions such as the following ones: are today's higher education students different from previous generations because of their continuous exposure to digital media and constant use of digital devices and services? When today's higher education students are entering into the classroom, are they also bringing new expectations regarding teaching and learning and particularly regarding the use of technology? Are higher education institutions devoting more attention and resources to fulfill these expectations? And, if so, what are the results in terms both of student satisfaction and academic performance? These seem to be very simple questions and one could expect to get straightforward answers, but is there enough research evidence to address them all?

How far are higher education students new millennium learners?

This section addresses the opening question of whether available data can sustain the assumption that the current cohorts of students are deeply attached to digital media. It first summarises what existing international and national surveys show about the levels of technology adoption. Then it goes more deeply into the details of whether their actual uses of technology correspond to what the concept of the new millennium learners suggests. Finally, the issue of the coexistence of very different student profiles is raised.

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3 . The number of articles in newspapers contributing to elaborate this hype is countless. A good, well-sustained example can be found in the piece by Zeller, Bernstein, & Marshall (2006).

On the whole, the available evidence depicts a complex and nuanced picture. On the one hand, the assumption that higher education students constitute the social category that shows the most intense and varied use of digital media can be sustained with data coming from different surveys. Therefore, the generation of today's higher education students are substantially different to previous ones when it comes to technology. But on the other hand, it would be dangerous to assume that this applies universally to all students in higher education. There are clear indications of the emergence of different student profiles, which go beyond levels of access to include issues of intensity and variety of uses.

A whole generational phenomenon?

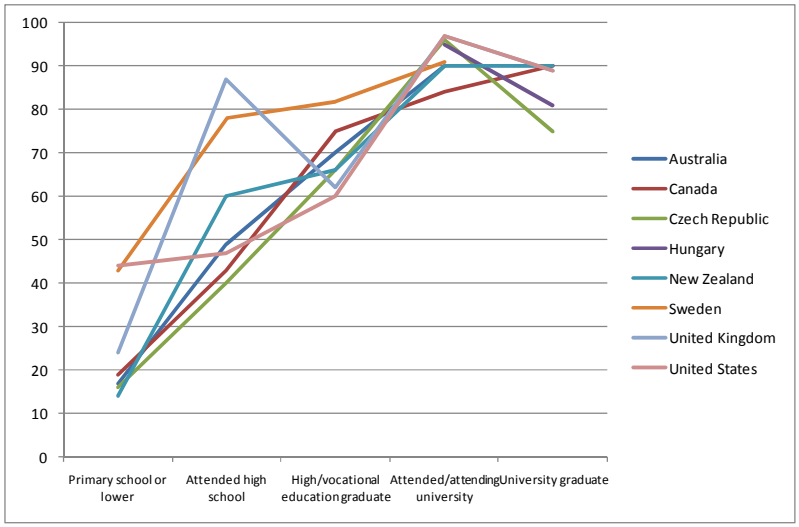
Drawing on both comparative and national data, it is absolutely clear that on the whole students in higher education do show high levels of technology adoption. This level is not only determined generationally, by age, but reinforced by the contemporary realities of being a student. And more importantly, there are clear indications that the pace of technology adoption will increase in the near future.

The importance of age and level of education

There are good indications revealing that both age and level of education can be said to be predictors of, for instance, higher use of the Internet. The following two graphs clearly reflect the importance of age and level of education for a group of OECD countries for which comparable data are available.

Figure 1. Internet use by level of education

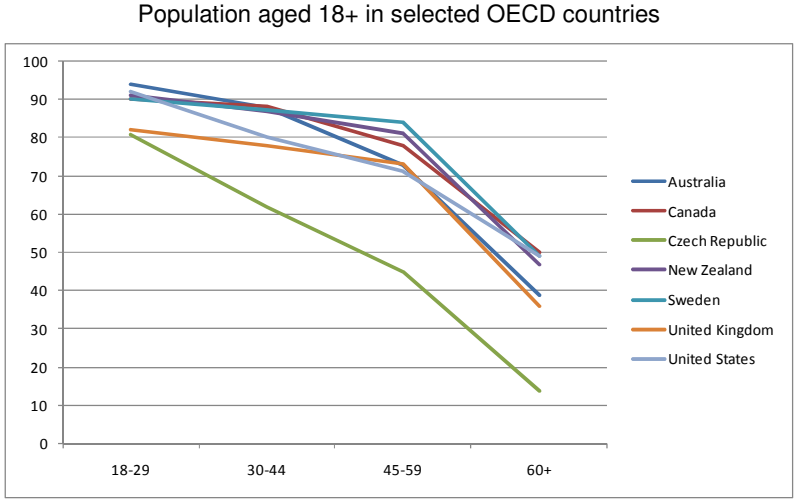
Population aged 18+ in selected OECD countries



Source : World Internet Project, 2007.

In all countries considered those aged 18 or more who have attended or are attending higher education courses have the highest rates of Internet usage compared to the rest of age groups – even including those who already gained a university degree and who are probably older than the ones in this category. Needless to say, this correlation may hide the impact of socio-economic status insofar as higher education graduates and students are likely to be more affluent than those with lower levels of education.

Figure 2. Internet use by age group



Source : World Internet Project, 2007.

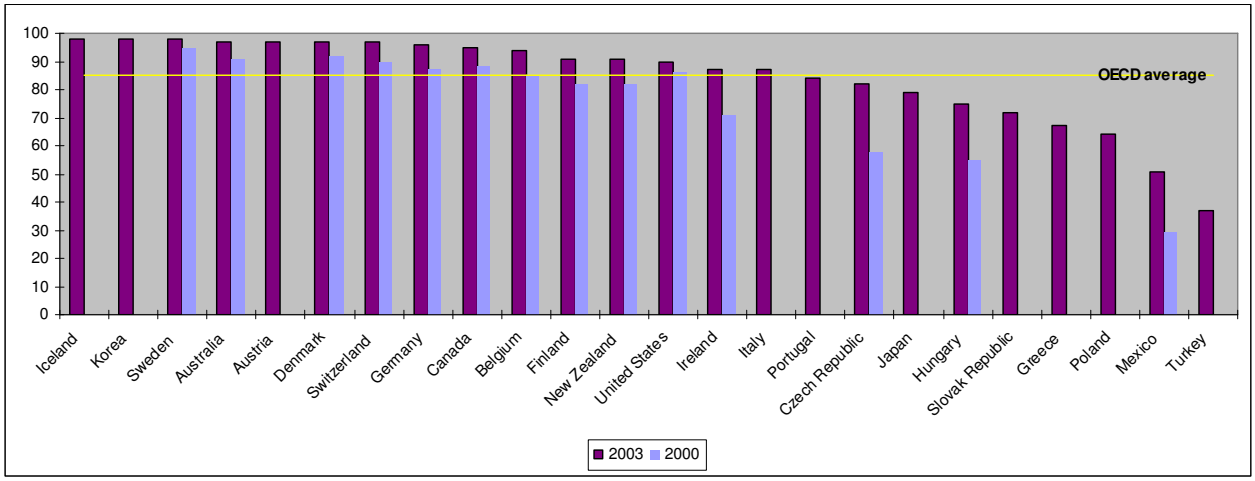
The relationship with Internet use is also clearly seen in the second graph which shows that the population aged 18-29 is the age group with the highest percentage of Internet users. This is confirmed by the latest Eurostat survey (2008) which found that 85% of European school or higher education students aged 16-24 reported that they are Internet users, while only 13% of people aged 55-74 went online. 25% of those who had not completed high school used the Internet, with the figure rising to 52% for those who attained a secondary school diploma and to 77% for college or university graduates. So, age and higher education correlate quite positively with the use of the Internet in a way that suggests that higher education students are likely to be among the heaviest Internet users in the adult population.

Baseline assumptions

In view of the lack of comparative data in this respect covering all OECD countries, a proxy measure has to be used. One such measure can be home access to computers by secondary school pupils, a majority of whom are likely to become university students in some years. Looking at secondary school pupils' rates of access and use can provide, in an indirect way, a glimpse into the likely behaviour of prospective higher education students. Following this argument, figure 5.3 shows the percentage of 15-year-olds having a computer available at home in OECD countries in 2000 and 2003. The data reflected in the figure 5.3 can be used as a rough estimate of access to computers by today's university students. This is because those who answered the questionnaire in years 2000 and 2003 are now aged 20 to 23 year olds, i.e. in the average age range in higher education students.

Figure 3. Percentage of 15- year-olds having a computer available at home in 2000 and in 2003

OECD countries participating in PISA 2003



Source : OECD, 2008.

Although there are striking differences among OECD countries, the average percentage of 15-year-olds who had a home computer in 2003 was 85%, but the number of countries surpassing this figure was higher than the corresponding countries lagging behind. Moreover, in thirteen out of the twenty-four OECD countries that participated in PISA 2003, this value was at least 90%.

On the other hand, the pace of increase in access to computers was impressive in those three years. Although data are available only for some countries, the differences in percentages between years 2000 and 2003 suggest a growth that could easily lead the majority of OECD countries to the universalisation of home access to computers in less than five years – or even earlier – with a matching development also in broadband access (OECD, 2008). The figure also reveals that the pace of growth during this period has been far more rapid in those countries where the starting point was lower. If these countries manage to sustain their growth pace during the next few years, they will be in a much closer position to the countries which now have higher rates of home access to computers.

Indications of higher values of technology use

However, it is worth considering that these figures might underestimate higher education students' access to technology for five main reasons:

- First, because of the speed of increase in access, which, as suggested above, is likely to have reached saturation in a number of OECD countries in a very near future. The estimates presented above are based on the assumption that the rates of access have not changed since the current students were aged 15, but they have increased worldwide as the comparison between rates of use drawing on PISA data show (Centre for Educational Research and Development (CERI), in press-a).

- Second, for those pupils accessing higher education can be expected to benefit significantly from better home access to computers than the rest –the most important determinant of home access being parents' educational level as a number of studies have shown repeatedly drawing on PISA data (Centre for Educational Research and Development (CERI), in press-a).

- Third, the requirements of most courses in higher education will demand students to present their assignments in due form, which inevitably means that they have to have access to a computer even if it is only to use it for word-processing purposes – and, as a matter of fact, universities give *.edu* addresses upon enrolment therefore assuming that they have the means to use email facilities. So either the university itself provides them with the required equipment, in the form of computer equipped rooms or labs, or by means of facilitating laptops to them, or most likely university students are going to have their own personal equipment not only as a learning tool but even more importantly as the most convenient way to go online for a variety of personal and social purposes.

- Four, a number of national surveys already point to high levels of technology adoption. As an example of this, the most recent survey of undergraduate students in the United States (Salaway, Caruso, & Nelson, 2008)[4] reveals that more than 80% of them own laptops compared to only 66% in 2006. Additionally, 54% own desktops, and approximately one-third have both of them. By all means, a computer connected to the Internet seems to be integral part of the necessary equipment of a higher education student nowadays. Although the situation in the United States might not be necessarily representative of the OECD average for obvious reasons, including the residential nature of campuses which reinforces the need for better opportunities for communication with friends and family, it is clearly a good indication of the speed at which higher education students are equipping themselves with computers: of those entering higher education in 2008, 71% have a laptop which is less than one year old.

- And five, younger higher education students appear to be even more attached to digital technologies than their older peers in the same institutions. There is some evidence supporting this last point. For instance, the project SEUSSIS, funded by the European Commission under the SOCRATES programme, compared among other things the rates of PC ownership by new entrant students and graduated students in a number of European universities[5]. As Table 5.1. shows, for some universities in the sample a much higher percentage of their established students own a PC as compared to their new entrants, while for some others this difference is rather insignificant. The reasons for such a disparity across universities and countries would need further investigation but, unfortunately, they are not discussed in the final report of the SEUSSIS project. However, it can be reasonably argued that this disparity is related to the different course requirements and practices in the use of technology in each of the participating universities which, in turn, are likely to be depending on the prevalent teaching and learning methods.

Table 1. PC ownership amongst new entrants and established university students

In seven European universities, 2003.

University	New entrants (a)	Established students (b)	Difference (b-a)
Abo	54%	84%	+30%
Bergen	56%	77%	+21%

4. This study involved some 27,317 students from community colleges, colleges and universities in the United States. The 2008 edition, as well as the previous ones, can be downloaded from www.educause.edu/ecar.

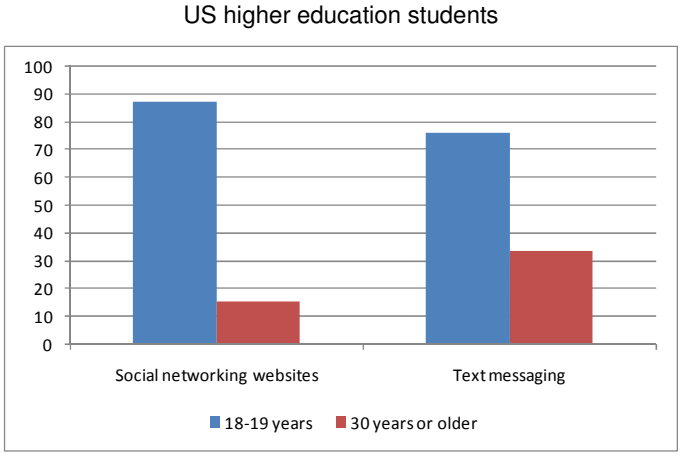
5. The project collected information about the Information and Communication Technology (technology) experience, skills, confidence and attitudes of students and academic staff at seven European universities in Finland, Norway, France, Spain, Italy, Belgium, and the Netherlands. The questionnaires were not administered in all universities to a representative sample of the corresponding population and accordingly are reproduced here only as mere indications. The total number of questionnaires received from students was 12,716. Information may be downloaded from www.intermedia.uib.no/seusiss.

Edinburgh	70%	73%	+4%
Groningen	89%	85%	-4%
Pavia	85%	83%	-2%
Poitiers	67%	63%	-4%
Salamanca	79%	80%	0%

Source : SEUSSIS Project, 2003.

As a matter of fact, there are also striking differences in the levels of use among university students according to age, which point to the fact that younger students are far more technology savvy than the older ones or, to say it differently, undergraduates rely more on technology than postgraduate students. As an indication of this figure 5.4 compares the use of a couple of significant applications (social applications and text messaging) by two different age groups of students in higher education institutions in the United States: new entrants and the oldest students, probably postgraduates. The percentage of younger students' use of text messaging is twice as high as the older students, whereas social networking applications are hardly accessed by older students.

Figure 4. Use of particular applications weekly or more often



Source : ECAR, 2008.

To sum up, there is sustained evidence to conclude that higher education students are, almost universally, used to access a computer connected to the Internet, and also that the corresponding rates have been progressing steadily and is very likely that they will continue to do so in the near future.

Are they really acting as new millennium learners?

When considered in independently of other factors, this close attachment to computers does not automatically transform higher education students into new millennium learners. According to the initial assumptions they are expected to use a variety of digital media to a very intense degree, and for a vast range of purposes, including personal entertainment, personal and social communication as well as learning. Certainly, there is enough evidence to support this assumption, at least for a vast majority of students.

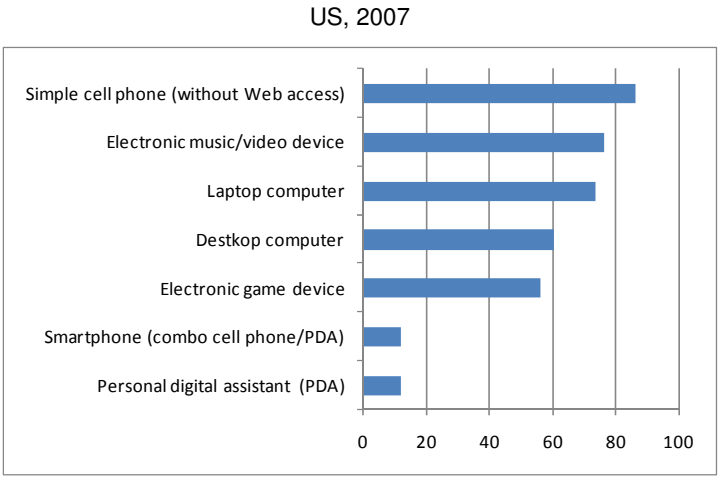
Variety of digital media

To be considered as true new millennium learners, students have to be using daily a variety of digital devices which form a constellation surrounding them. Once again there is little comparative information

covering all OECD countries but only some scarce evidence from a number of them. And it supports this initial assumption.

Certainly, there is a constellation of digital devices surrounding higher education students. A 2007 study concluded that virtually all higher education students in the United States owned some type of cell phone (Rideout, Vandewater, & Wartella, 2003; Salaway, Caruso, & Nelson, 2007). Roughly 98% of all students had either a simple cell phone (without web access) or a smartphone (a cell phone capable of connecting to the Internet). What came next as the most-owned device both by males and females, as the following figure presents, is not a computer but some kind of digital video or music player (like an mp3 player). But, in the third place, females prefer to have a laptop while males opt for an electronic game console.

Figure 5. Type of digital devices owned by students in higher education

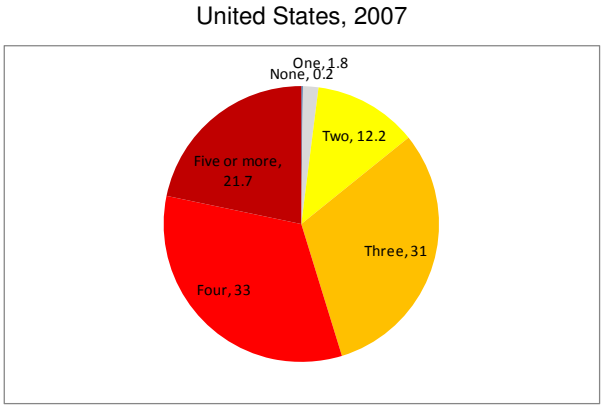


Source : ECAR, 2007.

Interestingly, in the United States the category of digital device with the highest rise in just one year has been the smartphone, owned by 66% of students in 2008 compared to just 12% one year before. But this seems to be more an indication of a growing trend to keep updated with the latest models than of a change in the preferred ways to connect to the Internet since only 17.5% declare to access the Internet from these devices weekly or more often. Students cite high cost, slow response, and difficulty of use as the primary reasons for not doing so (Salaway, *et al.*, 2008).

But it is not only about cell phones, as the next figure shows. At least 85% of all higher education students have at least three of these digital devices: a cell phone, a desktop computer, a laptop computer, an electronic music/video device, a digital game device, a personal digital assistant (PDA), and a smartphone. 55% had four or more of these, and finally 22% had at least five. On the whole, female students seem to be less eager to carry a large number of digital devices with them.

Figure 6. Number of different types of digital devices owned



Source : ECAR, 2007. The options listed included: a cell phone, a desktop computer, a laptop computer, an electronic music/video device, an electronic game device, a personal digital assistant (PDAA), and a smartphone.

Results from a recent comparative study between one American and one Australian university (Adams, Banks, Chase, & Herrod, 2007) show a similar pattern in both cases terms of technology ownership, with slightly more undergraduate students owing a computer (between 96% and 98%, depending on the university) than a cell phone (between 95% and 96%), and far more having a digital camera than an electronic music device. The Australian results are consistent with an earlier study at the University of Melbourne (Gregor Kennedy, Krause, Judd, Churchward, & Gray, 2006).

Intensity of use

A second important point regards the intensity of use, *i.e.* how often digital devices are used. Once again, new millennium learners are expected to be so adept with digital media that the intensity of use can hardly be matched by any other activity other than attending courses.

The current pattern of online activity by higher education students in the United States shows an average of 19.6 hours per week devoted to work, education, or recreation, with a minority devoting more than 40 hours per week (7.4%) which is roughly a full working week (Salaway, *et al.*, 2008). Certainly, the figures might be not so high in other OECD countries. For instance, the results of the Numedia research on the so-called "digital diet of university students", drawing on a representative sample of Italian university students (Ferri, *et al.*, 2008) present a slightly different picture, with more than a quarter accessing the Internet more than 20 hours per week, but roughly a third of all students less than 5 hours per week – on the whole far less than the students in the United States, but still with a quite significant amount of time. Earlier data, from 2003, obtained from eight universities from six different European countries (United Kingdom, France, Czech Republic, Italy, the Netherlands and Germany) revealed that 42% of their students used the network for at least four hours a day (Flather & Huggins, 2004).

What is technology used for?

But probably the most relevant aspect relates to the actual use of technology, *i.e.* what the Internet is used for and what the most prominent activities are. Once again, the scarce existing evidence supports the view that students followed the expected new millennium learner pattern in that their entertainment, social and personal communication and the ways in which they perform their academic tasks are clearly pervaded by technology.

The latest available data come once again from the United States, and are presented in the accompanying table. As it could be expected, two activities have been already universal since 2007 among higher education students: emailing and word-processing[6]. Although there is not much information about the uses of email facilities, the Europaeum survey (Flather & Huggins, 2004) revealed that university students appear ready to use email for communication with staff and fellow students they study with (77%), friends (83%), and university administrative staff (59%). Although there is no surprise in seeing that the main recipients of students' emails are friends and fellow students, there is certainly something new in the fact that emailing with university administrative staff ranks so high, which indicates that there is a point in introducing technologies to facilitate administrative efficiency at universities.

Table 2. Student computer and Internet activities

In US higher education institutions

	Students engaged in 2007 (%)	Students engaged in 2008 (%)	Median frequency of use
Create, read, send emails	99.9	-	Daily
Word processing for coursework	98.6	-	Several times a week
Use the institution's library website	94.7	93.4	Weekly
Presentation software	91.7	91.9	Monthly
Spreadsheet	87.9	85.9	Monthly
Social networking sites	81.6	85.2	Daily
Text messaging	84.1	83.6	Daily
Course management system	83.0	82.3	Several times a week
Download web-based music or videos	77.8	77.3	Weekly
Graphics software	72.3	73.9	Monthly
Instant message	-	73.8	Several times a week

Source : Own calculation on the basis of ECAR, 2007, 2008. Only those activities in which more than 50% of students are engaged are presented here. (-) data not available for that year.

Other than these, it is interesting to see the mixture of activities ranking with high levels of student engagement since they include both those which can mostly, if not only, be related to academic work with others which can possibly be linked to entertainment almost exclusively. Among the former it is really impressive to see the high levels of access to the library website, mostly on a weekly basis, as a natural development of the growing availability of academic resources in digital formats only, and the even higher use of course management systems – which are becoming increasingly a mandatory campus commodity. The same applies to British first-year students (Ipsos Mori, 2008), among whom 79% access course-specific materials at least once a week and 97% of these find it useful. Among the latter, the only noticeable increase in one year corresponds to the use of social networking sites such as Facebook. Such a pre-eminence of social applications can be also seen in British first year university students, even to a higher extent with 91% of them declaring a frequent use (Ipsos Mori, 2008). Again, a similar picture can be seen in Australia, with quite an impressive percentage of students using frequently the university learning management system to access course/related materials (81%) (Gregor Kennedy, *et al.*, 2006). European students, however, do appear to spend more time using the Internet for personal or entertainment activities than formal academic work (Flather & Huggins, 2004). Some 42% use the network for such purposes for four hours, or more, a week. This compares with 91% of students who use it for less than one hour a day to retrieve course or lecture materials.

6. In view of this it was decided not to ask anymore about these two activities in future surveys. This is way the 2008 survey does not contain information about any of these two activities, under the assumption that all students carry them out.

The conviction that Web 2.0 applications would transform Internet users increasingly into content producers (OECD, 2007) is also confirmed on the basis of this data. More than one-fifth of US higher education students are actively contributing content to blogs, wikis, photo or video websites such as YouTube, and 18% contribute regularly to at least three of these – although almost 39% declare not to contribute to any of these. While the pattern of Australian and British students seems to be equivalent to the one in the United States (Gregor Kennedy, *et al.*, 2006), Italian university students appear to be even more attached to blogs, with up to 42% of them contributing regularly to their own and 78% reading often others' blogs (Ferri, *et al.*, 2008). Another two areas where the differences between Italian and US students seem to be non-existent are text messaging and instant messaging, as the table 5.3. presents. Accordingly, it may well be that the differences in the digital diet of new millennium learners are not so high all over OECD countries.

Table 3. Percentage of students emailing, contributing to blogs, using text and instant messaging across countries

Australia (Melbourne, 2006), Italy (Milan, 2008), United Kingdom (first year students, 2008) and the United States (higher education, 2008).

	Australia	Italy	United Kingdom	United States
Emailing	94	100	100	100
Own blog	21	42	28	21
Text messaging	84	79	na	84
Instant messaging	80	82	83	74

Source : Kennedy *et al.*, 2006; Ferri *et al.*, 2008; Ipsos Mori, 2008; and ECAR 2008.

Back to the US example, it is also revealing to look at the actual levels of use of two more activities for which there has been a rising interest in the recent years. The first one is online multiuser computer games, in which almost a third of the students, mostly male, participate on a monthly basis. This is certainly a high figure but probably not as high as it might be expected particularly in view of the frequency of use whose median equals to a monthly value. Although no more information is available, it is likely that only a minority of students play these kinds of games on a daily basis. Even lower is the percentage of students who declare to participate in online virtual worlds, such as Second Life for which such hype and expectations regarding their value for higher education were developed only a short time ago (Chittaro & Ranon, 2007; De Lucia, Francese, Passero, & Tortora, 2009; Di Blas & Poggi, 2007). The actual percentage of users of these 3D virtual worlds among higher education students is less than 9%.

All this seems to indicate that students increasingly are gravitating towards more personalised technology which also allows great personalisation and is both mobile and privatised communication (*i.e.* no longer campus bound) (Langridge, 2003; Williams, 1997). This may signal shifts in relationships towards more enclosed personal relations which will have implications for the way students may engage in the future as integrated participants within higher education institutions. Students seem to be moving along a "life path within a shell of privacy", obeying the educational traffic rules but making contact only with other shelled individuals only as and when necessary. As Adams *et al.* (2007) have stated, this creates quite new challenges for university administrators when thinking about their student communities and how to contact them.

Not all higher education students are equally new millennium learners

A final and very important point has to be made about the risks students in higher education homogeneously as new millennium learners. Most of the few available surveys results emphasise the average values and thus convey a quite homogeneous picture of higher education students, but as a recent

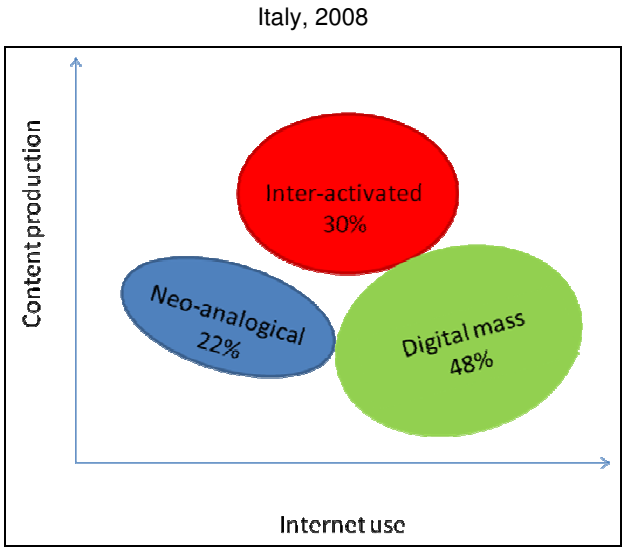
CERI report (in press-a) has emphasised in the case of secondary school pupils there are different profiles of new millennium learners, according not only to the amount of time spent with technology but also to the main activities carried out.

To begin with, at least in a number of OECD countries, an important part of the student body is constituted largely by people older than assumed. This accounts for as high as 40% of any student cohort, who might be older than 25 and certainly not responding to the stereotype of a new millennium learner, as this percentage certainly includes people with full or part-time jobs and sometimes family obligations.

It is true that when the observations are restricted to young new entrants, aged around 20, contrarily to what it might be expected, differences in the amount of use according to gender or age are minor, but they become relevant when the majors are considered. Not surprisingly, in the United States engineering majors are the ones using the Internet most often (mean of 25 hours per week) and those in education show the least use (mean of 17.6 hours per week) – which points again to significant differences in course requirements and teaching methods in different disciplines. Exactly the same is true of Australian university students, again with those majoring in education at the lowest level of the scale of use (Gregor Kennedy, *et al.*, 2006)[7].

Other than this, it is easily arguable that different profiles of students *vis à vis* technology coexist. A study at the University of Melbourne (Gregor Kennedy, *et al.*, 2006) noted there is little empirical support for the stereotypical depiction of the digital native –wired and wireless 24/7. When one moves beyond entrenched technologies and tools (*e.g.* computers, mobile phones, email) the patterns of access and use of a range of other technologies show considerable variation. Another important exception to this overall emphasis on the homogeneity of students is the Numediabios study (Ferri, *et al.*, 2008), which concludes that there is enough evidence to support the existence of at least three different higher education student profiles. These profiles result from a crossed analysis combining two factors: intensity of Internet use and content production, defined as uploading content to sites like My Space, Wikipedia, YouTube and, more in general, activity in social networks, as the following figure reflects.

Figure 7. Different profiles of new millennium learners in higher education



7. CERI is currently developing a study on the use of technology in initial teacher training, whose origins are partly connected to the evidence of the reduced use of technology in schools of education.

Source : Ferri *et al.*, 2008,

This is quite important because such a diversity of profiles may be asking for quite different implications at policy and institutional level. The three profiles are characterised as follows:

- The digital mass, which accounts for almost half of the students, are heavy Internet users but not so keen of producing digital content.

- The neo-analogical, roughly a fifth of the students, produce some content but connect to the Internet less than the average student; in a way, they are not so dependent on Internet use as the digital mass.

- The inter-activated, roughly a third of the students, are the ones which better fit into the prevalent image of new millennium learners: heavy Internet users and quite frequent content producers.

To sum up, there are a number of indications suggesting that today's higher education students are most likely to be new millennium learners, growing steadily and already having a universal character in some OECD countries. However, there are limits to this. As a matter of fact, as it happens with learning styles, there are different profiles of students in relation to the uses of digital media. Therefore it would be an oversimplification to claim that all students in higher education are equally complying with the stereotype of the new millennium learners.

Implications on learning and learning expectations

Does the fact of being new millennium learners have any impact on the way students learn? Has this any implication on their expectations regarding higher education? Quite often these questions have been addressed by analysts and essay writers who have mostly drawn conclusions from observations or made educated guesses, but who have not always considered evidence resulting from empirical research.

This section is intended to highlight how much of what has been predicated from new millennium learners can really be backed with empirical evidence, and what else remains as a matter of fact still unknown. Three areas are considered below: cognitive skills development, social values and attitudes, and expectations about learning. Whether new millennium learners develop alternative cognitive skills, which eventually could require new forms of teaching cannot be ascertained on the basis of the existing evidence base. Research in this domain is still at its infancy and the conclusions that can be drawn from its results are quite limited. Second, the issue whether new millennium learners' lifestyles, values and social attitudes have changed somehow as an implication of their attachment to technology has been addressed by research only partially: it has focused mostly on the negative aspects, related mostly with the effects of videogames, and therefore the resulting picture is clearly unbalanced and incomplete. And finally, even more importantly, the answer to the question of whether new millennium learners' expectations regarding teaching and learning in higher education are challenging today's prevalent teaching practices is less clear and bold than the prevalent image would suggest. Students value technology insofar as it provides more convenience and lets them benefit from productivity gains in their academic or course work. But their preferences stay with face-to-face teaching: they expect technology to supplement this approach, not to change it radically.

Alternative cognitive skills

New millennium learners' continuous use of technology is thought to have important implications on the development of their intellectual competences and cognitive skills, up to the extent that some analysts claim 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 repeated behaviour will result in students being impatient if sources of information are not instantly at their fingertips, and they rarely spend long hours thinking about the same thing. As well as changes in attention spans, the implications of an intensive use of technology 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, it is assumed that new millennium learners have grown up used to:

- Accessing information mainly on non-printed, digital sources.
- Giving priority to images, movement, and music over text.
- Feeling at ease with multi-tasking processes.
- 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 higher education institutions – longer attention spans, reflective activities, and focusing intensely only on one activity typically involving some form of properly written text.

For example, the enormous amount of time that they seem to spend on video games[8] 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 students' 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.

As a recent OECD report shows (Centre for Educational Research and Development (CERI), in press-b), the lessons emerging from meta-analysis seem to be quite limited but strong. The evidence from research on the impact of digital media use on cognitive skills is difficult to generalize, as it is always placed in context and set in relation to a number of factors such as age, gender, socio-economic background, time spent in computer activities, preference for certain activities. However, the majority of inquiries in this regard examine how the intended use of digital technologies in the form of training affect certain skills, competencies and behaviours.

Although such evidence might not show how technology use changes young people in broad terms, there are at least two important lessons. First, there is solid evidence regarding the effects of technology on cognitive skills development, particularly visual-spatial skills and non-verbal forms of intelligence. Probably the largest part of the empirical research regarding the impact of digital media use on cognitive skills focuses on the development of visual-spatial skills and another frequent topic is the impact of digital media use on memory skills. But second, the research base to support claims of a positive impact of technology use on meta-cognitive skills is weak. Despite the evidence regarding cognitive skills, however, the most appealing domains as those on which technology could have positive impact – information processing, reflective and critical thinking, creativity and, in general, meta-cognitive skills – have not been documented by empirical research.

8 . In the United States 8-10-year-olds spend more than an hour a day with video games (Rideout, Roberts, & Foehr, 2005) and this use increases until the age of 35 years old.

However, it seems to be that not enough research has been carried out to test empirically the effects of technology on cognitive development. As stated in a recent report on research on the effects of digital media on children, "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). Most of the criticism in regard to assessing the impact on cognitive skills is connected with taking measurements immediately after practicing, while the cumulative effect of digital media is not sufficiently examined. Although the reviewed findings reflect a mostly intentional training of cognitive skills, and not the effects from everyday use of digital technologies, the same mechanisms can be expected to operate in natural settings. Thus, most of the uses of digital media involve complex processes and are influenced to a large degree by structural design features, perception and cognitive properties. However, constructing mental models and internalizing concepts from using different computer applications and the Internet also influences how young people think, approach tasks and socialize. One of the major questions regarding the role of digital technologies in young people's lives concerns how the socialization processes and social behaviour are influenced by the increasing spread and use of computers and the Internet.

Changes in cultural practices and social values

As it is often the case with intergenerational change, today's higher education students are expected to show different cultural patterns and lifestyles as compared to those of past generations. However, what makes those 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 their consumption of digital media can be said to be less controllable by adults, be those parents or teachers, since new millennium learners 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 – or chatting – becomes increasingly important due to the physical constraints imposed by the devices and services used, up to the extent of generating new languages.

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, today's students would be particularly hopeful, self-assured and determined, active (even stressed), and close to their parents (Phalen, 2002). And following these values, their academic performance would increasingly improve when compared to previous generations. Nevertheless, there seems to be no empirical evidence yet to support such expectations.

The truth is, nevertheless, that the availability of technology and some criticized features of digital content, particularly in videogames, such as the stereotyping of women and minorities and the enforcement of violence, have raised concerns about the long-term effects on the identity and social development of young people. Once again, the available evidence restricts very much the perspective. Drawing on it (Centre for Educational Research and Development (CERI), in press-b), it seems clear that the effects of digital technologies on socialization are both positive and negative, adding to an already complex picture of media exposure. In this respect, there is enough empirical evidence to sustain the idea that playing videogames which support violence or sexual stereotypes does have a negative effect on young people, particularly if the use is far from being moderate. On the one hand, it has been shown that time devoted to digital technologies adds to time devoted to other media and thus reduces time spent on family interaction or face-to-face peer interaction. On the other hand, time devoted to digital technologies gives rise to other forms of socialization in a third space, virtual by nature, which is less exposed to adult vision or supervision.

Expectations regarding teaching and learning

The argument of dramatic changes in students' learning expectations as a result of their being new millennium learners is quite often mentioned as one of the most powerful drivers for change in learning practices in higher education. It is at the same time clearly consistent with what has already been supported in the previous sections. However, this proposition can hardly be backed with evidence. Contrarily to expectations, students cannot be said to have changed dramatically their expectations: although they value the convenience and the productivity gains that they get with technology, their preferences still go for a traditional face-to-face teaching where technology improves current practices. The idea that students would be the strongest supporters of radical transformations in learning in higher education, as attractive as it may seem, cannot be supported by research evidence as per today.

A rationale for evolving expectations

It is commonly stated that students' 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, school 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 technology-mediated educational innovations and for most students schools were the only place where they could get 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, students' technology-related competences grew exponentially, even by self-learning as the last PISA survey (2006) revealed, largely outperforming those of their teachers.

The story has been somewhat different in higher education, where computers only started to generalise as teaching-aids with the universalisation of the Internet. Actually, computers made their apparition in universities mainly because of research needs, and later as substitutes to typewriters and mail postage, as well as crucial tools for administrative and financial management. But the first institutionally sponsored initiatives to foster the use of technology in university teaching did not emerge until the late nineties. To some extent their development was hindered by the effects of the erosion of the Internet bubble, which seemed to cut down the expectations of revenues coming from the commercialisation of courses.

Be that as it may, it is reasonable to assume that students' expectations have changed dramatically and are completely different from the ones held by their teachers, particularly regarding:

- The kind of technology devices and services available at their fingertips.
- The frequency of their use.
- The range of possible activities.
- The opportunities for collaborative work and networking.
- The communication skills involved (including a reinterpretation of written language).
- The degree of learning personalisation.
- The standards of digital quality, in terms of interactivity and use of multimedia resources.

Just to give an indication of the growing competences of university students 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 (A. Lenhart, Madden, Rankin Macgill, & Smith, 2007) and, as it has been shown above, this translates into a relevant proportion of higher education students contributing to blogs, photo or video sites, thus becoming content producers. This in turn may have an effect on their expectations – for instance, most British prospective university students (79%) would expect to have to take their own computer to university with them and be able to use it logging on the university network (81%) (Ipsos Mori, 2007).

Teachers' estimates of students' expectations

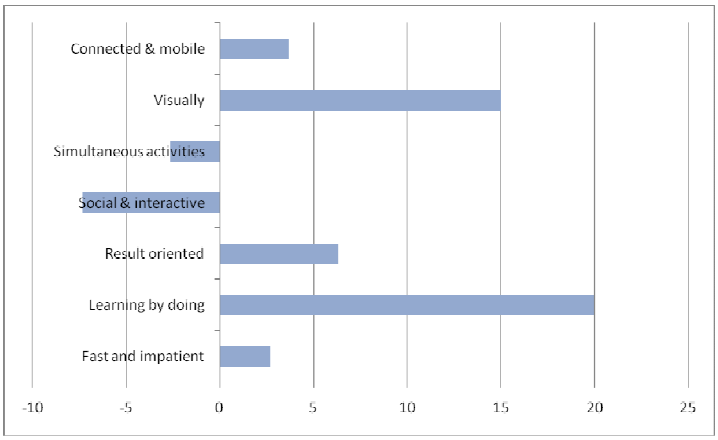
Bearing this in mind, it could be reasonably expected that today's students are more willing to use technology in learning activities than higher education institutions allow them to do. To what extent this contrasting situation makes them feel disappointed with teaching practices, or even increasingly disaffected from academic endeavours, has not been thoroughly investigated yet, but some indications exist pointing to a growing gap between students and teachers perceptions regarding the quality of the educational experience (BellSouth Foundation, 2003) and, moreover, how students conceptualize their new millennium learning styles and expectations and teachers' beliefs about these. In the end it turns out to be that teachers tend to overestimate the extent to which their students have new millennium learners type of expectations. This may be an effect of the estalishment of a dominant view which infers from students' current levels of digital media exposure a totally different approach to learning and radically new expectations when it comes to teaching, learning and the role that technology has to play in them. This is not the case –at least yet.

A clear indication of the level of such a disparity of views is reflected in figure 5.8., which is based on the results of a research project funded by the European Union, eLene-TLC (Lam & Ritzen, 2008)[9], covering six European countries (France, Germany, Italy, the Netherlands, Spain, Sweden). The figure presents the percentage of disagreement between how students see themselves and how teachers think of students, in a range of learning characteristics which are assumed to be attached to a new millennium learning style.

9. More information about this project at www.elene-tlc.net.

Figure 8. Percentage of disparity between university students' self-perceptions regarding their own learning characteristics, and teachers' views

Average values in six European countries (France, Germany, Italy, the Netherlands, Spain and Sweden), 2008.

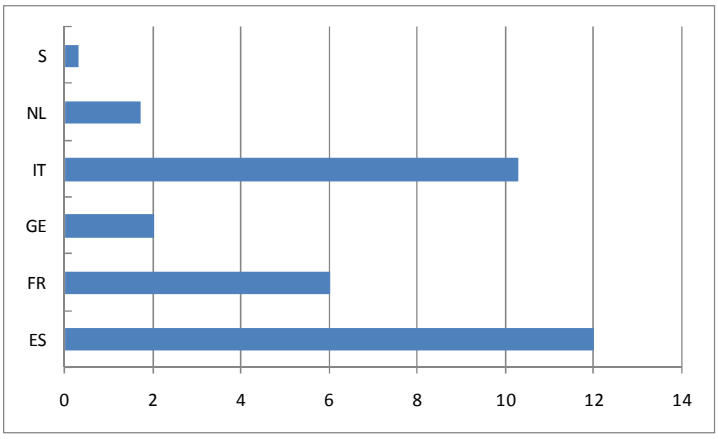


Source : Lam and Ritzen, 2008. Data are based on questionnaires administered in interviews. The percentage expresses the relative difference between teachers' and students' perceptions. Positive values indicate overestimates by teachers, while negatives indicate underestimates by teachers, in comparison to students' declared self-perceptions.

Teachers appear to slightly overestimate what students claim to be most of their learning characteristics usually attached to the concept of new millennium learners. The differences are high with respect to the willingness to benefit from learning by doing, and the preference for visual learning (20% and 15%, respectively). On the other side, teachers tend to underestimate only students' preferences for social and interactive learning as well as for carrying out several activities simultaneously – but the differences are much less significant. There are also important differences between countries, as figure 5.9. indicates.

Figure 9. Percentage of disparity between students' self-perceptions and teachers' views across countries

Average values per country, 2008.



Source : Lam and Ritzen, 2008. Data are based on questionnaires administered in interviews. The percentage expresses the relative difference between teachers' and students' perceptions. Positive values indicate overestimates by teachers, while negatives indicate underestimates by teachers, in comparison to students' declared self-perceptions.

It is in the Southern European countries covered in this study (France, Italy, Spain) where the disparities between students' self-perceptions and teachers' views of these are the highest. On the whole,

the disparities in Germany, the Netherlands, and Sweden are almost irrelevant. To sum up, the comparison between students' self-perceptions and teachers' views about students' learning preferences and styles seems to suggest a clear degree of teacher awareness of those preferences, and even a certain tendency to overestimate some of them. Therefore, teacher awareness appears to be already in place, with slight differences depending on country.

Are students more reluctant to technology adoption in teaching than expected?

On the whole, however, there is little empirical evidence regarding the so often assumed shift in students' demands. Although student surveys have been in place for a long time in a number of OECD countries, including Australia, France, the United Kingdom, or the United States, the issues related to expectations regarding technology in teaching have not been taken into account except in surveys where the main topic is precisely technology adoption[10]. International comparative evidence is even scarcer, and sometimes the nature of the methodology used does not allow room for generalisations. However, there are a few studies, with very limited and not representative samples, which might be taken as indicative of what could be going on.

What emerges from available data is that students appear far more reluctant to technology adoption in teaching and learning than their levels of digital media exposure would suggest. In general they welcome uses and applications that are intended to provide more convenience (for example, access to course guidelines, notes or background documents) or improve their productivity in academic tasks (for example, online databases or virtual libraries). Other than this, they advocate for a use of technology in teaching which supplements rather than changes the traditional models, and they certainly show a clear preference for face-to-face teacher or tutor relationship over computer-mediated communications.

To begin with, the main reasons for which students may be keen for use of technology in their courses are not so related to their willingness to see teaching and learning radically transformed as to the added value of convenience. This was already pointed out by Caruso and Kvavik (2006) who found that the most valuable reason for using technology in courses is precisely convenience (51% of students), followed by the ability to manage easily course activities (19%), and to a much lesser extent the opportunities to enhance learning (15%) and to communicate with peers and teachers (11%). Accordingly, from the student perspective technology is useful because of the convenience and control it provides, rather than for its transformative power.

Not surprisingly, overall European students clearly appear to want to see more use of technology in their courses although a significant number, roughly one-fifth, remain unsure (Flather & Huggins, 2004). This may be suggesting some concern that the benefits of improved communication may also lead to less direct contact with staff, with remote or distance learning replacing some traditional teaching methods but also that the way in which technology is actually being used by instructors is actually asking students to do even more things or even unexpected or not well understood activities whose added value is not clearly seen by them – or not well explained by instructors. Another European study (Spot+, 2002) found that although university students held a fairly positive view of the different advantages that ICT can bring to learning and education, they had also a similar positive attitude towards learning with traditional education methods and one which questioned the value of ICT in education. A closer inspection of the answers on the individual questions reveals that university students were especially interested in the use of ICT for purposes of information exchange, such as "to ask questions of experts and relevant people no matter where they are" and "to share information and ideas with people who have similar interests". With respect to explicit learning purposes the students expressed a stronger preference for traditional education methods (defined as printed text and a classroom setting) than for ICT-based methods. In many ways it may well be

10. For a comparative analysis of some of these surveys see Higher Education Academy (2007).

that student expectations regarding technology adoption in teaching are less supportive of innovations than it is commonly taken for granted. There are clear indications that their main assumption is that teaching is about conveying knowledge from the teacher to the learner, from a position of authority. If ICT is to be used in an educational context, students specifically expressed doubts about the quality of the human interaction when there is no face-to-face contact. Moreover, 21% of the respondents indicated that they did not know whether 'small-group learning may become disorganized in online courses', 14% did not know whether "learning with ICT is very time-consuming", and 13% did not know whether "ICT can improve their learning". A recent survey of prospective students in the United Kingdom found that four-fifths (80%) felt that the quality of teaching at university was more important than the IT provision (Ipsos Mori, 2007).

This is seen across the board – high or low ICT use does not necessarily correlate with perceived importance of quality of teaching over ICT provision. ICT is seen as a supplement to teaching, not as a substitute for the personal interaction to which they are used. This might indicate that, due to the lack of experience with ICT, students expressed themselves rather cautiously about its use in education, leading them to state a higher preference for traditional education methods, which are well known to all students. This means that students leaving secondary school and entering the university have a stronger preference for traditional education methods and a more negative attitude towards using ICT than students who are a few years older and have already passed some years at the university or in work. It could be said that prospective students think of technology improving their learning through giving them more access to data and research resources, rather than imagining totally new methods of teaching, learning, or interacting with peers and lecturers. This mirrors their understanding of how ICT works at school and home – and it also mirrors the experience they have had so far at school, a traditional teacher and pupil environment. They find it hard to imagine other kinds of interactions and engagements. So, when British prospective students were asked about being taught by lecturers, the traditional teacher/pupil environment was preferred. As the report concludes, "the face-to-face teaching quality was felt to be the most visible sign of the university's value for money – it's what they believe they are paying for" (Ipsos Mori, 2007, p. 25). In fact, it may well be concluded that prospective students in the United Kingdom are convinced of the benefits of technology adoption in universities, but provided that it is used to support established methods of teaching and administration, and not to change them dramatically; to act as an additional resource for research and communication; and to be a core part of social engagement and facilitate face-to-face friendships at university. A companion study done also in the United Kingdom one year later with first-year students found that face-to-face interaction is still seen as the best form of teaching, fitting well with the prevalent student view about what teaching should be. Therefore they may feel uncomfortable when teachers try to relate to them in a flat, non-hierarchical structure (*e.g.* getting involved with personal Facebook accounts). However, the use of ICT in teaching is now perceived to be a good thing, but only as long as it is done well. Face-to-face interaction supported by inefficient or inept use of technology is worse than using none (Ipsos Mori, 2008).

All this is totally in line with observations made, for instance, by Oblinger and Hawkins (2005) who argued that "the assumption that students want more technology may not be valid: especially younger students are less satisfied with complete online learning than older students. The reason appears to tie to their expectation of being in a face-to-face, social environment". Under a similar vein, Zemsky and Massy (2004) stated as well that "students do want to connect, but principally to one another; they want to be entertained, principally by games, music and movies; and they want to present themselves and their work. E-Learning at its best is seen as a convenience and at its worst as a distraction –what one student called *the fairy tale of e-Learning*". As a recent British report has signalled, "students do not fully understand how ICT and learning can work together. They imagine and like the idea of the traditional, Socratic, or chalk and talk methods with face-to-face learning" (Ipsos Mori, 2007, p. 31). As a result, the inherent assumption according to which because students are so attached to technology in their everyday lives this warrants

their full endorsement in teaching and learning, has to be contested. The least that can be said is that it is unclear that students want their everyday technologies to be adopted in full as learning technologies.

Therefore it is not surprising that European students also appear divided over the contribution that the increased usage of technology may make to the critical and intellectual abilities of students. Less than one out of ten (8%) respondents strongly agreed that ICTs encouraged independent learning, whilst 9% also disagree with this statement.

Moreover, as Kennedy *et al.* (2008, p. 4) have pointed out, "it is not clear that emerging technologies and students' everyday skills with them will easily translate into beneficial technology-based learning". In other words, the fact that they are digitally literate does not imply necessarily that they are capable of employing technology strategically to optimise learning experiences and outcomes. As it can be read in the preface by Katz to the ECAR 2005 study (Caruso & Kvavik, 2005, p. 7), "freshman students arrive at our institutions with a set of electronic core skills. Such skills include communications (telephone, email, text-messaging, and IM), Web surfing (not to be confused with research skills), word processing and video gaming… These young people can make technology work but cannot place these technologies in the service of (academic) work". In fact, higher education teachers may be expected to help students to employ technology more strategically, but do students want it?

How far are higher education institutions responding to the emergence of new millennium learners?

It would be an impossible task to find a higher education institution in the OECD area not claiming to be doing its best to benefit from the opportunities offered by information and communication technologies. This section examines the broad policy lines along which higher education institutions have been dealing with technology adoption. Particular attention is given to the strategies devoted to foster technology adoption in course teaching. Contrarily to the common assumption of teachers being reluctant to this, there appears to be that the degree of use in teaching is higher than the fact of their being digital migrants[11] would suggest. Finally, the issue of country differences in this domain is analysed by bringing into the picture the relevance of the prevalent teaching methods that are embedded into national traditions of higher education.

Technology adoption by higher education institutions

The basic goals higher education institutions pursue when adopting ICT-enabled learning platforms usually refer to (Pedró, 2003): a) the revision of the institution's organizational culture as to adapt its identity, mission and vision to the changing needs of society, economy, and politics; b) the facilitation of communication among all the members of the university community; c) the improvement of access to managerial applications and university services; and d) the provision of a quality learning experience to students.

This is actually happening in four main domains:

- *Institutional PR* on the Internet is a must. Higher education institutions have been setting up institutional websites and portals not only to better communicate but also to attract interest and attention from prospective students;

11 . The distinction between digital natives and digital migrants was introduced by Prensky (2001a) to suggest the difference between the generations which have always seen digital media surrounding them and those who haven't, but have migrated by adopting them while being adults. Generationally most teachers can be expected to be digital migrants.

- *Management, administration and funding* are clearly the areas where higher education institutions, as large organizations, have been investing more in terms of technologies, since the return is clear and apparent.

- *Research* has also been benefitting from the widespread use of digital information, both for dissemination and for access to relevant literature and findings. University libraries have actually changed to a digital mode where cataloguing and stocking is less relevant and frequent than organizing information and assisting users in their searches.

- *Teaching and learning* seem to be the less explored areas and those where the returns of the investments are less clear. By now it is likely that every higher education institution in the OECD area has set up a learning management platform, be that commercial or open source.

The issues and developments related to the latter are analysed below.

Universities seem to have made impressive progress in all these domains, with the exception of the teaching and learning. In a European survey of universities it was found that already in 2004 that 9 out of 10 European universities had intranets, primarily being used to make administrative information available, such as grades, examination schedules or course-related information like curricula, work plans or assignments (PLS Ramboll Management, 2004). However, the use of intranets to provide interactive digital services such as online courses and examination registration was not particularly common, with only 5 out of 10 European universities making it available for either some or all courses. The study clearly showed that the general level of integration of technology in teaching had increased greatly, with three out of four universities experiencing a high level of increase in this regard. However, considerable variation exists in this area. Most universities were still at the stage where the use of technology consists of treating the computer as a sophisticated typewriter and as a means of facilitating communication via traditional pedagogy and didactics in the actual teaching situation, *e.g.* through the use of presentation programs, databases or simulation modules.

Institutional policies and developments regarding technology in teaching

In the particular domain of teaching and learning higher education institutions have been struggling for some years to provide the adequate conditions to cope not only with the technology requirements of some disciplines, both in the scientific and professional domain, but also with what has been taken increasingly as a customer demand for an increased availability and use of technology in campus as well as online.

Looking backwards it is easy to see that higher education institutions across OECD countries have followed a similar path to the integration of technology into teaching. Broadly speaking, there are a number of pathways which can be seen repeatedly here and there, and most often run in parallel:

- Infrastructures and access;

- Classroom equipments;

- Virtual learning environments;

- Student support;

- Teacher training and support; and

- Digital contents and resources.

To provide the necessary infrastructures and grant access is a prerequisite for all the rest. The policies regarding access seem to have evolved from an initial phase where access points were available only in the then considered to be suitable spaces, such as the libraries and dedicated computer rooms or labs for public access, to another phase intended to promote access under the anytime, anywhere formula either by cable of Wi-Fi networks, assuming that students have access to a personal computer at home or simply carry with them a laptop all the time.

A second line of investment has focused on classroom equipment, assuming that teachers would need access to a computer and a projector to present their lesson materials, mostly slides. Increasingly the concept of classroom equipment has included also a connection to the university network and to the Internet. A number of institutions are currently experimenting with interactive whiteboards and introducing them as a more sophisticated extension.

A third line emphasises the opportunities created by virtual learning environments, which in some cases were initiated merely for e-learning purposes but are increasingly considered nowadays part of the standard set of learning tools that every university student should have. Virtual learning environments, digital campuses, e-learning platforms, learning management systems are proliferating here and there, with different options which include: self-developed platforms and applications, commercial products, and increasingly open source solutions. Even when the latter is preferred there are important costs attached to them, in terms of connectivity to existing institutional databases and applications, and support. On the whole, the idea is to facilitate every student with an anytime, anywhere intranet where it is possible to deal with administrative issues, university services of all kinds and, of course, access to course materials, digital resources and some tutorial or instructional support. Already in 2003 these kinds of intranets were so popular that only 14% of the students in eight different European universities had never used them (Flather & Huggins, 2004). In parallel to this, many institutions have explored the domain of distance education by way of incorporating e-learning activities and programs to enhance their outreach, with a clear expectation of maximising the benefits in a highly competitive market which has become increasingly globalised. In many respects, however, the initial hype gave rise to a more selective approach (Centre for Educational Research and Development (CERI), 2005) which resulted in many institutions having to revise their strategies (Bray, Harris, & Major, 2007).

As a consequence of all these investments, higher education institutions have had to expand the availability of technical support also to students, which was not available beforehand. In many cases, this increased need for support, which is not only technical but also related to use, has implied the consolidation of the existing university libraries and IT services into one unified support service which can cope both with technical problems and requests for tutorial assistance, often being supplied by more experienced peer students.

One of the most difficult issues has been teacher training and support. Although the tools for helping academic staff to grasp the opportunities to improve the quality of teaching being offered by technology have been always at hand, ranging from self-paced training materials to peer training and support, the crucial issue has been how to create the adequate incentives for real use in classrooms and outside, through the virtual platforms.

Finally there is the issue of digital contents, usually small pieces or chunks of information that can be of use when teachers build their own digital study materials or courses (Van der Wende & Van de Ven, 2003). In this respect, there is an increasing trend, if not a whole movement, in favour of the production and use of open educational resources whose nature seems to be, according to their advocates, not only

more suited to the collegial nature of university teaching but fit better into the principle that access to knowledge should be democratised (Centre for Educational Research and Development (CERI), 2007).

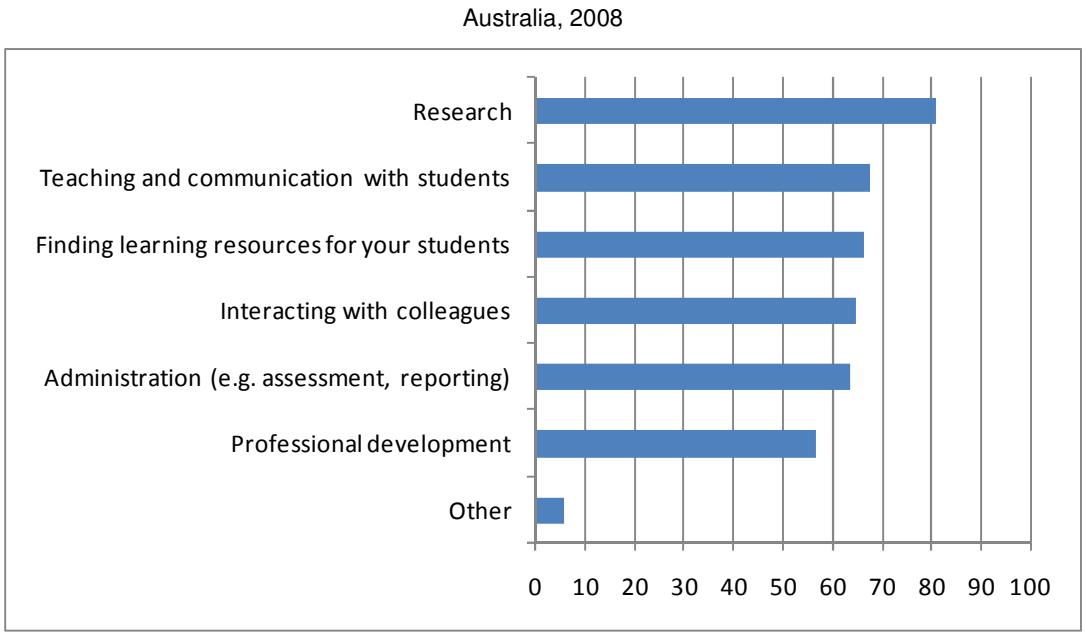
Teachers' response

It may well be true that when it comes to technology adoption in teaching in many OECD countries the progress made at university level clearly outperforms the realizations made in the lower levels of the education system[12]. Not only are university students increasingly using technology in their capacity as students to find and collect relevant information, to process it and to transform it into knowledge, but their instructors also seem to keep up to the promises in doing their best to incorporate technology to facilitate if not learning at least a number of activities that surround it, such as for instance access to study materials, course notes, guidelines for coursework, recommended reading lists and the like.

As a matter of fact, the assumption that most teachers in higher education are digital immigrants might be true only on the basis of their age, but certainly not regarding their technology skills and competences. For a number of reasons, including the important role that research plays in academic development, which increasingly requires a mastery of technological tools such as digital databases and libraries, most academics may have a quite impressive attachment to technology although not necessarily to do the same that their students do. It is important to realize that when compared to primary and secondary school teachers, higher education teachers tend to be well equipped and behave as heavy users of technology. Interestingly, the Europaeum survey found that in 2003 staff were more frequently networked from home than students, 83% possessing access to email from home, and 52% having direct access to the university campus intranet at home. Needless to add, ownership of computers by staff was very high (95%), with 91% reporting that they use email to communicate with academic colleagues, 86% with administrative staff, 78% with students, and 78% with friends. One out of two staff report regular accessing of the campus intranet while almost 10% claim that they never access this part of the network. Of course, all this might be the outcome of their careers being so attached to research, and thus to technology to access sources and process information, and probably less as an implication of their teaching and learning assumptions –although it may well be the case as well. A very recent Australian survey (Education Network Australia, 2008) found out that 90% of higher education teachers considered the Internet as very important for their work and, interestingly enough, it was not only for research purposes but also for improving teaching and learning opportunities and resources for students, as the figure below shows.

12 . Although this appears to be a bold statement, it is important to note that the level of granularity of data regarding technology adoption and use in teaching in higher education is, at least in a number of OECD countries, extremely high in comparison to the equivalent in the schools sector, for which such a level of detail does not exist at all. The different level of data availability is thus a clear indication of the degree of interest in the issue.

Figure 10. Percentage of higher education teachers who use the Internet for specific tasks

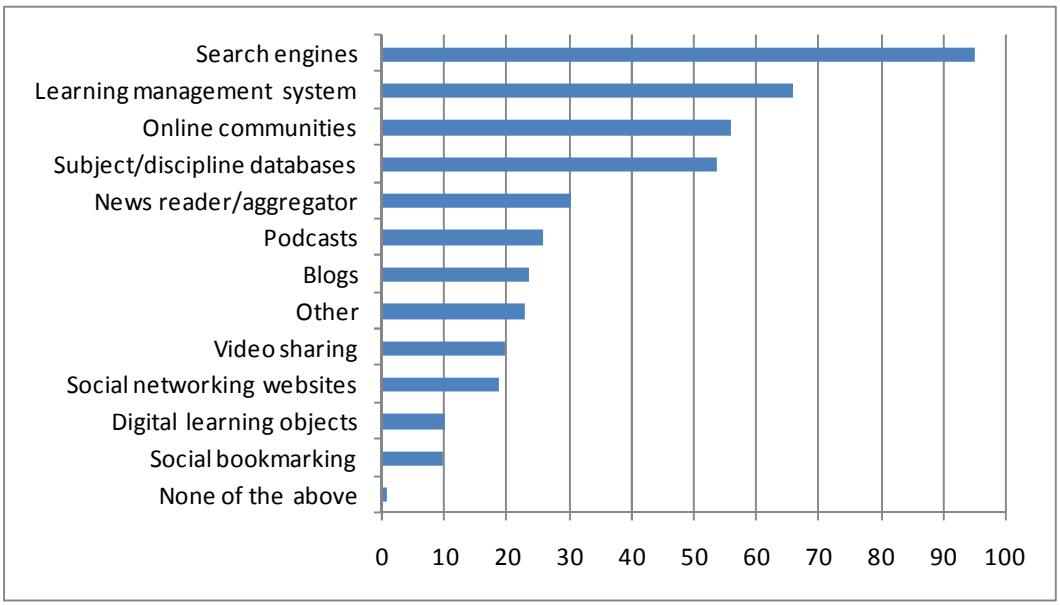


Source : Edna, 2008.

When it comes to the most frequently used online services, the profile of Australian higher education teachers shows precisely the combination of three different activities: research-oriented activities (searching subject or discipline databases), teaching-oriented activities, and activities related to community life. Clearly, the most frequently used application is a search engine, but immediately after this it comes the university's learning management system, which gives an indication of the impact of technology on teaching and learning. Certainly, some of the applications can be said to serve multiple purposes (*e.g.* a search engine), but the reference made to digital learning objects (mentioned by 10% of the teaching staff) is an additional indication of the importance of the digital dimension in teaching and learning in higher education.

Figure 11. Most frequently used online services by higher education teachers

Australia, 2008



Source : Edna, 2008.

As it was said when describing the different profiles of university students, it is clear that not all university instructors are eager to adopt technology in their teaching. The Europaeum survey (Flather & Huggins, 2004) found three types of them:

- *enthusiasts* (12%) who claim to spend three or more hours a week publishing online course materials while the majority of staff (58%) spend one hour or less undertaking this;
- *pragmatists* who see the value for both students and staff and feel reasonably comfortable with increasing use; and
- *skeptics* (17%) who still have a reluctance, and some even antipathy, to them.

The actual applications and uses of technology by teachers in higher education may not be all impressive innovations. Rather, it appears to be that "faculty have typically used advances in information technology either to automate conventional forms of instruction or to make small steps in expanding the range of communicative and experiential patterns we accommodate" (Dede, 2007). In so doing they are trying to replicate the productivity gains that they have obtained from an intensive use of technology in their research and managerial tasks, as well as the accompanying convenience and commodity.

Differences across countries

It may be taken for granted that not all universities or countries have implemented these developments equally at the same speed. In particular there seems to be a clear gap between the majority of higher education teachers in continental Europe and in Anglo-Saxon countries, where developments have been faster and pioneering in many different ways.

When comparing for instance the above-mentioned profiles with the ones emerging from a recent Australian survey (Education Network Australia, 2008), it becomes clear that the majority of Australian higher education teachers are convinced that they already possess the ICT capabilities required to transform practice, especially by means of introducing new ways of engaging students (29%) or are proficient and confident in the use of ICT to support learning out (37%) – only one-fourth of Australian higher education teachers consider themselves either with foundation or emergent ICT capabilities to support teaching and learning. Roughly two-thirds of Australian higher education teachers use frequently learning management systems, which compares badly to an equivalent one-fifth in European universities. Similarly, a pioneering work, drawing on an international survey, conducted by Collis & van der Wende (2002), tried to establish some kind of ranking of countries regarding the use of technology in higher education. According to them countries like Australia, the United Kingdom and the Netherlands would rank higher in comparison to Germany or Norway[13].

There are four main reasons for this gap between continental European and Anglo-Saxon universities, related to the technological context, the investing capacity of institutions, competence and predominant approaches to teaching and learning.

First, the technological context of the country matters a lot. To what extent prospective students, their families, and the firms they work for have easy access to ubiquitous technologies, or even depend on them for a number of goals, can certainly contribute to explain why some university systems may find it really more imperative to invest in technology for user-related purposes. It is simply a reflection of how society, and therefore teachers and prospective students, expects technology to be used. Although it would be very interesting to try to investigate the correlation between level of technology use in university teaching and digital literacy of the general population, lack of data prevent from doing it. However, a representative survey conducted some years ago in the European Union member countries (15 countries at the time of the survey), Switzerland, and the United States revealed clearly that the overall situation in terms of digital literacy[14] was dramatically different in the latter, as well as in the United Kingdom and Denmark – this one showing an index three times higher than the lowest in an European Union member country, *i.e.* Portugal (Danish Technological Institute, 2003). Figure 5.12 also shows that on average the level of digital literacy of the population in the United States is almost double the one in the European Union[15].

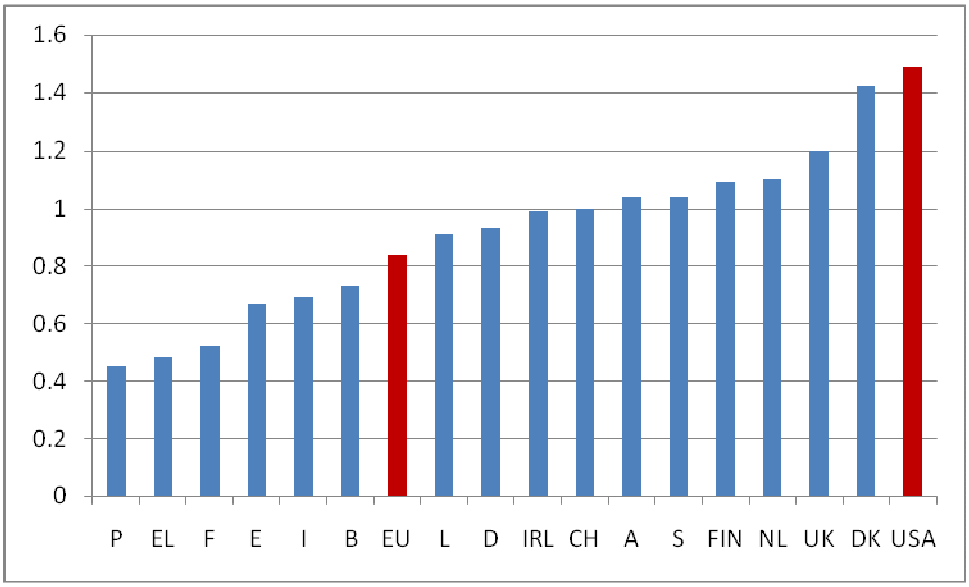
13 . However, the ranking exercise was drawing on the responses to a survey, mostly by higher education teachers and not by an analysis of objective data or indicators.

14 . For the construction of the indicator, digital literacy results of the measurement of competencies, indicated by ability to use the Internet for, four different areas: a) communicating with others; b) obtaining (or downloading) and installing software on a computer; c) questioning the source of information search on the Internet, and d) searching for the required information.

15 . A parallel exercise was done by the Economist Intelligence Unit (The Economist Intelligence Unit, 2003), leading also to similar results in terms of country e-learning readiness, with the United States at the top of the ranking, closely followed by the United Kingdom.

Figure 12. COQS Index of digital literacy of the general population

European Union, Switzerland, and the United States, 2002



Source : Sibis, 2002 GPS Base.

Second, there is an important cost attached to investments in technology and the rates of expenditure per student, and inevitably the fees, if any, are quite different. The investment capacity of many continental European universities depends heavily on direct State support, whose political priorities in higher education might be more focused on research than on improving teaching[16]. In the Australian survey of higher education teachers the main reason given for not using technology to its full potential (30%) was poor infrastructure, bandwidth, equipment reliability and access, so they are actually ready to do more than the current infrastructure allows them to do. In some OECD countries governments have contributed to the development of a national strategy regarding the use of technology and the promotion of e-learning in the university sector, such as in Austria, Finland, France, Germany, Greece, Luxembourg and Portugal, while others have no such strategies or have them integrated into wider ones (PLS Ramboll Management, 2004). The priority and attention given to technology integration and e-learning which exists at the central level (*i.e.* among either the national ministries or the regional authorities) is an important driver. This can be mediated via national institutions or nationally supported programmes. National institutions like JISC in the UK and the SURF Foundation in the Netherlands, and national programmes such as the UKeU and the Campus Numérique in France, have played a very important role in co-ordinating and initiating large-scale projects which the universities cannot undertake on their own. Also some countries like Finland, France, Sweden, or the United Kingdom decided to create their own national virtual universities, which not always succeeded (Garrett, 2004).

Third, continental European universities do not compete to attract students in the same ways that American universities, for instance, do. The residential campus experience is far from being as frequent in continental Europe as it is in Anglo-Saxon countries and therefore European higher education institutions might be not so inclined to offer the same range of technological facilities that can be found in other

16. In a pioneering dissertation, Boezerooij (2006) suggested that there are both external and internal contingencies that can help to explain which kind of strategy on the use of e-learning higher education institutions are adopting. Interestingly enough the two above mentioned factors, the technological context and the investing capacity of institutions, ranked very high in her empirical analysis.

countries, or at least haven't been so quick in equipping their campus with the technological facilities that they figure out that students are requesting. In universities with a higher residential population, it might well be that study and recreation often blend in together as overlapping time. This different approach to technology according to the residential or commuting nature of the campus is clearly seen in a comparison between American students in a residential campus and Australian students in a city campus, which found that although in terms of technology ownership they were quite similar, the patterns of use were completely different, with American students devoting far more time to entertainment and communication, and particularly to social applications such as MySpace or Facebook (Adams, *et al.*, 2007). Similarly, technology requirements of European students might on the whole be very different from their American counterparts. A survey conducted in eight European universities from the Czech Republic, France, Germany, Italy, the Netherlands and the United Kingdom, throughout 2003 concluded that European prospective students do not consider the importance of ICTs in their choice of either university or course (Flather & Huggins, 2004). More recent data from the United Kingdom regarding prospective university students unveiled that half of them had looked or asked about the technology facilities provided by the universities of their choice (Ipsos Mori, 2007), but a majority of the students did not consider this to be a critical aspect. So, in fact, technological facilities for general use do not act as an incentive to attract students as they probably do in the United States.

Finally, despite the efforts made so far under the framework of the Bologna process, the fact is that the predominant approach to teaching and learning in continental European universities seems to be much more depending on lecturing than on interaction. This difference in approach might be the result of different factors, ranging from larger classroom sizes or of a teaching paradigm which stresses less the importance of teacher communication and didactic skills, or of the combination of these factors altogether.

Conclusions and a look ahead

From the confrontation between the prevalent assumptions about higher education students as new millennium learners and empirical evidence four key messages emerge. These regard both students and teachers:

- **Students in higher education are heavy users of digital media**, so in that respect they can be conceptualised as a generation of new millennium learners. However, there is a variety of student profiles when it comes to the intensity of attachment to technology or the variety of uses. All of them are already in higher education institutions and it would be discriminatory to develop policies considering just one of the different profiles.

- **Students want technology to improve teaching and learning, not to change it radically.** They value technology adoption in teaching and learning provided that it improves convenience and productivity in academic and course work. Teachers' perception of students' expectations regarding learning tend to overestimate the degree of affection to course adoption of technology. In this respect that the image of the new millennium learners goes far beyond what the reality of today's students' expectations is. There are no indications that this will change in the short run.

- **Teachers in higher education are far from being digital immigrants.** The adoption of technology has contributed to transform academic work and, slowly than in other areas such as research, is clearly taking place in course instruction. It may well be that the actual use of technology in teaching in higher education clearly outperforms the equivalent in the schools sector in most OECD countries. And the gap in technology adoption between students and teachers in higher education is much more reduced than the equivalent in schools.

- **Teachers often take incorrectly for granted that the familiarity of students with technology makes them automatically savvy in information and communication skills.** This is evident as plagiarism is the most exacerbated indication of the lack of adequate education in this domain. Although higher education institutions can do a lot to educate for the 21st century skills in the respect of the academic values, previous education counts probably more.

From an institutional perspective a couple of questions emerge inevitably: What will the future bring? How should higher education institutions prepare for that future?

If anything is clear is that technology will continue to evolve as fast as it has done in the past decade, if not more. Digital devices that are considered to be indispensable by today's higher education students were not accessible to a majority of them only five years ago, if not less. As a number of reports outline (Johnson, Levine, & Smith, 2009), the future will bring also new applications and environments that may have, once again, an impact on the way young people communicate, get entertained, socialize, and deal with their coursework.

It is unclear however if the new technology developments will transform students' learning expectations and demands. Drawing on the past years, a prudent approach would be to state that a certain evolution will take place, particularly if the experiences with technology in the previous school years contribute to raise students' awareness of the opportunities of improved learning processes and outcomes. In the absence of previous successful experiences, an important level of reluctance will remain.

Until now higher education institutions have done a lot to support technology adoption in teaching, with important investments in infrastructure as well as in services both for students and teachers. They have to keep up with emerging technology developments, equipments and applications, and contribute to support innovations intended to explore the value and possible benefits of adoption for teaching.

Institutions have to invest in empirical research to elucidate in which ways technology can provide more than convenience and productivity, in particular learning benefits either by providing a more rewarding experience or better learning outcomes, or both at the same time. As Dede (2007, p. 4) has already outlined, one starting point for fruitfully locating technology in higher education pedagogy is to observe how students are using technology in other aspects of their lives, "sifting out the dross of behaviours adopted just because they are novel and stylish from the ore of transformational approaches to creating, sharing, and mastering knowledge". What is at least as important as the research effort is the ability to share the results in *fora* where they can be translated into recommendations for better practice. This should not be an individual task, but a commitment of the whole academic community.

Finally, no one can predict now how the teaching and learning experience in higher education will be in a decade. The recent evolution shows that whatever has taken place has been the result of the dialogue between students who master digital media but have quite prudent expectations about their use in teaching, and teachers who want to extend the benefits of convenience and academic productivity brought about by technology to enrich their teaching responsibility. It is in the best interest of higher education institutions to nurture with accompanying measures and incentives this ongoing dialogue. It should remain as open as the future usually is.

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