Ingrid Noguera
ingridnoguera@gmail.com

Ingrid Noguera has had a postdoctoral fellowship at Fondation Maison des Sciences de l'Homme- École Centrale Paris. She has been carrying a research related to the impact of ICT in education at different levels. In Spain she is associated teacher at the Pedagogy Faculty (University of Barcelona) and research assistant at the eLearn Center (Open University of Catalonia). She has a Bachelor of Pedagogy, Master's Degree in University teaching, and PhD in Educational Multimedia. Her research interests are: e-learning, ICT in higher education and CSCL.

Technology-enhanced education for Millennials: how the Information Society is changing the way of learning

Keywords:
ICT, education, Information Society, e-learning, effective practices

Abstract:
The Information Society has provided the context for the development of a new generation, known as the Millennials, who are characterized by their intensive use of technologies in everyday life. These features are changing the way of learning, prompting educational institutions to attempt to better adapt to young needs by incorporating technologies into education. Based on this premise, we have reviewed the prominent reports of the integration of ICT into education at different levels with the aim of evidencing how education is changing, and will change, to meet the needs of Millennials with ICT support. The results show that most of the investments have simply resulted in an increase of computers and access to the Internet, with teachers reproducing traditional approaches to education and e-learning being seen as complementary to face-to-face education. While it would seem that the use of ICT is not revolutionizing learning, it is facilitating the personalization, collaboration and ubiquity of learning.

1. Introduction

In 1999, the *President's Information Technology Advisory Committee* pointed out that ICT was going to be one of the key factors driving progress in the 21st century, transforming the way we live, learn, work, and play. In this sense, ICT has changed our society and our citizens, with the generation of *Millennials* being one of the clearest examples of this

change. Millennials can be described as independent people, emotionally and intellectually open, inclusive, innovative, with strong views, investigators by nature, who express their opinion freely, process fast and need immediacy (Tapscott, 1998).

If society changes education must change, thus, the characteristics of Millennials have significant implications on how they learn and how they need to be taught (if necessary). Digital learners are different from previous generations because they: a) are able to do several things simultaneously (multiprocessing), b) they are multiliterate (Hofstetter, 2000), c) they fuse web surfing for learning and entertainment (*infotainment*), d) their reasoning is based on *bricolage,* understood as "abilities to find something—an object, tool, document, a piece of code—and to use it to build something you deem important" (Brown, 2000:13), and e) they learn in situated actions.

Digital media is causing educators and students alike to shift to new ways of thinking about teaching and learning: a) from linear to hypermedia learning, b) from instruction to construction and discovery, c) from teacher-centred to learner-centred education, c) from absorbing material to learning how to navigate and how to learn, d) from school to lifelong learning, e) from one-size-fits-all to customized learning, f) from learning as torture to learning as fun, and g) from the teacher as transmitter to the teacher as facilitator (Tapscott, 1999).

This means that ICT is changing the way of learning; however, the way of teaching, the policies and curricula are still attempting to meet the challenge of preparing students for work and citizenship (Kozma, 2003). In this regard, we aim to evidence how education is changing, and will change, to meet the needs of Millennials with ICT support.

This paper presents a review of the available data concerning the impact of ICT on education (primary, secondary and tertiary level) focusing on the period 2002-2012. We have conducted the literature review based on the following questions:

- How has electronic communication ownership evolved in the Information Society?
- How do the characteristics of the young generation affect education?
- How is ICT being integrated into education at different levels? (primary, secondary and tertiary)
- What will the effective practices of the future be in technology-enhanced learning?

We have conducted exhaustive desk-based research into reports from all education levels and from all over the world, produced by the following prestigious institutions and

publications: Pew Internet, New Media Consortium, BECTA, IEA, Fundación Telefónica, JISC, European Schoolnet, Eurydice, European Commission, Institute for Prospective Technological Studies, OECD and Sloan Consortium. We selected reports covering the largest territory, from national reports with significant data to some specific reflections, large-scale quantitative and qualitative reports and reports that review the evolution of ICT integration into education. The following sections show a summary of findings answering the research questions.

2. ICT availability in the Information Society

The Information Society is characterized by the incorporation of technologies to collect and distribute information among people. The use of technologies is becoming increasingly intensive at home and in everyday lives. In Europe and the USA there has been a great effort to collect and analyse data regarding electronic communication (telephone, computers, other devices, Internet connection and online activities) since 2006 to understand how citizens derive benefits from the innovative digital environment.

Looking at the data, one could say that mobile telephone ownership has increased over the years in the USA, while in Europe there has not been a progressive evolution and there was, in fact, a regression in 2012 (see Table 1). Regarding the difference among generations, it is clear that young people lead the ownership of mobile telephones.

Table 1. *Comparison of telephone ownership.*

		Telephone						
		EU27			USA			
Year	**Means of access**	-29	30-59	60+	-34	35-56	+57	All adults (18+)
2006	Only fixed telephone	1%	10%	56%	-	-	-	-
	At least one mobile	97%	86%	37%	-	-	-	73%
	Only mobile access	58%	29%	6%	-	-	-	-
2007	Only fixed telephone	2%	11%	47%	-	-	-	-
	At least one mobile	95%	83%	43%	-	-	-	75%
	Only mobile access	54%	33%	9%	-	-	-	-
2008	Only fixed telephone	1%	12%	42%	-	-	-	-
	At least one mobile	95%	83%	50%	-	-	-	78%
	Only mobile access	54%	32%	11%	-	-	-	-
2009	Mobile phone	-	-	-	84%	-	-	83%
2010	Both (fixed & mobile)	44%	55%	42%	-	-	-	-
	Only fixed telephone	1%	5%	39%	-	-	-	-
	At least one mobile	98%	93%	55%	94%	89.5%	62%	86%
	Only mobile access	53%	38%	13%	41%	18.5%	5%	21%
2011	Only fixed telephone	0%	4%	31%	-	-	-	-
	At least one mobile	98%	93%	63%	95%	89 %	66.6 %	85 %
	Only mobile access	60%	37%	16%	-	-	-	-
2012	Only fixed telephone	1%	5%	32%	-	-	-	-
	At least one mobile	97%	92%	63%	-	-	-	88%
	Only mobile access	56%	38%	14%	-	-	-	-

Source: Special Eurobarometer: E-communications Household Survey (European Commission 2006-2012), Pew Internet & American Life Project April 2006 Survey (Horrigan, 2007), Pew Research Center (2010), Pew Internet & American Life Project 2009 survey (Lenhart et al., 2010), Pew Internet & American Life Survey 2010 (Zickhur, 2011), Zickhur& Smith (2012).

Notes: Personal distribution of ages in US data. Personal calculation of average in US data based on different reports previously cited. In the EU in 2006 the data refer to EU25, from here it is based on EU27. EU data based on Eurobarometer reports. There was no Eurobarometer report in 2009.

If we look at the use of computers in Europe, there is evidence of an increase in ownership. In the USA there is a proportional relationship between the decrease in desktop ownership and the increase in laptop ownership (see Table 2). Once again, the data show that young people own more computers than older people.

Table 2. *Comparison of computer ownership.*

	Computer							
	EU27				**USA**			
Year	-29	30-59	60+		-34	35-56	+57	All adults (18+)
2006	62%	51%	11%	Desktop Laptop	-	-	-	68% 30%
2007	72%	53%	15%	Desktop Laptop	-	-	-	65% 37%
2008	75%	52%	16%	Desktop Laptop	-	-	-	65% 39%
2009	-	-	-	Desktop Laptop	53% 66%	-	-	60% 46.5%
2010	80%	62%	20%	Desktop Laptop	-	-	-	59% 52%
2011	88%	69%	27%	Desktop Laptop	57% 70%	67 % 55 %	46.6 % 27.6 %	57% 54.5%
2012	83%	68%	27%		-	-	-	-

Source: Special Eurobarometers: E-communications Household Survey (European Commission 2006-2012), Pew Internet & American Life Project April 2006 Survey (Horrigan, 2007), Pew Internet & American Life Project 2009 survey (Lenhart et al., 2010), Pew Internet & American Life Survey 2010 (Zickhur, 2011), Zickhur& Smith (2012).

Notes: Personal distribution of ages in US data. Personal calculation of average in US data based on different reports previously cited. In the EU in 2006 the data refer to EU25, from here it is based on EU27. EU data based on Eurobarometers reports. There was no Eurobarometer report in 2009.

Besides having mobile telephones and computers, people in the USA are increasingly adopting other devices such as game consoles, e-book readers and tablets (see Table 3). Game consoles are the most widespread while iPods and MP3 players are decreasing interest in the adult population, and tablet ownership is growing. Looking at the differences among ages, one can assume that young people have more devices.

Table 3. *Comparison of device ownership.*

	Devices											
	iPod/MP3 player		**Game console**			**e-Book reader**				**Tablet**		
Ages	'09	'11	'09	'10	'11	'09	'10	'11	'12	'10	'11	'12
-33	73	74	59.5	-	63	-	-	5	-	-	5	-
34-55	-	44.6	-	-	41.6	-	-	6	-	-	4.5	-
+ 55	-	15	-	-	10	-	-	3.6	-	-	1.6	-
All adults (18+)	50	37	43.3	42	-	3	5	7	19	4	7	19

Source: Internet & American Life Project Surveys Oct.-Nov. 2006 and Nov. 2007-Feb. 2008(Jones & Fox, 2009), Pew

Internet & American Life Project 2009 survey (Lenhart et al., 2010), Pew Internet & American Life Survey 2010 (Zickhur, 2011), Zickhur& Smith (2012).

Notes: To abbreviate years we have used ('). Data are expressed in %. Based on US data. Personal distribution of ages. Personal calculation of average based on different reports previously cited.

In relation to connectivity, both in Europe and the USA broadband use has risen at the same time as narrowband use has diminished (see Table 4). From 2009, studies begin to focus solely on broadband connections, which suggests that this type of access is widespread. Looking at the differences between the generations, as expected, young people are using faster Internet connections.

Table 4. *Comparison of Internet connection.*

		Internet connection							
		EU27				USA			
Year		-29	30-59	60+		-34	35-56	+57	All adults (18+)
2006	Narrowband	14%	16%	4%	Narrowband	-	-	-	23%
	Broadband	23%	22%	4%	Broadband	-	-	-	42%
2007	Narrowband	8%	13%	4%	Narrowband	-	-	-	15%
	Broadband	40%	26%	6%	Broadband	-	-	-	47%
2008	Narrowband	8%	9%	3%	Narrowband	68%	-	-	10%
	Broadband	48%	33%	8%	Broadband	70.1%	65.2%	35.1%	55%
2009	Narrowband	-	-	-	Narrowband	-	-	-	7%
	Broadband	-	-	-	Broadband	50%	-	-	63%
					Wireless	46%	63%	34%	-
2010	Narrowband	-	-	-	Narrowband	-	-	-	5%
	Broadband	62%	45%	13%	Broadband	81%	70.5%	41.6%	66%
					Wireless	82%	63%	29.3%	59%
2011	Narrowband	-	-	-	Narrowband	-	-	-	3%
	Broadband	71%	56%	20%	Broadband	76%	70%	45%	66%
					Wireless	-	-	-	57%
2012	Narrowband	-	-	-	Narrowband	-	-	-	-
	Broadband	71%	55%	22%	Broadband	-	-	-	-

Source: Special Eurobarometers: E-communications Household Survey (European Commission 2006-2012), Pew Internet & American Life Project Surveys Oct.-Nov. 2006 and Nov. 2007-Feb. 2008(Jones & Fox, 2009), Pew Internet & American Life Project 2009 survey (Lenhart et al., 2010), Smith et al. (2011), Pew Internet & American Life Survey 2009-2010 (Zickuhr, 2010), Zickhur& Smith (2012).

Notes: Personal distribution of ages in US data. Personal calculation of average in US data based on different reports previously cited. In the EU in 2006 the data refer to EU25, from here it is based in EU27. EU data based on Eurobarometers reports. There was no Eurobarometer report in 2009.

Finally, concerning the type of activities that people carry out online, one could argue that US citizens are becoming more active online year after year except in the use of social network sites, which decreased in 2011 (see Table 5). In the USA, people are more engaged in online videos, online classifieds, music and online news. Regarding blogging, it seems that the youngest people are blogging less every year while people aged 34 and older are increasingly blogging. While the Millennials' dominance of online activities is clear, older generations are also making notable gains.

Table 5. *Comparison of online activities.*

	Online activities												
	Social network site use			Online video		Online classifieds		Music		Blogging		Online news	
Ages	'08	'10	'11	'08	'10	'08	'10	'08	'10	'08	'10	'08	'10
-33	66	83	75	64,.5	80	39	64	55	65	24	18	68,5	76
34-55	28	56	50	53	64	33.5	53.5	32	53	8	13.5	73	77.5
+ 55	8	31	18	22.6	39.6	17.3	29.6	18.6	25	6.3	8	54	65.6
All adults (18+)	35	61	60	52	66	32	53	34	51	11	14	70	75

Source: Internet & American Life Project Surveys Oct.-Nov. 2006 and Nov. 2007-Feb. 2008(Jones & Fox, 2009), Pew Internet & American Life Project 2009 survey (Lenhart et al., 2010), Pew Research Center (2010), Smith et al., (2011), Pew Internet & American Life Survey 2009-2010 (Zickuhr, 2010).

Notes: To abbreviate years we have used ('). Data are expressed in %. Based on US data. Personal distribution of ages. Personal calculation of average based on different reports previously cited.

Europeans use the Internet to send instant messages, for online networking and reading weblogs (see Table 6). Regarding leisure activities, European people use the Internet to listen to web radios or watch web television, to download and listen/watch/play music, films or games and to upload and share self-created content. It can be said that young people are the population who use Internet most intensively. In 2009, people used the Internet to find information and to read online, however, there was also an increase of people using the Internet to learn (Redecker et al., 2010).

Table 6. *Comparison of social Internet use.*

	Social Internet use								
	e-mailing	Social media	Instant messaging	Online networking	Weblogs	Audiovisual content	Web radio, television	Music, films, games	Self-created content
All Internet users (+18)	57%	57%	35%	26%	25%	61%	33%	67%	19%
16-24	-	73%	7%	50%	39%	81%	46%	78%	32%

Source: Redecker, Ala-Mutka&Punie (2010).
Notes: Based on European data. Data regarding e-mails refers to 2009. Data regarding social media and audiovisual content refers to 2008.

The data presented and compared in this section show that in the Information Society, people are using more devices (mobile, tablets, laptops), are more connected through the Internet (broadband), are consuming Internet in a social way and are using multimedia resources. We observe that young people are using these devices and connection in a more intensive way than other generations and are using them for learning purposes.

3. Young generation characteristics and learning expectations

The young generation born after 1977 (Zickhur, 2011) are known as the Millennials, Net Generation, IM Generation, Gamer Generation, Digital Natives, Digital Residents or Homo Zappiens (Pedró, 2006). Millennials have been characterized as confident, liberal, optimistic,

open to change, more educated than previous generations, always connected, steeped in digital technology and social media, and embracing multiple modes of self-expression (Pew Research Center, 2010).

Their life is characterized by immediate communication and an active use of digital media. This has changed their notions of communication, knowledge management, learning, and their personal and social values. For example, young Internet users use social software to find information and decide whether to buy a product or to visit the doctor based on this information (Ala-Mutka et al., 2008a). This demonstrates a change compared with previous generations.

Eynon (2009) confirmed that young people are high users of technology (at home and at school); however, it does not mean that they are competent, as they need support from parents, friends and school. Ferrari (2012) has distinguished several competence areas that need to be developed by users in order to function in a digital environment such as: information management, collaboration, communication and sharing, creation of content and knowledge, ethics and responsibility, evaluation and problem-solving and technical operations. In this regard, Ala-Mutka (2011) considers that digital competence is no longer linked to the access and use of technologies but also includes the capacity to benefit from them for life, work and learning. Thus, to be digitally competent means having: a) instrumental knowledge and skills for digital tool and media usage, b) advanced skills and knowledge for communication and collaboration, information management, learning and problem-solving, and meaningful participation, and c) attitudes for strategic skills usage in intercultural, critical, creative, responsible and autonomous ways.

Digital competence is one of the many features of Millennials that has implications for education (see Table 7). The literature (Conole et al., 2006; Redecker, 2009) indicates that, in learning processes, Millennials simultaneously and extensively use multiple types of web-based participatory media, multi-task, personalize technologies, tend towards independent learning, are constantly connected and synchronized, need immediate communication and social interaction, prefer to learn by doing and to work with things that matter, prefer to work in teams, need new skills for the digital era, are transferring practices of technology use to other aspects of their lives, and are changing working patterns.

Table 7. *Educational implications of the Net generation (based on Oblinger & Oblinger, 2005).*

Features	Implication for education

Students are comfortable using technology	Understanding of the technology, or source quality, may be shallow
Visually literate	Text literacy may be less well developed than previous cohorts
They use the Internet for searching more often than the library	They do not find all the information they need. Cut-and-paste culture
Constantly connected and always on	The devices that allow them to be connected and are used ubiquitously may have to be rethought
Multitask and they have fast responses	Speed is more valuable than accuracy
Learn by doing, through discovery	Not to teach, facilitate them to discover
Open to interacting with people	Work in teams or interact peer-to-peer
Focused on achievements	Prefer a structured plan and know what they have to do to achieve a goal
More comfortable in image-rich environments than with text	They like doing things, not just thinking or talking about things, they refuse to read large amounts of text
Take part in community activities	They prefer working on things that matter

In research conducted by Pedró (2006), the results showed that Millenial learners have different expectations to previous generations concerning teaching and learning based on: a) the kind of ICT devices and services available at schools, b) the frequency of their use, c) the range of possible activities, d) the opportunities for collaborative work and networking, e) the communication skills involved, f) the degree of learning personalization, and g) the standards of digital quality (interactivity and use of multimedia resources).

To sum up, we could say that Millennials are using technologies intensively (and are demanding to use it in education also), are multitasking (and want to have a range of different activities in education), use multimedia resources (and expect high quality interactive materials in education), are social (and demand collaborative work and networking opportunities in education), personalize technologies to fit their needs (and assume that learning is personalized), have new skills (and expect to develop 21st century skills in the classroom), and are developing new working practices (and demand that education accepts and takes advantage of these new practices).

4. ICT integration in primary and secondary education

Young people are intensively using ICT for leisure, however there is a huge difference between social and academic use of ICT. The integration of ICT at the educational level is more focused on providing tools and access to the Internet than changing methodologies or moving to virtual contexts. There are many studies regarding ICT access and equipment in primary and secondary education in Europe and just a few that compare this internationally.

Looking at the data, in primary and secondary education in OECD countries, almost all educational centres are equipped with at least one computer, have Internet connection, and the ratio of students per computer is decreasing (OECD, 2010). In an international study, the results indicated that the USA has the smallest ratio of students per computer (3 students per computer), unlike Japan, Brazil and South Africa which have the highest ratio of students per computer (Fundación Telefónica, 2012).

In Europe, ICT is part of everyday life in education, however, there are still disparities between countries in terms of computer availability, there is a shortage of ICT resources, and there is an increasing gap between the opportunities for using ICT at home and at schools. Less than half of European countries promote the use of online learning, although teachers' use of ICT hardware and software in the classroom is widely encouraged. Nevertheless, in several countries computers are still not readily accessible to students in the classroom (Eurydice, 2011). In fact, students use less ICT in classroom than their teachers and use more computers at home than at school. The main activity in using the Internet at school is to find information while at home they also use it to develop assignments and to share their efforts with other students (Pedró, 2011).

Research shows that ICT has a positive impact on educational performance. Results show that in e-mature schools there is a rapid increase in performance scores (Balanskat et al., 2006; European Commission, 2008b) and a positive relationship between the perceived effect of ICT on teaching and on the personalization of learning (Underwood et al., 2010). There is also a consensus (Balanskat et al., 2006; Condie & Munro, 2007; European Commission, 2008b; Balanskat, 2009) on the positive impact of ICT on learners and learning (competences, motivation and assessment, adaptation to individual needs, support a range of learning styles-cognitive processing, independent learning, critical thinking, teamwork and student-centred learning approach), on teachers and teaching, and on communication between schools and the community (Condie & Munro, 2007).

Based on these positive effects of ICT on education, in OECD countries, the 1:1 program has proliferated. Countries are investing in netbooks because of the low cost, light weight and the increasing availability of wireless connectivity. However, it is not enough to provide students with computers; teachers also need high quality infrastructure, technical support and formal training. It is clear that ICT devices do not change strategies of teaching and learning, thus, 1:1 programs depend largely on teachers (Valiente, 2010).

One of the strong findings in the current literature is that although teachers' basic ICT skills have increased, they use ICT to support existing pedagogies and, in fact, many teachers do not believe that the use of computers in class has pedagogical advantages (Balanskat et al., 2006). Less than half of the teachers in European countries consider that they have good ICT skills and are sufficiently competent to make good didactical use of ICT. ICT is more used in scientific subjects and mainly to improve the efficiency of traditional methods (Sola & Murillo, 2011). Most primary school teachers use computers in class for administration, organization and planning (using a VLE) but do not have enough knowledge to integrate ICT effectively into their teaching (Balanskat, 2009). Interactive Whiteboards (IWB) and Learning Platforms (LP) are widespread and are a key element in the e-learning development of schools, however, IWB are more popular than LP because IWB support traditional practices in a most effective way. Nevertheless, LP have a more transformative role (Underwood et al., 2010).

Teacher training programs are having a limited impact on teachers' daily methodological competences in student-centred constructivist approaches (Sola & Murillo, 2011). However, these programs, together with government interventions and issuing teachers with their own laptop computer, increase positive attitudes among teachers (Balanskat et al., 2006). Findings demonstrate that there is a need to train teachers on ICT use in Brazil and South Africa, while in Germany and the USA teachers are trained in ICT and use it intensively (Fundación Telefónica, 2012).

Nevertheless, the main problem in integrating ICT is the rigidity of educational systems and not the teachers. In fact, most European teachers have a positive attitude towards ICT (the most sceptical are the most experienced teachers) because of its potential to create new dynamics of classroom work, to individualize learning, to promote creativity and to motivate students. However, there is a division between teachers' practices (copying, listening, class discussion, taking notes and computer work) and students' preferences (teamwork, practical activities, working with friends, use of the computer and copying) (Sola & Murillo, 2011).

Based on Eurydice (2011), it could be said that in Europe there are many efforts to improve education by promoting ICT through: national policies (i.e., digital literacy, driving progress, public and private funding), including digital competences in national curricula, promoting ICT for teaching and learning (i.e., tutorial software, office and multimedia

applications, digital learning games, communication software and digital resources, and less commonly, mobile devices and e-books), assessing ICT competences (standardized and non-standardized certifications, few countries use e-portfolios), and facilitating cooperation between schools and community (mainly through web pages).

Despite these efforts, the integration of ICT in the USA is more extended than in Europe. Currently, US teachers bring a wide variety of digital tools into the learning process and allow mobile phones, e-readers and tablets to be used in the classroom. Half of teachers conduct online learning activities, feel satisfied by the ICT support offered by the school and say they have received formal training in this area. However, most of them also search for new ways to learn how to effectively incorporate digital tools into the classroom. Furthermore, almost all US teachers use ICT to prepare their lessons, have different devices (laptop, smartphone, tablet, e-book) and participate in social networking. Just a few of them consider that they know more than their students about ICT, with the youngest teachers being the most confident about using ICT in education (Purcell et al., 2013).

In general terms, in OECD countries, equipment and connectivity have improved in primary and secondary education, and the ratio of computers per students is decreasing; however, there are still differences among countries (in the USA ICT use is more extended). The main gaps are between the students' use of computers at home and at school, the students' and teachers' use of technologies, the teachers' use of ICT in the classroom and the students' preferences. Teachers are reproducing existing pedagogies with ICT, which highlights a need to train teachers pedagogically in using ICT; however, the main problem is the rigidity of the system and not the teachers. Overall, ICT is considered to have a positive impact, although online learning is not widespread.

5. ICT integration in higher education

5.1 E-learning in higher education

Reports focused on the impact of ICT in higher education do not address the number of computers or access to the Internet but focus more on the discussion about face-to-face and virtual learning and, currently, reflect on the use of web 2.0 tools. The research has mainly been conducted in Europe (most of the studies were conducted in the UK) and the USA, with a lack of international comparisons.

Coinciding with the results in primary and secondary education, Glenn (2008) considers that technology has had—and will continue to have—a significant impact on higher education. There is evidence that students in online conditions perform better (if they are guided and have media to control their interactions and prompt reflection) and that blended learning is better than face-to-face learning (if it includes variation in terms of curriculum materials and instructional approach) (Means et al. 2010).

In a survey conducted in OECD countries (OECD, 2005) the results demonstrate that tertiary education institutions feel that e-learning has a positive effect on education, offering a place to experiment pedagogically and changing students' learning experience. At a European level, ICT is bringing improvements to teaching methods (tending towards collaborative, problem-based and project-based learning), is transforming the role of teachers and students, is motivating students, and is fostering the internationalization of higher education through virtual mobility (European Commission, 2008b). JISC infoNet (2008) evidenced that in the UK e-learning also benefits: learners (results, personal development, satisfaction, recruitment), innovation in teaching, learning and assessment, educational research, staff (personal development, satisfaction), policy, resources, learning spaces, management of learning assets, and social justice agenda.

Regarding the benefits of social computing, the literature (Ala-Mutka et al., 2009; Redecker, 2009; Redecker et al., 2010) indicates that that learning 2.0: a) facilitates access to information within the institution, b) promotes collaboration and networking, c) responds better to the changed cognitive processes and learning patterns, d) facilitates teaching learner-centred methods and redefines the roles of teachers and students, e) contributes to the personalization of learning, f) promotes independent, autonomous and self-directed learners, g) increases motivation, academic achievement, participation and new forms of expression, h) facilitates inclusion, equity, lifelong learning and learner mobility, and i) enhances innovation and creativity.

Undoubtedly related to the belief in the positive impact of ICT on education, evidence shows (European Commission, 2008b; OECD, 2005; PlsRamboll Management, 2004; Punie et al., 2006) that e-learning is growing, although face-to-face learning remains central in higher education where e-learning is seen as a supplementary tool (most universities use LMS). Findings demonstrate that e-learning has not revolutionized learning and teaching; however, it is having an important impact on administrative processes.

In 2006, data showed that few adults in Europe used the Internet for formal learning activities and not many adults and students had participated in e-learning courses (although most of the students used the Internet in formal learning). Adults participating in education and using the Internet could not imagine taking an e-learning course and more than half the people surveyed preferred guided learning to autodidactic methods. From those who had taken an online course, more than half were satisfied with online learning and most of them preferred to participate in online courses rather than in face-to-face courses (Punie et al., 2006).

The results from the USA demonstrate that they are a step further ahead in ICT integration and confidence in comparison to Europe. Based on surveys from the last decade regarding online higher education in the USA (Allen & Seaman, 2013), it can be argued that the number of students enrolled in online courses is growing and academic heads are progressively including online learning in their long-term strategies (although they believe that teaching online takes more faculty time). Academic leaders are increasingly considering that students' learning outcomes in online learning are the same or superior to those in face-to-face courses, however, the faculty do not always accept the value and legitimacy of online education. In fact, the results of one study (Taylor et al., 2011) demonstrate that just a third of people (and a third of adults who have taken a class online) consider online courses as valuable as face-to-face ones, while half of the college presidents surveyed consider it equally valuable.

Most college presidents state that their institutions offer online courses (almost a third of college graduates have taken a class online) although half of them predict that 10 years from now most of their students will take classes online. Regarding the use of devices in classroom, half of the college graduates surveyed state that they have used a laptop, smartphone or tablet computer in class sometimes and almost half the college presidents say students are allowed to use these devices (Taylor et al., 2011).

Apart from collecting statistics and interviewing university presidents and staff, there has been a great effort to analyse students' experiences in e-learning around the world. In research conducted by Conole et al. (2006) results showed that UK students were comfortable using technology and see it as integral to their learning. They appeared to be sophisticated users, critically aware of the use of different technologies and seemed not to view technology as anything special, just as another tool to support their learning. According

to this data, research conducted at the Open University of Catalonia (Tubella et al., 2011) demonstrates that students choose to study online because of the flexibility and compatibility, and being able to have time and manage it autonomously. For them, the technological issues are not important; they feel very comfortable in a virtual environment.

In fact, students continue to view face-to-face interaction as the best way of teaching (Ipsos Mori, 2008; Committee of Inquiry into the Changing Learner Experience, 2009). The research conducted by Ipsos Mori (2008) shows that students can feel uncomfortable when teachers relate to them in non-hierarchical structures or less formal methods, they consider themselves to be more digitally literate than their teachers and they prefer teachers not to use technologies if they are not sufficiently competent.

Nevertheless, students have difficulties using social tools in education, and need teachers to use ICT effectively to improve their practical skills with ICT. Currently, web 2.0 tools are being used unsystematically without common paths and are more widespread in administration areas (Committee of Inquiry into the Changing Learner Experience, 2009). Students use social networks intensively but sometimes react negatively when they are promoted by teachers. They clearly see the usefulness of some technologies for learning (i.e. WebCT, online administration, course specific information online, emailing tutors) but do not see how wikis and collaborative learning can help them to learn (Ipsos Mori, 2008).

In general terms, the literature (Allen & Seaman, 2013; Committee of Inquiry into the Changing Learner Experience, 2009; OECD, 2005) shows that the barriers to implementing e-learning are: the infrastructure, funding and institutional culture (digitalization of learning materials, open source), resistance from faculty members (traditional approaches, 21st century skills), the scaling and sharing of good practices (active, within a community, based on individuals' needs, driven by process, self-directed learning, independent learning, project and group-based), online students' self-discipline, lower retention rates, lack of acceptance of online degrees, and the digital divide.

To overcome these barriers, the drivers for developing e-learning approaches should attempt to increase student recruitment, promote flexibility in time and place, engage students through rich media and pedagogic support, make teaching relevant to Millennials, evidence the development of skills and professional attitudes, prepare students for employment and practice, maintain reputations for innovation at institutional level, preserve institutional assets, and assure quality (JISC infoNet, 2008).

5.2 Emerging technologies in higher education

Besides analysing the general impact of ICT in higher education, there has been huge interest in analysing the specific technologies emerging in higher education every year. The *Horizon Report*, published by the New Media Consortium, collects and summarizes emerging technologies divided into three time horizons. It began to analyse the emerging technologies in North America and progressively incorporated other regions such as Australia (2008) and Iberoamerica (2010). In the UK, since 2006, some independent research (BECTA, 2006, 2007, 2008; Sharples et al., 2012) has collected emerging technologies in a non-systematic way.

If we analyse the evolution of emerging technologies in higher education we could say that the same technologies are highlighted everywhere (see Table 8). In general, technologies are becoming more ubiquitous, social, personal, open and based on cloud computing. Game-based learning, augmented reality and semantic applications are also having a great impact. However, the main emerging technology for learning seems to be the mobile phone. In 2012, mobile apps and tablet computing were still emerging technologies in North America and Iberoamerica.

Social computing has grown faster than expected. In North America, in 2005, it was predicted that social computing was going to be present in education by 2009. However, in 2006 it was already highlighted as an emerging technology on the horizon of one year or less. Other technologies such as virtual worlds have had a small impact on education (they were only cited in 2007-2008).

There are a few differences between countries. For example, in the UK ubiquity and games are not cited until 2007 while in North America they appeared in 2005. In Australia they are more focused on devices while in Iberoamerica the emerging technologies are those related to collaboration and social practices.

Table 8. *Comparison of emerging technologies.*

	Emerging technologies		
	-1	**2-3**	**4-5**
2004	Learning objects, scalable vector graphics.	Rapid prototyping, multimodal interfaces.	Context-aware computing, knowledge webs.
2005	Extended learning, ubiquitous wireless.	Intelligent searching, educational gaming.	Social networks and knowledge webs, context-aware computing and augmented reality.
2006	Social computing, personal broadcasting.	Mobile phones, educational gaming.	Augmented reality and enhanced visualization, context-aware environments and devices.

	Mobile learning, ambient web, human-computer interaction, social networking, broadband home.	-	-
2007	User-created content, social networking.	Mobile phones, virtual worlds.	New scholarship and emerging forms of publication, massive multiplayer educational gaming.
	Social software learning networks, game-based learning, ubiquitous computing.	-	-
2008	Grassroots video, collaboration webs.	Mobile broadband, data mashups.	Collective intelligence, social operating systems.
	Networking and wireless, multimedia, hardware, software and internet.	-	-
	Virtual worlds and other immersive digital environment, cloud-based applications.	Geolocation, alternative input devices.	Deep tagging, next-generation mobile.
2009	Mobiles, cloud computing.	Geolocation, personal web.	Semantic-aware applications, smart objects.
	Mobile internet devices, private clouds.	Open content, virtual, augmented and alternate realities.	Location-based learning, smart objects and devices.
2010	Mobile computing, open content.	Electronic books, simple augmented reality.	Gesture-based computing, visual data analysis.
	Collaborative environments, social media.	Open content, mobiles.	Augmented reality, semantic web.
	Electronic books, mobiles.	Augmented reality, open content.	Gesture-based computing, visual data analysis.
2011	E-books, mobiles.	Augmented reality, game-based learning.	Gesture-based computing, learning analytics.
2012	Mobile apps, tablet computing.	Game-based learning, learning analytics.	Gesture-based computing, Internet of things.
	Cloud computing, collaborative environments, mobile apps, open content.	Game-based learning, geolocation, personal learning environments, tablet computing.	Augmented reality, learning analytics, MOOCs, semantic applications.
	e-books, publisher-led short courses.	Computer-based assessment, badges, MOOCs, open access publishing, seamless learning, learning analytics, personal inquiry learning.	Rhizomatic learning.

Source: BECTA (2006-2008), Horizon Report North America (2004-2012), Horizon Report Iberoamerica (2010-2012), Horizon Report Australia (2008-2010), and Sharples et al. (2012).
Notes: North America (grey), Iberoamerica (blue), UK (orange), Australia (green).

Broadly speaking, one could say that ICT is having a great and growing impact on higher education, thus favouring e-learning practices. However, face-to-face practices remain central while e-learning is seen as a supplementary tool. E-learning allows educators to experiment pedagogically and to change the learning experience. However, ICT is far from revolutionizing teaching and learning. Students are active users of technologies but still prefer face-to-face practices and sometimes react negatively to the promotion of technologies by teachers. Teachers are using technologies in higher education, particularly in the USA, with ubiquitous, social, personal, open and mobile technologies leading the field.

6. Effective technology-enhanced practices for the future

6.1 Future effective practices

ICT use is widespread at all education levels; however there is a need to integrate it in a more effective way and to promote good practices in implementing ICT in education. In general terms, conducting effective practices in e-learning involves identifying objectives, recognizing learners' needs, selecting the most suitable approach, and then striking an appropriate balance between e-learning and other modes of delivery (Knight, 2004). Effective practices can be characterized as those that promote extended access and choice, exploration and inquiry, communication and social interaction, replicating the real world, digital literacy, and creativity and responsiveness (Knight, 2009). Nevertheless, Pedró (2011) states that the key factors in good practices are the perception of usefulness and the satisfaction of students and teachers related to competence, motivation, comfort (degree of personalization and flexibility), relevance, efficiency and unanimity (jointly positive perception).

Currently, at a European level, innovative teaching methods include project-based learning, personalized learning, individualized learning and scientific investigations (Eurydice, 2011). There are also several ways to innovate with social computing, such as: collaborative creation, new forms of communication, personalized and learner-centred environments, new forms of blended learning scenarios, motivation, integrated solutions, and virtual worlds (Simon et al., 2009).

Researchers (Ala-Mutka et al., 2008b; ICT cluster, 2010; Pedró, 2006) recommend encouraging pedagogical innovations with ICT by transforming the institution (increasing ICT availability, networking and best practise exchange, open and networked institutions, vision of ICT and innovation for lifelong learning, open and inclusive policies), promoting teacher training and support, and renewing the pedagogical approach. Thus, summarizing the recurrent ideas in the current literature (Redecker, 2009; Punie et al., 2006, Pedró, 2011; Punie and Cabrera, 2005; Redecker et al., 2010; Ala-Mutka et al., 2010; Redecker et al., 2011; Fundación Telefónica, 2012; Davidson & Goldberg, 2010), the effective pedagogical approach of the future for Millenial learners will be based on: a) ubiquity and flexibility, b) personalization, self-regulation and learner-centred, c) experimental, real life, participative and active learning, d) collaboration, interactivity, social learning and networking, e)

creativity, f) reflection, g) responsibility, h) digital competence, and i) lifelong and life-wide learning.

For Punie et al. (2006) the future trends of learning enabled by ICT are related to obtaining and creating knowledge at the right time, in the right place, in the right way, on the right device, available for everyone and adapted to learning styles. Nevertheless, Pedró (2011) states that the future of education with ICT support is to learn more (using technologies to be more efficient in introducing new methodological approaches), to learn better (using technologies to personalize learning), and to learn in a different way (using technologies to facilitate the acquisition of 21st century skills). In this sense, it will be necessary to be skilled in ICT use and social competence, problem-solving, creativity, learning to learn, risk-taking, entrepreneurship, critical thinking, knowledge sharing and cooperation techniques (Punie et al., 2006; Redecker et al., 2011).

Redecker et al. (2010) envisage that ICT will facilitate that formal institutions in 2020-2030 will be more flexible, transparent and open, and will promote practical and real-life learning opportunities, multicultural, collaborative, self-regulated and personalized learning. School teachers consider that over the next 10-20 years learning will be focused on competences, based on the needs of individuals, more active and connected to real life, technologies will be an integral part of learning and teachers will become lifelong learners. (Ala-Mutka et al., 2010).

Redecker et al. (2010) predict that formal education will still be based on schools while Miller et al. (2008) consider that learning is tending towards the abandonment of the technocratic, hierarchical and exclusive approach to education and skills achievement and the marginalization of institutionalized learning. In this sense, the *Committee of Inquiry into the Changing Learner Experience* (2009) foresee that the next generation will not adapt to higher education (which is hierarchical, introverted, guarded, careful, precise and measured) which will imply changes to provide a stimulating, challenging and relevant learning experience based on experimentation, networking and collaboration.

Some authors (Punie and Cabrera, 2005; Miller et al., 2008) have characterized the learning scenarios of the future as: connecting and social, personal and digital, trusted, pleasant/motivating and emotional, learning spaces (allowing differentiation between learning moments and other moments), creative and flexible/experimental, controllable, open and reflexive, and evaluated and certified.

Regarding the challenges and barriers identified in the current literature (Ala-Mutka et al., 2009; Knight, 2005; Pedró, 2006; Redecker, 2009; Simon et al., 2009), it can be summarized that to effectively and efficiently implement ICT in education it will be necessary to take into account the following factors: technical issues (availability, accessibility, functionalities of the tools, scaffolding of the tools, device size), competences (digital and didactical competences of teachers and students' digital skills), students (attitudes, motivation, reduce the gap of experiences with ICT outside and inside classrooms), teacher's role, pedagogical concerns (scaffolding, personalization, to take into account students voices and needs, design of well-structured online environments), organizational and financial support, quality insurance mechanisms for user-generated content, safety and privacy concerns.

6.2 Emerging technologies for the future

In relation to the technical challenges, there are efforts to envisage the characteristics of the emerging technologies of the future. If we compare the emerging technologies in different geographical regions based on the *Technological Outlooks* of the *Horizon Report* (Johnson & Adams, 2011; Johnson et al., 2011, 2012b; Durall et al., 2012) we can see that for the next four years there is no common prediction of what the emergent technologies will be (see Table 9). In the 2012-2015 horizon, in Australia, New Zealand and the UK, game-based learning, the ways of publishing and open content will be a trend. Learning analytics and semantic webs will be prominent in Iberoamerica and the UK and digital identity and PLEs will be a trend in Australia and New Zealand. In Iberoamerica, augmented reality and MOOCs will have a place in the near future of education.

For the 2016-2017 horizon, there are few coincidences between countries. In Australia and the UK the future of education will be based on telepresence and in New Zealand and the UK there will also be augmented reality and smart objects. In Australia digital presence, MOOCs and individual user interfaces are all highlighted. In Iberoamerica the future will be based on games, geolocation, PLEs and tablets. In New Zealand gesture-based computing and next-generation batteries are also cited while in the UK collective intelligence will become more present.

However, one could say that, in general, the future of education seems to lie in technologies that are more adapted to users, more visual, collaborative and ubiquitous.

Table 9. *Comparison of emerging technologies for the future.*

On the whole, the effective technology-enhanced practices of the future will be those seen as useful by teachers and students. These practices will be based on flexibility, personalization, active learning, collaboration, creativity, reflection, responsibility, digital competence, lifelong and life-wide learning. Thus, the emerging technologies for the future will be those adapted to learners and that are visual, collaborative and ubiquitous.

7. Conclusions

Young people are leading the change in the Information Society by using technologies intensively to communicate and to learn. The characteristics of the Millennials are creating a gap between students and educational institutions. For this reason, there have been great efforts to introduce ICT into education, expecting a positive impact.

ICT integration into primary and secondary education is more focused on providing tools and access to the Internet than on changing methodologies or moving to virtual contexts. In higher education the use of ICT is more widespread than in other educational levels, and is

	Future trends (2011-2017)			
Years	**Australia**	**Iberoamerica**	**New Zealand**	**UK**
-1	Cloud computing, learning analytics, mobile apps, tablet computing.	Cloud computing, collaborative environments, mobile apps, open content.	Cloud computing, collaborative environments, mobile apps, tablet computing.	Cloud computing, mobiles, open content, tablet computing.
2-3	Digital identity, game-based learning, open content, PLEs.	Augmented reality, learning analytics, MOOCS, semantic applications.	Digital Identity, e-publishing, game-based learning, PLEs .	Game-based learning, learning analytics, new scholarship, semantic applications.
4-5	Digital preservation, MOOCs, natural user interfaces, telepresence.	Game-based learning, geolocation, PLEs, tablet computing.	Augmented reality, gesture-based computing, next-generation batteries, smart objects.	Augmented reality, collective intelligence, smart objects, telepresence.

Source: Technology outlook of the Horizon Report of Australia, Iberoamerica, New Zealand and UK (2012-2017).
Notes:
In UK and New Zealand, the future trends are from 2011 to 2016.
In Iberoamerica and Australia, the future trends are from 2012 to 2017.

more focused on blended and e-learning practices. However, face-to-face practices remain central while e-learning is seen as a supplementary tool. Teachers tend to reproduce traditional methodologies and it could be said that technologies are not revolutionizing teaching and learning at this level.

There are very few studies comparing the impact of ICT on education internationally and the prominent research is based in Europe and the USA. In the USA there is a long tradition of gathering information about ICT in education and they are better equipped and aware of the positive implications of using ICT.

The emerging technologies are those that are more ubiquitous, social, personal, open and mobile. The effective technology-enhanced practices of the future will be those seen as useful by teachers and students and will be based on flexibility, personalization, active learning, collaboration, creativity, reflection, responsibility, digital competence, lifelong and life-wide learning.

8. References

Ala-Mutka, K. (2011). *Mapping Digital Competence: Towards a Conceptual Understanding*. Seville: Institute for Prospective Technological Studies. Retrieved from http://ftp.jrc.es/EURdoc/JRC67075_TN.pdf.

Ala-Mutka, K., Punie, Y. & Redecker, C. (2008a).*Digital Competence for Lifelong Learning*, JRC Technical Note 48708; Publication date: 11/2008. Retrieved fromhttp://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=1820

Ala-Mutka, K., Punie, Y. & Redecker, C. (2008b). *ICT for Learning, Innovation and Creativity, Policy Brief*. Seville: JRC-IPTS. Retrieved fromhttp://ftp.jrc.es/EURdoc/JRC48707.TN.pdf.

Ala-Mutka, K., Bacigalupo, M., Kluzer, S., Pascu, C., Punie, Y. & Redecker, C. (2009). *Learning 2.0: The impact of web 2.0 innovations on education and training in Europe.* Final report. Seville: Institute for Prospective Technological Studies. Retrieved fromhttp://ftp.jrc.es/EURdoc/JRC55629.pdf.

Ala-Mutka, K., Redecker, C., Punie,Y., Ferrari, A., Cachia, R. & Centeno, C. (2010). The future of learning: European teachers' visions report on a foresight consultation at the 2010 eTwinning conference, Seville 5-7 February 2010. *JRC Technical Notes.* Retrieved from http://ftp.jrc.es/EURdoc/JRC59775_TN.pdf

Allen, I. E., & Seaman, J. (2013). *Changing course: Ten years of tracking online education in the United States.* Newburyport, MA.

Balanskat, A. (2009). *Study of the impact of technology in primary schools: Synthesis Report*. European Commission. Retrieved from http://insight.eun.org/ww/en/pub/insight/minisites/steps.htm.

Balanskat, A., Blamire, R. & Kefala, S. (2006).*The ICT Impact Report: A Review of Studies of ICT Impact on Schools in Europe.*European Schoolnet. Retrieved fromhttp://insight.eun.org/shared/data/pdf/impact_study.pdf

BECTA (2006). *Emerging technologies for learning*. BECTA. Retrieved fromhttp://dera.ioe.ac.uk/1501/1/becta_2006_emergingtechnologies_vol1_report.pdf
BECTA (2007). *Emerging technologies for learning*. BECTA. Retrieved fromhttp://dera.ioe.ac.uk/1502/2/becta_2007_emergingtechnologies_vol2_report.pdf
BECTA (2008). *Emerging technologies for learning*. BECTA. Retrieved fromhttp://www.mmiweb.org.uk/publications/ict/emerging_tech03.pdf
Brown, J.S. (2000). Growing up digitally: How the web changes work, education and the ways people learn. *Change*, 32(2), pp. 10-20.
Committee of Inquiry into the Changing Learner Experience (2009). *Higher Education in a Web 2.0 World.* Retrieved from http://www.jisc.ac.uk/media/documents/publications/heweb20rptv1.pdf
Condie, R. & Munro, B., British Educational Communications and Technology Agency (BECTA), corp creator. (2007). *The impact of ICT in schools: Landscape review*. BECTA Research. Retrieved fromhttp://dera.ioe.ac.uk/1627/1/becta_2007_landscapeimpactreview_report.pdf.
Conole, G., De Laat, M., Dillon, T.& Darby, J. (2006). *JISC LXP: Student experiences of technologies, Final report of the JISC-funded LXP project.* Southampton: University of Southampton. Retrieved fromwww.jisc.ac.uk/elp_learneroutcomes.html.
Davidson, C & Goldberg, D. (2010).*The Future of Thinking: Learning Institutions in a Digital Age*. Chicago: The John D. and Catherine T. MacArthur Foundation. Retrieved fromhttp://goo.gl/jVC7n.
Durall, E., Gros, B., Maina, M., Johnson, L. & Adams Becker, S. (2012). *Technology Outlook: Iberoamerican Tertiary Education 2012-2017.* Austin, Texas: The New Media Consortium.
European Commission (2006). *Special Eurobarometer 249: E-communications Household Survey.* Brussels: European Commission. Retrieved fromhttp://ec.europa.eu/public_opinion/archives/ebs/ebs_249_en.pdf.
European Commission (2007). *Special Eurobarometer 274: E-communications Household Survey.* Brussels: European Commission. Retrieved fromhttp://ec.europa.eu/public_opinion/archives/ebs/ebs_274_en.pdf.
European Commission (2008a*). Special Eurobarometer 293: E-communications Household Survey.* Brussels: European Commission. Retrieved fromhttp://ec.europa.eu/public_opinion/archives/ebs/ebs_293_full_en.pdf.
European Commission (2008b). *Commission Staff Working Document. The use of ICT to support innovation and lifelong learning for all - A report on progress.* SEC(2008) 2629 final. Retrieved fromhttp://goo.gl/O0gSf.
European Commission (2010). *Special Eurobarometer 335: E-communications Household Survey.* Brussels: European Commission. Retrieved fromhttp://ec.europa.eu/public_opinion/archives/ebs/ebs_335_en.pdf.
European Commission (2011). *Special Eurobarometer 362: E-communications Household Survey.* Brussels: European Commission. Retrieved fromhttp://ec.europa.eu/public_opinion/archives/ebs/ebs_362_en.pdf.
European Commission (2012). *Special Eurobarometer 381: E-communications Household Survey.* Brussels: European Commission. Retrieved fromhttp://ec.europa.eu/public_opinion/archives/ebs/ebs_381_en.pdf.
Eurydice (2011). *Key Data on Learning and Innovation through ICT at School in Europe 2011.* Brussels: EACEA P9 Eurydice. Retrieved

fromhttp://eacea.ec.europa.eu/education/eurydice/documents/key_data_series/129en.pdf.

Eynon, R. (2009).*Mapping young people's uses of technology in their own contexts - A nationally representative survey.* Coventry: Becta. Retrieved fromhttp://dera.ioe.ac.uk/1528/.

Ferrari A. (2012). *Digital Competence in practice: An analysis of frameworks*. Seville: Institute for Prospective Technological Studies. Retrieved fromftp://ftp.jrc.es/pub/EURdoc/JRC68116.pdf.

Fundación Telefónica (2012). *Aprender con tecnología Investigación internacional sobre modelos educativos de futuro.* Madrid/Barcelona: Fundación Telefónica, Ariel. Retrieved from http://goo.gl/Cz73H.

García, I., Peña-López, I., Johnson, L., Smith, R., Levine, A. & Haywood, K. (2010).*Horizon Report: 2010 Iberoamerican Edition*. Austin, Texas: The New Media Consortium and the Universitat Oberta de Catalunya.Retrieved fromhttp://www.nmc.org/pdf/2010-Horizon-Report-ib.pdf.

Glenn, M. (2008). *The future of higher education: How technology will shape learning.* Economist Intelligence Unit, New Media Consortium.Retrieved fromhttp://graphics.eiu.com/upload/The%20Future%20of%20Universities.pdf.

Hofstetter, F. (2000). *Multimedia Literacy Textbook*. New York: McGraw-Hill Education.

Horrigan, J. B. (2007). *A Typology of Information and Communication Technology Users*. Washington, DC: Pew Internet & American Life Project. Retrieved from http://www.pewinternet.org/pdfs/PIP_ICT_Typology.pdf.

ICT cluster (2010). *Learning, innovation and ICT Lessons learned by the ICT cluster Education & Training 2010 programme*. Retrieved from http://www.icde.org/filestore/Resources/Reports/KeyLessonsICTclusterReport.pdf.

Ipsos MORI on behalf of JISC. (2008). *Great Expectations of ICT: How Higher Education Institutions are measuring up.* London: Ipsos MORI. Retrieved fromhttp://goo.gl/wkAfl

JISC infoNet (2008). *Exploring Tangible Benefits of e-Learning: Does investment yield interest?* UK: Northumbia University. Retrieved from http://tools.jiscinfonet.ac.uk/downloads/publications/tangible-benefits.pdf.

Johnson, L. (2004). *The 2004 Horizon Report*. Austin, TX: The New Media Consortium. Retrieved from http://www.fdi.vt.edu/online-resources/2004-Horizon-Report.pdf.

Johnson, L. & Adams, S. (2011). *Technology Outlook for UK Tertiary Education 2011-2016: An NMC Horizon Report Regional Analysis.* Austin, Texas: The New Media Consortium. Retrieved from http://www.nmc.org/publications/technology-outlook-uk-tertiary-education.

Johnson, L., Adams, S. & Cummins, M. (2011). *Technology Outlook for New Zealand Tertiary Education 2011-2016: An NMC Horizon Report Regional Analysis*. Austin, Texas: The New Media Consortium. Retrieved fromhttp://www.nmc.org/pdf/2011-technology-outlook-new-zealand-tertiary-education-A4.pdf.

Johnson, L., Adams, S. & Cummins, M. (2012). *The NMC Horizon Report: 2012 Higher Education Edition.* Austin, Texas: The New Media Consortium. Retrieved fromhttp://www.fdi.vt.edu/online-resources/2012-Horizon-Report.pdf.

Johnson, L., Adams, S. & Cummins, M. (2012b). *Technology Outlook for Australian Tertiary Education 2012-2017: An NMC Horizon Report Regional Analysis*. Austin, Texas: The New Media Consortium. Retrieved fromhttp://www.nmc.org/pdf/2012-technology-outlook-australian-tertiary-education-A4.pdf.

Johnson, L., Levine, A.& Smith, R. (2007). *The 2007 Horizon Report.* Austin, TX: The New Media Consortium.Retrieved fromhttp://www.fdi.vt.edu/online-resources/2007-Horizon-Report.pdf.

Johnson, L., Levine, A. & Smith, R. (2008). *The 2008 Horizon Report*. Austin, Texas: The New Media Consortium. Retrieved from http://www.fdi.vt.edu/online-resources/2008-Horizon-Report.pdf.

Johnson, L., Levine, A. & Smith, R. (2008). *The Horizon Report: 2008 Australia-New Zealand Edition.* Austin, Texas: The New Media Consortium.Retrieved fromhttp://www.nmc.org/pdf/2008-Horizon-Report-ANZ.pdf.

Johnson, L., Levine, A. & Smith, R. (2009). *The 2009 Horizon Report.* Austin, Texas: The New Media Consortium.Retrieved fromhttp://www.fdi.vt.edu/online-resources/2009-Horizon-Report.pdf.

Johnson, L., Levine, A., Smith, R., Smythe, T. & Stone, S. (2009). *The Horizon Report: 2009 Australia-New Zealand Edition*. Austin, Texas: The New Media Consortium. Retrieved from http://www.nmc.org/pdf/2009-Horizon-Report-ANZ-Edition.pdf.

Johnson, L., Levine, A., Smith, R.& Stone, S. (2010).*The 2010 Horizon Report*. Austin, Texas: The New Media Consortium.Retrieved fromhttp://www.fdi.vt.edu/online-resources/2010-Horizon-Report.pdf.

Johnson, L. & Smith, R. (2005). *The 2005 Horizon Report.* Austin, TX: The New Media Consortium. Retrieved from http://www.fdi.vt.edu/online-resources/2005-Horizon-Report.pdf.

Johnson, L. & Smith, R. (2006). *The 2006 Horizon Report.* Austin, TX: The New Media Consortium. Retrieved fromhttp://www.fdi.vt.edu/online-resources/2006-Horizon-Report.pdf.

Johnson, L., Smith, R., Levine, A. & Haywood, K. (2010).*The 2010 Horizon Report: Australia-New Zealand Edition.* Austin, Texas: The New Media Consortium. Retrieved from http://www.nmc.org/pdf/2010-Horizon-Report-ANZ.pdf.

Johnson, L., Smith, R., Willis, H., Levine, A. & Haywood, K. (2011). *The 2011 Horizon Report.* Austin, Texas: The New Media Consortium.Retrieved fromhttp://www.fdi.vt.edu/online-resources/2011-Horizon-Report.pdf.

Jones, S. & Fox, S. (2009). *Generations Online in 2009*. Washington, DC: Pew Internet & American Life Project. Retrieved from http://www.pewinternet.org/Reports/2009/Generations-Online-in-2009.aspx.

Knight, S. (2004). *Effective practice with e-learning: A good practice guide in designing for learning.* UK: JISC. Retrieved from http://www.jisc.ac.uk/media/documents/publications/effectivepracticeelearning.pdf.

Knight, S. (2005). *Innovative Practice with e-Learning. A good practice guide to embedding mobile and wireless technologies into everyday practice*. Bristol, UK: JISC Development Group. Retrieved from http://www.jisc.ac.uk/media/documents/publications/innovativepe.pdf.

Knight, S. (2009). *Effective Practice in a Digital Age. A guide to technology-enhanced learning and teaching*. HEFCE. Retrieved fromhttp://www.jisc.ac.uk/media/documents/publications/effectivepracticedigitalage.pdf.

Kozma, R. (2003). ICT and educational change. A global phenomenon. In. Kozma, R. (Ed.). *Technology, innovation, and educational change: A global perspective*. Eugene, OR: International Society for Educational Technology.

Lenhart, A., Purcell, K., Smith, A.& Zickuhr, K. (2010). Social media & mobile internet use among teens and young adults. *Pew Internet & American Life Project*, 1-51. Retrieved fromhttp://goo.gl/GQvO3.

Means, B., Toyama, Y., Murphy, R., Bakia, M. & Jones, K. (2010). *Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning*. Center for Technology in Learning, U.S. Department of Education. Retrieved from http://www.ed.gov/about/offices/list/opepd/ppss/reports.html.

Miller, R., Shapiro, H. & Hilding-Hamann, K.E. (2008). School's over: Learning spaces in Europe in 2020 : An imaging exercise on the future of learning. In Punie, Y., Ala-Mutka, K. & Redecker, C. (Eds.*), JCR scientific and technical reports* (pp. 1-80). Luxembourg: Office for Official Publications of the European Communities. Retrieved from ftp://ftp.jrc.es/pub/EURdoc/JRC47412.pdf.

OECD (2005). *E- learning in Tertiary Education: Where Do We Stand?* Paris, France: OECD Publishing. Retrieved fromhttp://www.oecd.org/dataoecd/27/35/35991871.pdf.

OECD (2010). *Are the New Milleninium Learners Making the Grade? Technology use and education performance in PISA*. Centre for Educacional Research and Innovation.

Pedró, F. (2006).*The New Millenium Learners: Challenging our Views on ICT and Learning.* France: OECD. Retrieved from http://www.oecd.org/edu/nml/.

Pedró, F. (2011).*Tecnología y escuela: lo que funciona y por qué*. Fundación Santillana. Retrieved from http://goo.gl/U5aui.

Pew Research Center (2010). *Millennials:A Portrait of Generation Next*. Retrieved fromhttp://goo.gl/iqIqy.

Pls Ramboll Management (2004). *Studies in the context of de e-learning initiative: virtual models of European Universities*. EU Commission, DG Education &. Culture. Retrieved fromhttp://goo.gl/QQ0Xn.

President's Information Technology Advisory Committee [PITAC]. (1999). *Information technology research. Investing in our future.* Arlington, VA: National Coordination Office for Computing. Retrieved from http://www.aaas.org/spp/yearbook/2000/ch24.pdf.

Punie , Y. & Cabrera , M. (2005). *The Future of ICT and Learning in the Knowledge Society* - Report on a Joint DG JRC - DG EAC Workshop held in Seville, 20 - 21 October 2005. Seville: European Commission Directorate - General Joint Research Centre.

Punie, Y., Zinnbauer, D.& Cabrera, M. (2006). *A review of the Impact of ICT on Learning*. Working paper prepared for DG EAC. Institute for Prospective Technological Studies (IPTS), JRC, European Commission. Retrieved from http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=1746.

Purcell, K., Heaps, A., Buchanan, J. & Friedrich, L. (2013). *How Teachers Are Using Technology at Home and in Their Classrooms.* Pew Research Center. Retrieved from http://pewinternet.org/Reports/2013/Teachers-and-technology.

Redecker, C (2009). *Review of Learning 2.0 Practices: Study on the Impact of Web 2.0 Innovations on Education and Training in Europe*, JRC Scientific and Technical Report, EUR 23664 EN. Retrieved fromftp://ftp.jrc.es/pub/EURdoc/JRC49108.pdf.

Redecker, C., Ala-Mutka, K. & Punie, Y. (2010). *Learning 2.0 - The Impact of Social Media on Learning in Europe*. Seville: IPTS.Retrieved fromhttp://ftp.jrc.es/EURdoc/JRC56958.pdf.

Redecker, C., Leis, M., Leendertse,M. Gijsbers, G., Punie, Y., Kirschner, P. Stoyanov, S. & Hoogveld, B. (2010). *The Future of Learning: New Ways to Learn New Skills for Future Jobs.*Results from an online expert consultation.Retrieved from http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=3659.

Redecker, C., Leis, M., Leendertse, M., Punie, Y., Gijsbers , G., Kirschner, P., Stoyanov, S. & Hoogveld, B. (2011). *The Future of Learning: Preparing for Change*. Seville, Spain: Institute for Prospective Technological Studies, JRC, European Commission. Retrieved from http://ftp.jrc.es/EURdoc/JRC66836.pdf.

Sharples, M., McAndrew, P., Weller, M., Ferguson, R., Fitzgerald, E., Hirst, T., Mor,Y., Gaved, M. & Whitelock, D. (2012). *Innovating Pedagogy 2012*: *Open University Innovation Report 1*. Milton Keynes: The Open University.

Simon, H., Fischer, T. & Kugemann, W. F. (2009). *Good Practices for Learning 2.0: Promoting Innovation. An In-depth Study of Eight Learning 2.0 Cases*. JRC Technical Note, JRC 53212. Retrieved from http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=2599.

Smith, A., Rainie, L. & Zickuhr, K. (2011). *College students and technology.* Pew Internet Research Group.Retrieved fromhttp://goo.gl/G1pFm.

Sola, M. & Murillo, J. F. (Coords.) (2011). *Las TIC en la Educación: Realidad y Expectativas. Informe anual 2011.* Madrid : Fundación Telefónica y Ariel. Colección Fundación Telefónica.

Tapscott, D. (1998). *Growing up digitally: The rise of the Net Generation.* New York: McGraw-Hill.

Tapscott, D. (1999). Educating the Net Generation. *Educational Leadership*, 56 (6).

Taylor,P., Parker, K., Lenhart, A. & Patten, E. (2011). *TheDigital Revolution and Higher Education*. Washington DC: Pew Research Center. Retrieved from http://www.pewsocialtrends.org/files/2011/08/online-learning.pdf.

Tubella, I., Gros, B., Mas, X. & Macau, C. (2011). Flexible education: Analysing the changing demographic of online students at the UOC. *eLearning Papers*, 24. Retrieved from http://www.elearningpapers.eu/index.php?page=home&vol=24.

Underwood, J., Baguley, T., Banyard, P., Dillon, G., Farrington-Flint, L., Hayes, M., Le Geyt, G., Murphy, J. & Selwood, I. (2010). *Understanding the Impact of Technology: Learner and School level factors.* Coventry: Becta. Retrieved from http://dera.ioe.ac.uk/1434/.

Valiente, O. (2010). 1-1 in Education: Current Practice, International Comparative Research Evidence and Policy Implications, *OECD Education Working Papers*, 44, OECD Publishing. Retrieved from http://dx.doi.org/10.1787/5kmjzwfl9vr2-en.

Zickuhr K. (2010). *Generations 2010*. Pew Internet & American Life Survey 2009-2010. Retrieved fromhttp://goo.gl/KSM7v.

Zickhur, K. (2011) Generations and their gadgets. Pew Internet & American Life Survey 2010. Retrieved fromhttp://www.libraryworks.com/bynumbers/pip_generations_and_gadgets.pdf.

Zickhur, K. & Smith, A. (2012). *Digital differences*. Pew Internet & American Life Project, Pew Research Center. Retrieved fromhttp://goo.gl/aJ4Yh.