New media and education

Digital natives, schools and universities

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Abstract

The present contribution will outline the evolutionary path of teaching and learning methodologies in the last thirty years devoting a more detailed analysis about the last ten/fifteen years, the so called Internet era. The main aim of the first three sections is to provide the evolution of the scenario and some recent trends. The second part of the paper describes the effects of this environment on young generations and more in detail the educational benefits and drawbacks. In the last thirty years many things changed. Pioneers and curious explorers of the digital domain left the arena to digital immigrants and more recently digital natives come on stage.

Teachers and Professors, mainly belonging to the digital immigrants community, are training people grown up with smart phones, the Internet and social web. It is really so evident a different mind-set?

Is it true that pupils refer to the Web as their own memory and basic knowledge? Do they really think: why do I need to memorize when Napoleon did surrender at Waterloo if I can click on Wikipedia? What about the social impact of the "internet generation"? Do they need to learn more about what was before and the evolution of computing? What about potential drawbacks and risks?

How did and still do trainers adapt their curricula methodology and pedagogy to the evolving environment? Is the way to transfer information and knowledge significantly different from the traditional one? Do we need to re-train trainers? How can we bridge the gap between the traditional way of thinking and the huge set of opportunities offered by the information age? Is creativity only constrained by our imagination?

Foreword

In the last thirty years we witnessed to a number of relevant innovations and changes. Some of them belong to the information technology domain and parts of them were the reason why the IT domain became the ICT domain.

In order to better understand problems and issues related to education and learning it is useful to outline some of the most relevant achievements and milestones in the technological domain.

If we focus on the European approach to the spread of information technology termed in the '90ies "Information Society" we can find initiatives such as i2015 the EU policy framework for the information society and media for the

next decade and, at global level, the WSIS+10 a ten years activity aimed to draw the guidelines for an harmonious and fruitful development of the information society. It promotes the positive contribution that information and communication technologies can make to the economy, society and personal quality of life.

Everyone experienced in "ICT based innovation" knows that "It is not only a matter of technology". Of course technology advances are one of the potential actors as in the case of the diffusion of personal computing or easy access to digital networking. Anyway different parameters are actively influencing e-Services success or failure: cultural aspects, organisational issues, bureaucracy and workflow, infrastructure and technology in general, user's habits, literacy, capacity, market models, interaction design or merely mind-set!

Before looking in detail how all these aspects are impacting on education and learning let's take into account some additional relevant aspects.

Never alone, you are always online!

One of the most significant changes to occur in the field of information technology over the last few decades has been the implementation of real-time communication and information exchange between computers: networking.

Mainframes

A computer was originally considered to be Leibniz's "monad", an ultimate atom without windows and doors; a sealed entity. Intercommunication processes activated external access to these monads, allowing information and data exchange between them and thus multiplying their added value; networks of computers possess expanded functionalities and services. A number of different standalone proprietary networks were gradually merged into the network of networks: the Internet.

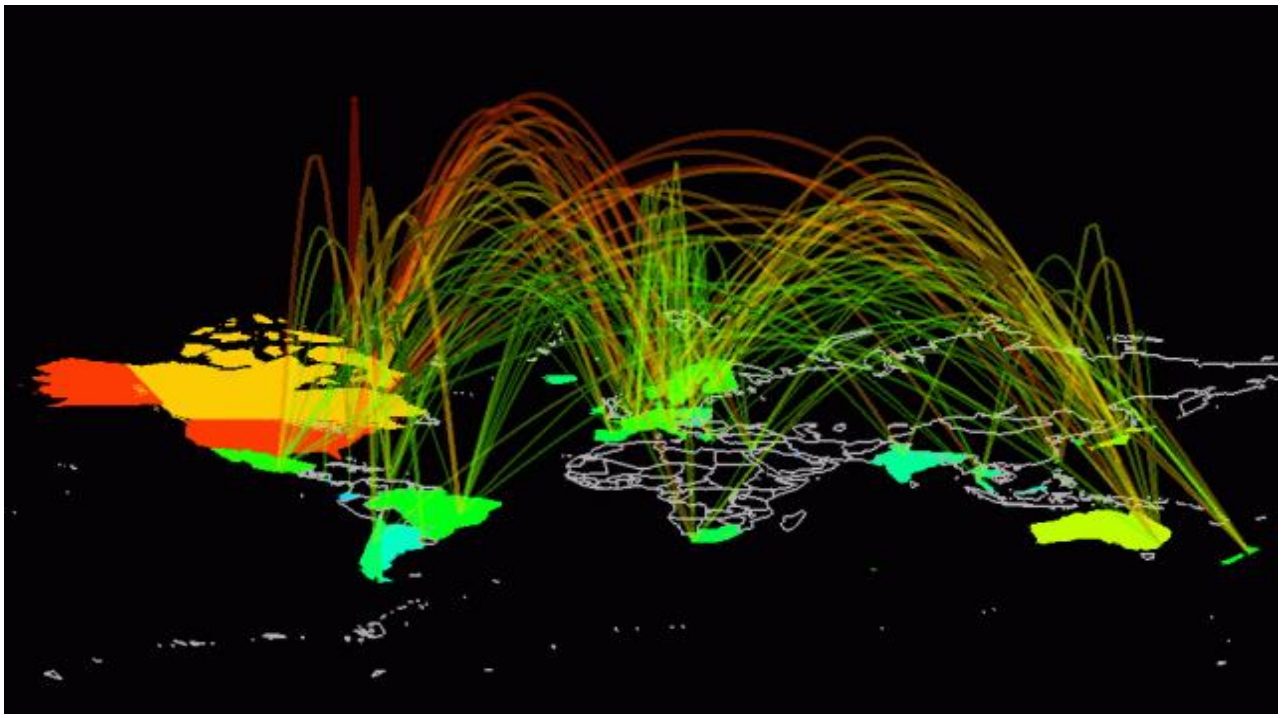
The Internet, the de facto implementation of global networking, has revolutionised the world of computing and communications like nothing before.

From an ontological point of view, we are dealing with a new class of objects. Digital information and its related technologies have the potential to make a huge impact on culture and society. Digital technologies, especially the Internet, have completely overturned the concept of commercial and distribution goods, since any product that can assume the digital format can be cloned an essentially unlimited number of times at almost no cost.

Super Computers

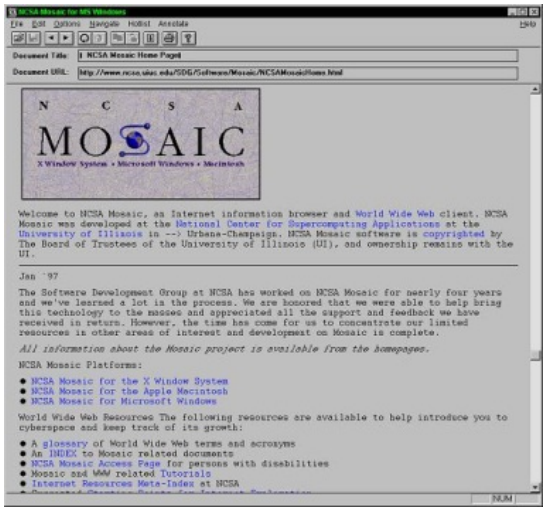
The Internet has incredibly facilitated access to mass communication. It combines a worldwide bi-directional broadcasting capability with a mechanism for information dissemination, which offers us the opportunity to reach a wide audience with minimal effort. Before the Internet, the only way to reach wide audiences was radio and television broadcasting, and before those were invented, mainly printed materials or heralds. In addition, it is a medium that encourages collaborations and interactions between individuals and their computers without regard for geographic location,

gender, social class and age. Recent social and political phenomena outlined the power of real-time unlimited freedom of communication and information not only limited to local hosts but even open to mobile personal terminals such as smart phones and tablets.



From a passive to an active role

The diffusion of the Internet lowered the threshold to become "publisher"; it was the first time that a single citizen may reach a huge audience. This opportunity was originally limited to webmasters and web publishers but in a glimpse it became a common right[1].



The first public "browser" NCSA's MOSAIC

As it happened more in general in the field of Internet technology, enhancements and developments were "user trained" instead of "technology trained".

On the occasion of the first three or four WWW conferences a number of enthusiast users proposed their personal contribution to the Web, tables, different image formats, colours, etc. The common feeling to become "active" contributors of on line content boosted the evolution of this new medium.

On the contrary, it is a common understanding that television is a passive medium, sometimes even a pure companion or decorative device. Some people use to switch it on simply to do not feel alone.

Previous inventions, such as the telegraph, the telephone, the radio, and the computer itself, set the stage for this unprecedented integration of capabilities. Even the future evolution of such an

[1] Some countries consider the access to the Internet as a human right by law (eg. Belgium).

innovation is into a degree unpredictable; will the global network be a mixture of networks (wired, wireless, satellite, sensors, peer-to-peer, private, phone and other appliances)? This includes some major revolutions. A part from “stand-alone” to “ubiquitous always on”, there is now a kind *of info and service - sphere* all around. Moreover, there is a shift from top down info and services to bottom up even crowd based services, in addition from the risk to get lost in the cyberspace to a number of specific applications providing an aimed insight in the cyberspace as it happens with Apps.

Some years ago after the general rise of the Internet as an almost mono-directional media, from webmaster/web editors to the users an interesting phenomenon appeared: the so-called social network.

With new devices like smart phones or Internet “pads” people just “click” on the screen and receive a specific service, tailored for their needs. Then, there is the shifting from stand-alone users to communities, which is a complete different concept to work together and to contribute that includes crowdsourcing. Many people and companies are thinking about this way to provide useful content and are asking people, consumers, and “prosumers” to contribute in order to set up interesting services. So, we passed from a lack of content, highways without cars, to massive user generated content. One of the side effects, is the "15 minutes of fame", an expression coined by Andy Warhol many years ago.

"Celebrities" in the 21st century can now be famous simply by being in the right place at the right time. The social Web does the rest (Flikr, Twitter, MySpace, YouTube, Facebook, Picasa, etc). As regards competition between different media, we already saw in the past that new technology will not completely reduce the market of the previous technologies.

There will probably be different arrangement and a balance between the old solution and the new one that rearranges the market. To some extends social networking is the “active” brother of peer to peer approach. As peer to peer communication and information interchange is the realm where "All the users are equal" social networking is the realm where "All the users are both consumers and authors/contributors". Nowadays we are experiencing the start-up of a completely new way to use computers and design software.

One of the significant innovations in this period has been activated by Apple introducing the iPhone before and more significantly introducing the iPad concept later on. Even if the basic idea is dated long time ago, even before the iTunes on line shop, different companies thought about online software market selling or even hiring software components thanks to the network. In the following part of this paragraph I will refer to Apple devices as an example even because they where the rule braker but now the same applies to competitors.

The two basic innovation aspects introduced by Apple are a seamless hardware/software

access to network content and services and a new way to sell and buy software in a digital market arena. Let's start from the last one, the way in which it is conceived the Apps delivery platform facilitates the exchanges and re-opens the market to single software developers sometimes competing for their own 15 minutes of fame reaching the top of the hit parade sometimes looking for business opportunities. This mechanism changed the market approach moving this software market segment closer to other media markets such as music and movie. The first aspect, seamless hardware and software access to the Internet and on line applications generates a different feeling between users and electronic appliances contributing to bridge the digital gap.

Looking more in detail to the Apps philosophy from the user point of view we find a third innovative key point. Ninety per cent of the information accessible through the Apps is already available on the Internet so which is the revolutionary concept? The key of success of the Apps is the ease of use, the idea to provide one specific service in a very practical and easy to understand way. It is a kind of extension of the iPod concept one device specifically designed in order to provide one service or fulfil one task, no compromises. The Apps are a "filter" between the "ocean[2]" of content laying on the Internet and the user. In addition a set of tight rules defined by Apple ensured software quality standards and security. The Apps market looks more similar to the music and movie market than the traditional software market. There are trailers, hit parade, Apps of the week, application appeal, etc. Of course Apple is not alone in the market arena, Android and friends are there as well. Back to the first aspect mentioned, seamless access is relevant as well in this scenario because the *service-sphere* offered by iPhone and iPad perfectly fits both with the "disappearing computers" and the "information at your fingertips" concepts. Such a shift in the perception of the service provision opened a new scenario where the so called "digitally divided" were probably less or no more "divided".

Internet Citizens alias Netizens

The human sense of belonging. The idea to share something with someone else, a group of people, sometimes generates a sense of belonging to a "community". Memetics use to consider this "something" as the "meme[3]". A meme is a cognitive or behavioural pattern that can be transmitted from one individual to another one. Consider young people that wear clothes in an unconventional way or use signs and gestures that show that they belong to a particular community. The basic mechanism is very simple; since the individual who transmitted the meme will continue to carry it, the transmission can be interpreted as a replication. A meme carrier, known as a replicator, is created when a copy of the meme is made in the memory of another individual.

Replication or self-reproduction is the basis for the memetic life cycle. This leads to the spread of memes to more and more individuals, such that the meme acts as a replicator, in a similar way to the gene (Dawkins 1976; Moritz 1990).

Communities are integral part of the history of technology; in the specific field of communication we find "amateur radio" also called *ham radio* or OM (old man) and later on the citizens' band

[2] David Weinberger, Too Big to Know, Basic Books 2012 - Its hypothesis is that knowledge and expertise are becoming networks, and are taking on the properties of networks.

[3] In analogy with "gene"

(CB) community. Of course technical communities are not limited to the field of communications, we have computer graphics, video games, and more such as the Manga Fandom[4] but communication is the key player in the creation of communities and due to this communities directly dealing with communication means are facilitated.
In the early stages of computer intercommunication, apart from exchanging signals and data, a basic text messages service was implemented. Ancient timesharing computer systems had local "mail" services so its users could communicate. But the real power of "electronic" mail came true when mail could be distributed to distant computers and all the networked users could communicate. Late in the '80ies the increasing use of bulletin board systems (BBS), file transfer protocol (FTP), Telnet and other communication tools such are Veronica and Gopher prepared the playground for the massive use of the Internet and the World Wide Web. Since the beginning of computer users communication a sense of community arose and a common feeling on behavioural rules was implemented.
Michael Hauben, professor at the Columbia University, terms the users of this new social institution, an electronic commons, Netizens or Citizens of the Network. The set of shared rules are by consequence, termed Netiquette, etiquette governing communication on the network (1982).

The present: some trends

After a quite long period of time without major changes some major trends are now recognizable. Such trends are affecting technology, users and the market.

Technology is evolving sometimes reshaping already proposed solutions. Smart phones much more comprehensive than the old "Palm PCs", they integrate mobile phone, GPS and multimedia PC functionalities. Almost the same happened for the old "Tablet PC" newly reborn under the flag of "iPad" and brothers. The new generation is *always on* and *position aware* as smart phones are.
The availability of such devices together with the necessary widespread diffusion of wireless connectivity both Wi-Fi or cellphone based make the Mark Weiser[5] concept of ubiquitous computing and "calm technology" come true. A possible definition of Calm technology it might be "that which informs but doesn't demand our focus or attention." The Weiser's concept of computer as a pure mean, an invisible servant extending our unconscious and creating calm seems to be closer now. Calm technology is our next goal, an ambitious goal.
Users are now surrounded by a kind of info-sphere ensuring the best and cheapest connectivity everywhere. The combined effect of portable devices and info sphere pushed users from "e" services to "m" services (e.g. from eLearning to mLearning).
The immediate success of the Apple iFamily switched the interest of users from software programmes to Apps. Last but not the least almost at the same time the computer scientist concept of "Clouds" captured the users in perfect synergy with smart phones and pads, so we moved from local storage and processing to cloud computing in its various declinations (SaaS, PaaS, IaaS,

[4] Manga fandom is a worldwide community of fans of Japanese cartoons manga.
[5] Mark D. Weiser (July 23, 1952 – April 27, 1999) was a chief scientist at Xerox PARC in the United States. Weiser is widely considered to be the father of ubiquitous computing, a term he coined in 1988 (Wikipedia)

Haas). So clouds are now populated by business data as well as by personal data, photo albums and songs. Such a new trend unleashed the creation of innovative devices designed as data access appliances and enabled cross platform fruition of services. Anyway at least the idea to access your data anytime anywhere is again a powerful driver of innovation.
One last comment on the evolution of technology, as it happens in the maturity phase of many sectors "performances are good by definition… users' choice is about appeal and perceived utility."

Users are evolving; their own requirements and expectations are changing. It is evident that a new way to use / "consume" media, information & news is coming to the fore. In some way the paradigm "media is the message" is now media, message and consume are tightly linked together. One of the first sectors touched by such a new age was the music sector. In a glimpse we turned our approach to contemporary music from few "long playing" per year to thousands of mp3 files constantly updated.
In recent times the digital domain, once strictly populated by professional users and computer scientists, open up to former digitally divided. Of course this is a natural part of the game, in the last twenty years we witnessed the progressive change of the audience attending major events. Traditional highly scientifically skilled ACM Siggraph attendees left the arena to artists, special effects supervisors, architects, video clip and promo producers. The World Wide Web conferences did the same in favour of philosophers, writers, art historians, and civil servants.
The other side of the coin of such a renewed audience is the evolution from content consumer to content prosumer. Users are no more simply "consuming" content, they are even creating and sharing their own content adding a new dimension to IPRs.
There is another significant trend directly addressing users: from information provision to service provision. For quite a long time the sentence due to Bill Gates "information at your fingertips" ruled the digital domain and the incredible information container represented by the Internet was, right or wrong, the source. Next step was to pass from information provision to service provision; this means in general a bidirectional flux of information and a higher level of interaction. As a tangible result a number of eServices appeared in already known or completely new sectors increasing the added value provided by technology. At the same time started a shift from the Information Society toward Knowledge Society:

Market is evolving in a very significant way. First of all the transition between the purchase of plastic boxes on the shelves containing DVDs plus printed user manuals and on line purchase and download of applications with pdf or ebook manuals. The idea to buy something "immaterial" on line transferring the right to use in a immaterial way is now accepted by the market. iTunes as a kind of rule breaker promoted this approach in the field of the on line music market many[6] years ago.
At the same time we witnessed to a significant shift from few expensive software solutions to many cheap and small Apps. This is in some way related to the interesting re-opening of the software market to single and small groups of software developers due to the availability of new successful

[66] Many years in the ICT time scale of course!

development and delivery platforms to be "populated" by applications and the advantage of the new software market model based on online distribution and support. The last aspect has relevant effects on the software industry because on one side it bridges the gap between micro and small software enterprises and medium and big companies both offering a set of very well-known e-commerce platforms and creating business opportunities for compact and well-focused applications. This may recall the dilemma between multipurpose devices, many things at an average level and ad hoc devices; few things in the best way. Many years ago, "many" of course in the ICT time scale, a "guru" in the field of interaction design, Donald Norman, proposed his own solution to this problem creating the iPod. Apps in general use to follow this last approach; you may need many single apps in order to accomplish a number of different tasks.
Online distribution and payment based on e-shops enabled the access to the mass market to single developers, in addition standardization of systems and guidelines helped.
This opportunity extended the market from software companies to single or small groups up to social and crowd sourcing.

Crowdsourcing seems to be a completely new paradigm of software development beyond user groups and open software, the only way to face huge projects and compete with key software enterprises; moreover the way to imagine and create completely new services based on voluntary active or even passive contribution due to crowd of users. This is the case of services that does not find a proper economic dimension or even do not have the required appeal in order to be provided by companies may only rely on the crowd. In the global society crowds are playing the role of "public services". In conclusion even the consumer software market is changing, now is getting closer to the music market.

- People is looking for the Top 10 Apps;
- The consume of Apps is continuous;
- The market model is based on low costs /big numbers;
- The IPR management is evolving in order to self-adapt to the new trends;
- Digital media are evolving . . .
- . . .

Social Media: opportunities and threats

Social media is the key of success of the digital domain the reply to the Win '95 promo "*Where do you want to go today?*", the real mass use of digital resources, the one creating "addiction" is the social side. Since the creation of the first Blogs opening the opportunity to share opinions and beliefs with a significant number of users the number of "social" application grow up very quickly: Blogs ('90), Wikis ('95), Semantic Web ('97), Wikipedia ('01), Picasa ('02), My Space ('03), Facebook ('04), YouTube ('05), Twitter ('06), ... Social newspaper (Youreporter, Bambuser) . . . . self made journalists . . .

In the early stage of the Internet, communication was based on the so-called "netiquette", a kind of Galateo or Bon Ton of Internet users, the advent of Web X.0 and the social web requires more specific rules addressing first of all the field of ethics. Of course freedom of expression is one of the most appreciated opportunities offered by the network and it is already evident that any kind of top

down censorship or control does not succeed. The evident vocation toward freedom of expression is many times a direct cause of governmental censorship forbidding social applications in some countries. So it happens that Tweeter, Facebook, YouTube or even some thematic web sites are not allowed. Here apart from ethical and philosophical issues it may come to the fore the economic and financial aspect of entering that market adhering to the requested censorship or not[7].

Anyway on the reverse there is a real risk of misuse and misinformation thanks to these technologies. The movie "Citizen Kane[8]" directed and interpreted by Orson Welles in 1941 outlined the relevant "power" of journalism[9], the movie "Network[10]" directed by Sydney Lumet outlined the power of television in 1996 and perhaps "The Net[11]" and "S.Y.N.A.P.S.E.[12]" together with "The Social Network[13]" started to outline the power of the Internet.

News and Media are key elements in the global society. CNN, BBC, Al Jazeera[14], Al Arabiya[15] are writing the history of the planet 24x7 and on the grassroots side YouReporter[16] and Tweeter are complementing this effort. The risk of misuse of such technologies and misinformation is probably higher than in the past. So it might happen that we will watch an updated version of the movie "Wag the dog[17]" in the near future.

In June 1993 The New Yorker published a cartoon by Peter Steiner. The cartoon features two dogs: one sitting on a chair in front of a computer, speaking the caption to a second dog sitting on the floor "On the Internet, nobody knows you're a dog". Right or wrong, that's one of the features of the Internet. That's the story of the Syrian "lady" blogging in 2011, the starting point for the "dark power" of the Internet, the realm of hackers and cheaters. The key point is: what is written or anyway appears on the Internet is news by itself. There is no more time in order to check everything Internet provides real time news. The transition to on line journalism and the feeding frenzy of press apparently brook the old rule the accurately check the source, at least three times, before launching a news.

We are flooded[18] by user-generated content (UGC) largely without any qualification and certification of the source. Many times the drawback attributed to the amanuenses is affecting even web publishers: information and content is re-used and re-published adding or replicating errors and bugs. The short content production chain, sometimes even limited to a one-stop shop, does not include an editor in chief or a supervisor; so far the overall quality of prosumer content and information is quite low.

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[7] E.g. the Chinese market offering million of additional customers.

[8] Citizen Kane directed by Orson Welles, 1941 RKO Pictures

[9] The Italian title of the movie was "The forth power" in analogy with the third "The workers" depicted in the extraordinary paint by Pellizza da Volpedo.

[10] Network, directed by Sydney Lumet, 1976 Metro-Goldwyn-Mayer United Artists

[11] "The Net" directed by Irwin Winkler (Columbia Pictures Industries Inc. - 1995)

[12] S.Y.N.A.P.S.E. (Antitrust) directed by Peter Howitt (Metro Goldwjn Mayer - 2001)

[13] The Social Network directed by David Fincher (Columbia Pictures 2010)

[14] www.aljazeera.com/

[15] www.alarabiya.net

[16] A recent event in the field of newspapers is the birth of The Huffington Post, inventing a completely new approach to newspapers.

[17] Wag the Dog (1997), Dustin Hoffman, Robert De Niro and Anne Heche, directed by Barry Levinson

[18] Roger E. Bohn, James E. Short (2009), How Much Information? 2009, Global Information Industry Center University of California, San Diego

As an IBM top manager told recently on the occasion of the Global Forum: “Do not trust in any information coming from unknown source”
The evolution of on line news due to the social web and the birth of “prosumers” did the rest. Twitter, YouTube, Facebook and blogs represent a real revolution in the domain of news.
As already stated Internet is much more a counter-power than a power, the common idea about the Internet is the network as a powerful tool of freedom and democracy. This is probably true but it is even true the opposite a misuse of the network and misinformation disseminated and empowered by the Internet and its powerful mechanism.

Cyber IDs allow multiple IDs and potentially Dr Jekyll and Mr Hide. The misuse of these powerful resources may damage the reputation of persons or blackmail them. Some teenagers have been encouraged or forced to suicide. An additional aspect related to the use of the Internet compared with traditional media is the long-lasting persistence of information. Personal information wrote ten years ago is still available on line, this is good on one side but the “right to be forgotten” has to be be ensured like the giant Google did in recent times.
Last but not the least, we can mention even personal information, there is a need to stress that personal information are “personal”, they belong to the single person not to the service provider or business company. This is a switch of paradigm between protection to right.

Immigrants & Native

Now let’s get closer to the main topic, young students and new generations. Is a common understanding that recent generations represent a discontinuity if compared with the past one. Such discontinuity or if preferred singularity is recognised both by adults complaining because their children do not pay attention or are getting bored by learning and by adults that discovered new skills and capabilities in young generations. Why my daughter may remember one by one dozens of Pokémon names and attributes and she completely unable to remember the names and the time sequence of the seven kings of Rome? What is the difference between Pikaciu and Romolus?
What’s wrong? Do we need at least to re-shape our didactic methodology? Probably yes, and unfortunately we are already in late, we miss and are still missing an incredible learning potential due to the improved mind-set of new generations. Of course, as mentioned in the title of this contribution, such generations are now attending university courses and in glimpse the problem will find a natural solution, they will educate future generation taking advantage from their own vision and approach to information and knowledge. Of course the lack of our “cultural mediators” role will cause, in such a situation, some drawbacks in the implementation of the new approach to traditional content.

The impact on daily life of digital technology is much more relevant than the effect due to previous technologies. The appeal and the broad field of applications favour a real change of behaviour.

More than ten years ago the report *New Information Technologies and the Young*[19] identified the extent of provision and access to technologies, the ways in which young people use them, and some of the opportunities and difficulties associated with each form of communication and expression. The report provides a comprehensive picture of young people as users and consumers of new technologies, how many hours per week watching television, how many hours playing video games, downloading music and videos, browsing the internet, using smart phones, instant messaging and more. In addition it provides some information in terms of their creative activity, such as their use of digital audio and video, website creation, and distributing visual, musical or literary work across the Internet.

Causes and effects: the origin of this pandemia

A detailed analysis of the pattern of usage shows that in the year 2000 television was the most established and the most traditional medium. Accordingly with official surveys in 1998 the average weekly viewing time for all age groups amounted to forty-three hours a week (81% terrestrial television, 12% on cable and satellite), a similar survey in 1990 increased by 5%. In addition we have to take into account the time spent watching VCR tapes and later on DVDs. More specifically young people was and still is much more attracted by specific shows such as MTV. A channel characterised by dynamic schedule, high speed, smart communication and ad hoc arrangement.

On the other side of the Atlantic Ocean M. Chen, in the "Smart Parents Guide to Kid's TV", (1994) gives the number as 4 hours/day four years later "Television in the Home, 1998: Third Annual Survey of Parent and Children[20]" gives the number of TV hours watched per day as 2.55. Taking the average, 3.3 hours/day x 365 days = 1.204,5 hours spent watching television every year. In recent times, in addition to the boost of channels offer due to the digital terrestrial television including a huge number of international thematic channels we must consider the YouTube and Facebook "effect" so we must add some more time spent watching videos.

Another relevant branch of communication strictly related to TV programmes is commercials. There are roughly 18 30-second commercials during a TV hour. 18 commercials/hour x 3.3 hours/day x 365 days (infants love commercials) = 21.681 commercial per year.

Video games, this is one of the most interesting and powerful digital domains. In the '70ies young people start to enjoy arcades playing with Pong, Space Invaders and Pack Man. The rise of computer games in their different shapes and formats generated a wide range of criticism. This may be true but on the positive side playing computer games pupils develop specific skills in real time

[19] The project New Information Technologies and the Young was launched by Screen Digest—General Direction Office IV of the Council of Europe. A final report on the project was published; see Council of Europe (2001).

[20] "Television in the Home, 1998: Third Annual Survey of Parent and Children, Annenburg Policy Center, June 22, 1998 gives the number of TV hours watched per day as 2.55. M. Chen, in the Smart Parents Guide to Kid's TV, (1994) gives the number as 4 hours/day. Taking the average, 3.3 hrs/day x 365 days x 18 years = 21,681.

interaction, visual perception and parallel processing. Of course such skills may differ due to different game families, abstraction or simulation, logic or action and more.
The videogames average playtime it was estimated in 1966 as 1.5 hours/day[21], forty years later in 2006 it was estimated 5,5 hours, 7,3 in 2009 and 8 hours in 2010[22]. So 8 x 365 = 2920 hours[23].
If we consider the time spent playing games, this in the past was much more than the time spent in using the PC but nowadays due to Internet browsing, instant messaging and social activities, video gaming is probably less relevant.
Taking into account all the different appliances: PC[24], smart phone, gaming consoles, tablets and pods, it seems reasonable to estimate round 8 hours per day average usage. That means 8 x 365 = 2920 hours per year. Of course this usage is many times mixed up with the previous one, video games, this of course means that the overall total will be in average at least the same.

In the seventies fax messages revolutionised communication in some countries, especially those were the post service wasn't really efficient, later on mobile phones started to change our behaviour. The explosion of mobile communication associated with the pre-paid cards lowered the threshold to access mobile communication. But the real revolution was due to SMSs[25]. The impact of such a service was originally so much underestimated that it was offered for free. SMSs unleash fantasy and creativity mixing up characters, signs, emoticons, empty spaces and time delay I can activate imagination. Such a successful service opened the market to instant messages and on line chats. Now is evident the power and social impact of such communication media so if we try to size this branch we can assume an average 40 per day x 365 = 14.600 instant messages and email per year. This is not unrealistic even for pre-teens – in just one instant messaging connection there may be over 100 exchanges per day – and most people do multiple connections.
I don't want to compare this figures with the one concerning reading. Apart from very few young "book eaters" there is no comparison between time spent reading books and digital devices.

Across Europe in 2001, the six main activities related to the Internet were educational content searching, email messaging, use of chat rooms, online entertainment, online gaming/gambling and shopping. More than ten years later the pattern is a little bit different. The advent of the so called "social web" boosted the profile of "prosumers" and private Internet usage is in average dominated by Facebook, Twitter, YouTube, etc.

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[21] Source: "Interactive Videogames, Mediascope, June 1966.
[22] NPD, Video Games Market Research, https://www.npd.com
[23] Of course 8 hours/day are split in different blocks during day and night.
[24] Steven Reinberg, U.S. Kids Using Media Almost 8 Hours a Day - Survey finds few parents set rules as use of 'smart' phones, computers soars, Bloomberg Businessweek, 2012
[25] Mobile communication enabled a kind of virtual ubiquity. Originally intended to be a minor aspect of mobile communication, the utility and popularity of short message service (SMS) messages were initially hugely underestimated as communication tools. As we have seen, they have enabled a new way to work and are an incredibly powerful aid to interpersonal relationships. Today they are often used as a private channel, as opposed to a public channel. SMS offers typing and paging features plus emoticons and the time dimension. The employment of text and the time delay enable the use of imagination the most powerful tool supporting communication.

Young and kids are constantly feeding their own Facebook profiles or posting their own video clips on YouTube. They are part of the digital community, they have a specific sense of belonging to the on line community.

It is not completely clear whether computer-based activity and particularly Internet browsing together with "social" interaction will decrease the amount of time devoted to traditional study or even work. According to a report from the UK, network activities eat into the time normally reserved for other entertainment activities, nighttime and even active work.

The Internet Generation

As a result of this environmental change, the combined action of long term exposure to TV programmes, video games, Internet browsing and more we face now a completely new generation, the digital natives[26]. They are the eCitizens. How do we identify a digital native? "Digital Natives are used to receiving information really fast[7]". Their brain seems to be able to process information in parallel and multi-task. So they prefer direct/random access to information and content. Graphic and Video, let's say "Visual" content, are longer preferred than text. They use to look for support on line and use to belong to one or more communities (users, supporters, owners,). This is a side effect of their special skills acquired in hours and hours of digital tasks.

Similar skills are often misunderstood or very little appreciated by older generation, the *digital immigrants*, they perceive a mix of drawbacks such as students look bored and pay a very little attention or they do other tasks during lectures. This is a side effect of their special skills acquired in hours and hours of digital tasks. The information transfer rate of MTV or the attention required by a video game is much more than a foreign language lesson. The power of digital story telling is a strong competitor in many cases. The skill to learn by example or by doing is very relevant in digital generations; they do not need instruction manuals or training courses. Nowadays digital devices, and not only them[27], do not include users manuals, people use to learn by doing, only if they require special safety instructions there is an instruction sheet within the box.

Digital natives prefer games to "serious" work; they prefer edutainment applications or serious games. There is a very well known example of marketing strategy based on educational games. An American company launching a new 3D CAD software on the market decided to market this new product thanks

[26] Marc Prensky, Digital Natives, Digital Immigrants, On the Horizon (NCB University Press, Vol. 9 No. 5, October 2001).

[27] E.g. IKEA furniture kits use to provide a very basic instruction sheet.

to an on line game. In order to play the game the user must recreate some mechanical details using the 3D CAD software tool, at the end of the game the user have learned enough in order to use the CAD system.

Dealing with digital natives

In 2001 in a very well know paper[28] Mark Prensky outlined: "It is amazing to me how in all the hoopla and debate these days about the decline of education in the US we ignore the most fundamental of its causes. Our students have changed radically. Today's students are no longer the people our educational system was designed to teach."

In the same period of time another expert, Francesco Antinucci, a cognitive psychologist wrote a book entitled "La scuola si è rotta – Perché cambiano i modi di apprendere[29]" ("The school crashed: why learning patterns are changing"). Later on the same author wrote "Computer per un figlio[30]" ("Computer for a child"). I was involved myself in the same field both because of my direct interest in exploring the use of digital technologies in the academic field[31], early in the nineties my lab was in charge for the EMWAC (European Microsoft Windows Academic Centre) and because my research activity in the field of new technologies for Cultural Heritage and Museums. Again the discontinuity between past and actual generations was the key topic of the book.

Is it true that pupils refer to the Web as their own memory and basic knowledge? We may say basically Yes even if this represents for many reason a concern. Is information available on line quality proof? And more and more they really think: why do I need to memorize when Napoleon did surrender at Waterloo if I can click on Wikipedia?

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[28] Marc Prensky, Digital Natives, Digital Immigrants, On the Horizon (NCB University Press, Vol. 9 No. 5, October 2001).

[29] Francesco Antinucci, "La scuola si è rotta – Perché cambiano i modi di apprendere", Editori Laterza, 2001

[30] Francesco Antinucci, Computer per un figlio: giocare, apprendere, creare, Editori Laterza 2001

[31] Alfredo M. Ronchi, Hypertext in Education, International Conference ECAADE, Budapest (H), September 1990, Alfredo M. Ronchi, Windows in cattedra, SOFTTIME n°1 /1992, Alfredo M. Ronchi, Patrice Arenra, Philippe Benthien, Eric Busch, Sébastien Canus, Bruce Damer, Elseline Smit, David Villechaise , Virtual University: a connective intelligence exercise, MediARTech, Fortezza da Basso. Firenze 23 maggio 3 giugno 1996, 2. Alfredo M. Ronchi, "Enseignement a distance: personnalisation, interactivite' et evaluation", Fondation Sophia Antipolis, Sophia Antipolis 27,30 March 1996.

Part of the problem is due to the fact that in recent times some technologies are (re-) enabling and extending some "old" communication formats. Today, people have the opportunity to create digital objects, a new class of objects from an ontological point of view, and they can use multimedia, virtual reality technologies and the Internet, which are all powerful communication tools, but still immature technologies that have yet to fulfil their full potential.
We cannot forget that a relevant part of education in the past was based on "personal" mentors and direct training in ateliers. This educational approach was based on customised methodology and learning by example or learning by doing. In many cases the format of knowledge transfer was in parallel and multitasking. Later on mainly due to the need to multiply the number of learners we choose to rely on books and lectures and linear formats the only one supported both by speech and books.

Let's consider the mechanisms utilized by the human cognitive apparatus. Cognitive psychology[32] defines two methods of acquiring, elaborating and communicating knowledge.
One of these methods is well known to everybody and is associated with learning processes such as reading, interpreting, understanding, reflecting, reasoning, induction, deduction, and involves processing information being aware and conscious. This method is termed the "symbolic - reconstructive" mechanism, as involves decoding symbols (language) and then mentally "rebuilding" the transmitted concept.
The second method is not as obvious as the first, even though it is familiar to us. It is the "perceptive - motor" method, which involves watching, touching, testing, and then imitating or retesting in other words "learning by doing".

We use this approach when learning a skill for example. This primary mechanism of perception (visual, tactile, kinaesthetic) is embedded in human beings and some other animals. Objects and the environment are perceived by watching them and touching them and, above all, by noting the resulting reactions and behaviour.
This second method is really the primary mechanism from a biological and psychological point of view (phylogenetic). It is the method embedded in the human organism, and it is the method by which the child initially experiences and learns until the child artificially develops the symbolic-reconstructive method.
The perceptive-motor mechanism is without doubt the one that has been around the longest and is the one that becomes the best developed over the course of our lifetimes, and in this sense, the most powerful.

The only limit to this mechanism (although it is an important one) is that we can only apply it to visible and tangible objects, and so thus far we have only been able to apply it to objects that exist physically.

[32] Relevant contributions in this field come from Prof. Francesco Antinucci (CNR, Rome). This section is mainly based on his work and research.

I can learn how to ride a bicycle or to roller-skate by attempting to do so; a symbolic–reconstructive description of the process is not usually sufficient or convenient. Most well-designed objects ones that have good "mapping[33]" are simple and easy-to-use because they make efficient use of the primary learning mechanism, the perceptive - motor method.
However, the primary mechanism can only be activated, if the object belongs to the physical world and digital media such as virtual and enriched reality make it happens.
Thanks to the "undo" option, the same trial and error approach entered the world of software, enabling us to use the "learning by doing" method.
But, what about non-physical objects? How do we learn scientific concepts, algebraic or geometric hyperspaces, molecular structures, etc.?
In this case, we can only use the mechanism of secondary learning, which is not naturally embedded in humans and is much more difficult to use. A deep knowledge of a specific symbolic language is required that we can then use to mentally reconstruct the object and complete the abstraction.
We must consider that it takes a very long time to acquire or, as some researchers use to say, "re-shape" our brain in order to learn to read, write and activate the symbolic reconstructive mechanism. We work on this at primary and secondary schools at least. So it is clear that this is an artificial methodology, and in order to take advantage from this we must linearize parallel processes. Linearize means turn complex knowledge structure into linear sequences of entities and relations. This is one of the main limits both of writing and speaking, we must put in sequence in a user defined order concepts and relations. This is not a unique process, each person may arrange in a different way the description of the same concept, and here comes the skill and ability of professors and writers.

It is really so evident a different mind-set? Some experts[34] call this "neuroplasticity", the ability of our brain to re-shape accordingly with specific input patterns and reaction required. In addition to neuroplasticity, social psychology offers compelling proof that thinking patterns change depending on an individual's experiences. A sufficiently long training may activate this phenomenon[35]. In fact, some researchers believe multi-sensory input helps kids learn, retain and use information better. Does this sound familiar? Our digital natives engage in this type of brain plasticity every day. Digital natives have acquired special skills thanks to the "involuntary" massive training due to TV, games and digital services. They have grown up paying close attention to the sensory input of MP3 players, cell phones, video games and computers. Such an experience on one side let them re-experience old training formats and on the other side emphasize the gap in efficiency between

[33] In his work The Design of Everyday Things, Donald H. Norman defines mapping as "the self-explicative shape or behaviour of an object". Mapping implies that "...you always know which control does what (in the book, I call this a 'natural mapping'). When the designers fail to provide a conceptual model, we will be forced to make up our own...". Furthermore: "A good conceptual model can make the difference between successful and erroneous operation of the many devices in our lives." See Norman (1998).
[34] Cathleen Richardson, 21st Century Learners: Research, Hotchalk - http://www.hotchalk.com/mydesk/index.php/editorial/54-students/66-21st-century-learners-research, Mark Prensky, Do They Really Think Differently?, On the Horizon (NCB University Press, Vo 6, December 2001), The Partnership for 21st Century Skills - http://www.p21.org/
[35] This period of time and the quality of the result depend on another factor termed "malleability"

traditional education and the potential of digital communication and new formats. It is a common understanding that people who grow up in different cultures do not just think about different things, they actually think differently. The environment and culture in which people are raised affects and even determines many of their thought processes. So the Apple motto "think different!" is much more than a motto.
Digital communication tools means: multimedia, virtual and enhanced reality, games and serious games, simulation, the Internet, communities and much more.

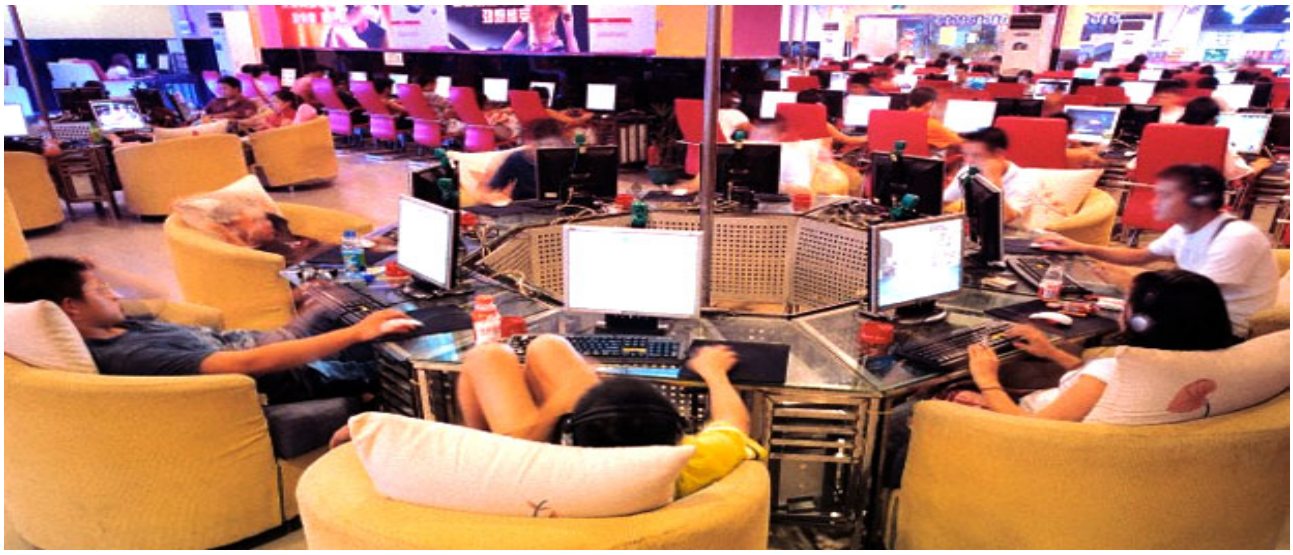
Teachers and Professors, mainly belonging to the digital immigrant's community, are training people grown up with smart phones, WIIs, the Internet and the social web. They speak an out-dated language (that of the pre-digital age), are struggling to teach a population that speaks an entirely new language.
Immigrants even if citizens of the digital domain keep some "attitudes" that are typical of the domain of origin. They prefer to print out email[36], they prefer to read documents on paper not on computer screens, they call by phone asking "did you receive my email?", they keep a paper based archive and basically do not thrust too much in on line services, if they buy air or train tickets on line they choose the option to fetch the original printed version at the ticket counter or at least to print it at home. Their general behaviour is strictly "linear" and mainly "mono-medial".

As a consequence do we need to re-train trainers? How can we bridge the gap between the traditional way of thinking and the huge set of opportunities offered by the information age?
Is the way to transfer information and knowledge significantly different from the traditional one? Do trainers need to adapt their curricula methodology and pedagogy to the evolving environment?
Let us try to answer to some of these questions. Of course, as already mentioned, the gap will be eliminated in a short while, digital natives will reach key positions in schools and universities but this seems the way to skip the problem not to solve it.
Today's teachers have to learn to communicate in the "language" and "style" of their students. It has to be clear that this is not a matter of "content" it doesn't mean changing the meaning of what is important, or of good thinking skills. But it *does* mean to change the format, use different media to focus the concept, going faster, less step-by step, more in parallel, providing different point of view or examples with more direct/random access, among other things. It is evident that there is no a unique recipe in order to update our methodology. It depends by a number of factors such as topic, classroom, resources and more.

[36] Even more remote - ask the assistant to print them out.

A frequent objection from Digital Immigrant educators is “this approach is great for facts, but it wouldn’t work for my subject”. We can try to get much more in detail subdividing theoretical subject and “practical” subjects. Learning maths is different from learning how to design something. There is another potential distinction between new topics and the traditional ones. Traditional content includes reading, writing, arithmetic, logical thinking, understanding the writings and ideas of the past, etc.
We need to invest some time and resources in order to “think differently” preparing learning materials concerning recent topics such as information technology, mechatronics, robotics and more.

“Classical” topics require a more relevant investment because we need to remove the bias due to “traditional” thinking trying to start from “tabula rasa” using the digital generation toolbox.
There are some relevant and successful examples; simulators are on stage since quite a long time and they are now “the” learning “materials” in many sectors. Serious games are gaining a leading position in some sectors: military, government, healthcare, corporate training and education. This approach is one of the best in order to train and test group of people that must work together as a group / task force. Serious games are a valuable tool in order to discover and test the attitudes and behaviours of groups or even single persons.
Mobile phones and tablets offered the opportunity to explore additional channels to transfer information and knowledge.
Is creativity the only constrain? Probably yes, if we cooperate with our students in co-creating updated learning resources.



Co-creation and crowdsourcing, what about the social impact of the “internet generation”? The “agora” as a social place that disappeared for quite a long time in the “global village” ruled by metropolis and TV programmes has been reinvented on line through chats, blogs, Tweets. This time is really a “global village”, a share point of interests, aims, issues and problems.

Lost something, any concern, drawbacks?

Did we lose anything in the process? What about potential drawbacks and risks?
The idea, but it is more than a feeling, is that in such a process digital natives lost some basic assets. Their own "culture" seems to be much more a set of bi-dimensional tiles sometimes interconnected. Direct access to information or even knowledge atoms may cause the lack of understanding of the rationale beyond. So it becomes very difficult to build up a mental model or to activate reflection in order to evaluate and criticise what they learn. They miss the opportunity to elaborate what their learn by doing, their experience.
Learning and working at "warp speed" does not provide them the opportunity to "pause" and assimilate, reconsider, amend or criticise what they are learning or doing.

Do they need to learn more about what was before and digital native generation? I think that it is embedded in the humankind to investigate and know from where we come from and where are we going to. Unfortunately part of this knowledge is in the gap between traditional "content" and "new topics". One of the key role of "cultural mediators" is to bridge this gap trying to provide the best and most successful mix of traditional content and new topics taking advantage from the native innovative skills stimulating the rise of relevant missing skills. This topic is relevant enough to deserve another full paper.

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