

## From analog to digital: new ways of teaching and learning A quick view of ICT in Spanish schools

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### Summary

Education and new technologies are always controversial. Beyond the mere introduction of Information Technology in schools, the fundamental debate is to find a way to innovate our methodology and transform our education in a way in which it reflects the world around us. New Information and Communication Technologies (ICT), as we shall discuss later, are a great way to pursue this change. In this article we highlight the aspects that, directly or indirectly affect, influence, facilitate and hinder the transition of an analog school to a digital school.

We part from the basis that in many cases Spanish schools are still working with an analog paradigm of understanding education. That means, among many other things, that schools are still attached and enslaved to a rigid schedule: they base teaching resources (too many textbooks) to fixed forms of assessing, they use very little globalized knowledge, and work within very specific learning spaces (classrooms). In today's Spanish classrooms the use of ICT is minimal. We could give many examples of schools which continue to have a 19<sup>th</sup> century philosophy (industrial) rather than a 21<sup>st</sup> century viewpoint (informational), but many authors - not in vain- have already argued that today we have schools from the 19th century, teachers from the 20th century and students from the 21st century.

In the first part of this paper we make a brief summary of the relationship between society and technology and, consequently, we identify some previous assumptions which will allow us to understand better the current socio-educational context regarding ICT. In the second part we see the different characteristics that define this transitional stage of an analog school becoming a digital one. Finally, we end up with a series of proposals to make digital schools a close reality.

**Keywords:** ICT, digital schools, Spanish education, digitization, pedagogical innovation, modernization

## 1 An overview of the current socio-educational context towards the ICT

*"Our society is undergoing a profound transformation. So profound that it has been equated to a second industrial revolution. We are moving from a society organized around the production and distribution of goods to a knowledge-based post-industrial society (Bell, 1973, Touraine, 1969), a new socio-ethnic organization model"*<sup>1</sup>

The history of civilizations is, in one way, the history of their technologies and not until now has there been such a close of a relationship between technology and society. Society today is being influence more by different emerging technologies than in any time in our history.

<sup>1</sup> Adell i Gisbert (1997)

Among them, we would like to emphasize technologies that relate to ICT, the basis of today's society. If there is a distinctive attribute of the society in which we live in, it is our technological perspective in the domestic, cultural, economical and political spheres, and even in our leisure. We have gone without realizing it, from a society basically based on traditional and first-wave<sup>2</sup> industrial technologies to a society where a multitude of technologies converge, ranging from microelectronics to biotechnology to telecommunications. According to many authors<sup>3</sup>, society has gone through different technological phases or stages that can be classified into the three great revolutions: the agricultural revolution, the industrial revolution and the information revolution.

The first great revolution was characterized by men having power and control over the land and the natural elements that surround them: control of fields and crops, use of animals' strength, crop rotation, the automation of agriculture and the selection of seeds, among other things. As previously mentioned, the first stage is based on the technological capacity of man's agricultural production. The conquest, control and production of land were crucial at this stage.

In the second stage, industry overshadowed the land. Industrial production processes, development of the first textile and steel industries, and especially the advent of electricity set up what we call industrial revolution. The automation processes in the products generation and the industry mechanization, left aside the rather traditional technology of the first stage.

Finally, the third stage is characterized by the invention and the development of technologies that have information as the nerve center, which put the emphasis not on the products but on the developed processes, not in an isolated way but in a constant net, in mutual reinforcement. This is the information revolution, where control no longer comes from the physical and tangible world but rather the virtual. What one author<sup>4</sup> calls the transition from a society which has based its vision on atoms to one that sees more and more the importance of something that can be neither seen nor touched: Bits.

For their part, many authors have already determined certain changes in society in the last third of the twentieth century. As stated, we are living in a social system where the "informational paradigm"<sup>5</sup> takes priority. This paradigm leads to a society where the generation, processing and transmission of information become the fundamental source of productivity and power. In the same vein, our current society is also defined as the "network society"<sup>6</sup>, understood as the result of the increasing influence of ICT and capitalism.

*"Mankind has historically been measuring its progress in terms of technology, with the result that, every age, technology has outstripped us more quickly than previous. Homo sapiens appeared 1400 generations ago, but for only 200 generations we have been writing, while printing has only been in use for the last twenty generations."<sup>7</sup>*

Even though, as defined, the information society<sup>8</sup> is like an emerging society, a new culture that causes a real revolution in social values and human activities of all kinds. The information

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<sup>2</sup> Alvin Toffler (1980)

<sup>3</sup> Majó (1997); Castells (1997); Terceiro (1996)

<sup>4</sup> Negroponte (1995)

<sup>5</sup> Information society has been approached in many perspectives, for that reason it has been called with different terms: post-industrial society (Bell i Touraine), technotronic society (Brizezinsky), consumer society (Jones & Baudrillard), computerized society (Nora-Minc), wired society (James Martin), electronic state (Romà Gubern), *the third wave* (Alvin Toffler), *global village* (Mac Luhan), digital society (Negroponte, Terceiro, Cebrián, Majó), *third setting* (Javier Echeverría) and also cybernetic society. All these terms describe, one way or another, the new society resulting from the merger of computing and telecommunications, basis of all the technological development of the 90's and of the future that we will live throughout the 21<sup>st</sup> century. However, according to Joyanes Aguilar (1997), we always find two common and primordial factors: information as an unifying element, and technological innovation as a tool for getting to the information.

<sup>6</sup> Castells (1997)

<sup>7</sup> Terceiro (1996)

<sup>8</sup> Marqués (2002)

society has powerful engines: the prodigious scientific progress (that continually brings new technological resources to society) and the constant move towards globalization (economic and cultural). The definition of a knowledge society is derived from the information society, that is to say, when the information reaches its highest value and applied to the various activities of human life it becomes knowledge. For that reason an information society is also called a knowledge society. It is interesting to note that the information or knowledge society is also defined as a **digital society**<sup>9</sup>. We will focus on the term “digital” or the digitization phenomenon in order to understand many of the facts and events that have substantially changed the way we connect and communicate with technological devices in the newly emerging telecommunications market.

The introduction of digital code, *digitization*, is the representation of information, which greatly enhances the convergence of all former and different technologies to transmit information (visual, verbal or written). The digital code or digitization means that the data is not transmitted itself but its numerical measurement. And normally the binary code (1s and 0s) allows the measurements of the data, because in the end, computers are processing information in this new emerging society. The information generated by the digital world is highly flexible, malleable, and adjustable. That is to say that it is lithe and easily changed. Therefore, the degree of reconstruction of reality is substantial and so a new concept of creativity arises, different from the one we have understood so far.

In short we can deduce, from the previous text, that we have a digital and network society that breaks many of the behaviours and perceptions that we have learned and understood so far: where we used to say atoms, now we say bits. Learning to unlearn is, and will be, key in a society like this one.

*“If technologies must be integrated in schools it is not to teach typing, Business English or the use of Internet search engines for future advisors, but to develop in all students, skills and a documented and critical relation with technology or, rather, a documented and, therefore, critical relation with technology”<sup>10</sup>*

## 2 The transition from an analog to a digital way of learning<sup>11</sup>: digitization applied to the Spanish schools

Once we look at the most essential feature of a society where basically the asset lays in ideas, in everything “intangible”, how we treat that information so that it becomes knowledge becomes important. We are going to analyze, from our point of view, all of the factors that help or hinder the transition from an analog school to a digital school. However, we would like to start with series of previous considerations that justify and allow us to understand better the current situation and the binomial technology-pedagogy in schools.

### 2.1 The current situation

*a) Technology is technology only for those who were born before it*

Our children do not feel the same as us when we talk about technology. For them, the latest generation electronic devices seem normal and in a way, almost natural. So, you could say that for them technology has become invisible. And this fact is easily explained: our children are born surrounded by today's technology and therefore, see a GPS in use in our daily lives and a video call on our cell phone is commonplace; whereas for the people born before the invention of this technology it may seem new and novel. The technological change is easier for them than for us,

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<sup>9</sup> Majó (1997)

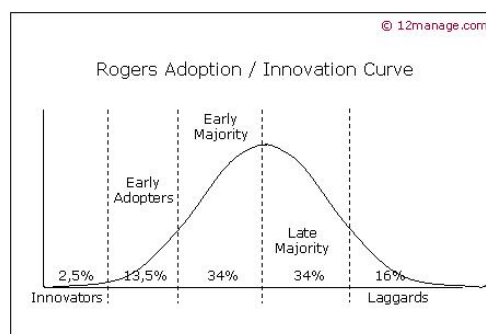
<sup>10</sup> Maulini (2006)

<sup>11</sup> More interesting reading for Seymour Papert (1998). See in [http://www.ait.net/technos/tq\\_07/4papert.php](http://www.ait.net/technos/tq_07/4papert.php)

therefore, it is much easier for them to adapt to this new society and new electronic or digital language.

b) *Technology generates “apocalyptic” or “integrated”<sup>12</sup> positions among teachers*

Satisfactory or frustrating experiences with technology end up creating a perception of what we can expect from it. Moreover, technological obsolescence and rapid technological changes create confusion among teachers. This is the reason why we must bear in mind that in many schools is very easy to find the faculty divided on issues of educational innovation. Those who no longer expect anything from technology and no longer see it favorably and those who think it can be a great benefit and a good engine for educational change and therefore, they are the ones who show more enthusiasm for incorporating technology in school. In this sense, some authors have already described the typology of attitudes towards innovation and therefore the innovation adoption curve among organizations<sup>13</sup>.



c) *Technology is increasingly challenging teachers*

Because of the emergence of technology we are increasingly questioning our own methods of teaching and learning in the classroom. The most typical case is the appearance of a website called “*El rincón del vago*”<sup>14</sup> (“Lazy’s corner”), where students can freely publish and upload to the web homework that is assigned at school. Then, we wonder... who is *lazier* or more *wicked* in this case: the educational system which has been assigning exactly the same kind of work in the classroom for more than 20 years, or, the students who have found a more effective and intelligent use of the power of collaborative technology tools they have at their disposal?

d) *Technology amplifies not only our abilities but our disabilities in the classroom*

The technological devices can enhance everything we do in the classroom. This means, among other things, that a bad teacher will be even worse using technology. Therefore, it is necessary to have the maximum institutional support possible from the top down on investing in technological equipment focused on the real needs of teachers and students, along with maximum support of qualified technical personnel who are sensitive to educational issues and who are really thrown into the service of teachers, and not the other way around. It would not be the first time that teachers end up being slaves of school information technology services.

e) *Technological change needs to be supported by people and ideas, not just machines.*

As we shall see later, we believe that the secret is the awareness and progressive incorporation of technology in the classroom. It needs to come from the hands of teachers involved in a strategic project of educational innovation with the support of technology. Teachers that are encouraged, not only economically, but in other ways (a lighter work load, different office hours, and advice to colleagues, as well as trips to conferences and visits to educational environments that have been successful thanks to technology best practices, and simulation and training in action) for example, are more apt to support and embrace the change and then incorporate it in their methodology.

<sup>12</sup> Umberto Eco (1965)

<sup>13</sup> Interesting work by Rogers (1995) where he describes the pace of change and innovation curve. Visit [http://www.12manage.com/methods\\_rogers\\_innovation\\_adoption\\_curve.html](http://www.12manage.com/methods_rogers_innovation_adoption_curve.html) where you can also find the categorization of the innovation “adopters” among organizations

<sup>14</sup> For further information visit <http://www.rincondelvago.com>

## 2.2 The scale of the problem: ICT in Spanish schools

Next, we are going to focus on some key issues, from our point of view, to establish the status (more or less generalized)<sup>15</sup> of the use of ICT in schools and, broadly speaking, the problems associated with innovation in the Spanish schools.

### 2.2.1. *System technocracy: pedagogical innovation with the support of ICT is more than installing computers, email and free software in schools*

As we stated before, to innovate with ICT is more than just introducing technology into classrooms and providing teachers with email. We believe that so far the Spanish government has taken an overly technocratic<sup>16</sup> role with regard to understanding innovation with the support of ICT. That is, until now they have only ensured the correct use and distribution of technological resources, leaving aside the real engines of change and educational innovation spaces and dynamics that have more to do with pedagogy and didactics. Obviously, we are not downplaying technological resources but, an exaggerated effort by the government reveals a policy based more on public sentiment and election results, than a concern for innovation and transformation of basic education.

### 2.2.2. *The problem of infrastructure: the base of the pyramid*

We would prefer a school with no Internet connection than one with it, but with the connection not working every now and then, or the server down or the router out of order. Because technology, when it works, generates many expectations, lots of dependency and lots of need. The level of frustration and disappointment is often very high when, for reasons that escape us, things do not work. This is where we must learn from technology: first, if a school elects to start the innovation process with the support of ICT, it is necessary to have a good infrastructure, "intelligent" classrooms and spaces and, a policy of continuous investment in this area. They also need to consider a collective policy with regards to decisions on the acquisition of technology developed by both the ICT and Pedagogical departments. Second, it is necessary to have an in house technical and maintenance service to review and periodically update the hardware and software installed. Third, it is necessary to have an ICT director-pedagogue to coordinate the work of technicians and teachers and, moreover, to lead the various project teams of pedagogical innovation with the support of the ICT department. Fourth and last, we should keep in mind two basic principles: (A) the so called and feared "demo" effect which consist of the technology being out of order just when you need to show something publicly; (B) that the current technology is still an obstacle race, it is not completely polished and it is not completely friendly to any novice or the digitally illiterate.

### 2.2.3. *A management question: strategic plan or marketing plan?*

Incorporating new technologies in school can be a good selling point for a school. Saying that the school is involved in virtual projects is always a guarantee of a school willing to meet the challenge. ICT is often implemented with good technological intentions but reality notes that many classrooms have a computer due to an aesthetic reason and not due to a didactic or pedagogical needs. We want to make clear that an innovation project with the support of ICT requires confidence, time, patience and perseverance, four qualities often forgotten in the educational field. A project of this type needs to be part of the strategic plan of organization in

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<sup>15</sup> In this sense, it is interesting to know the work published by Textos de Infonomia jointly with the Departament d'Educació to note that there are also successful experiences with the use of technologies. The work called *XTEC: perfils d'innovació en educació* aims to collect and spread 50 best practices with the support of ICT and be a model, an example and a reference point for innovative school experiences. Further information at <http://www.xtec.es/perfils/>

<sup>16</sup> See the reports update dates and their result at <http://www10.gencat.net/dursi/es/si/observatori.htm> and at [http://astrolabi.edulab.net/int\\_inf.html](http://astrolabi.edulab.net/int_inf.html)

order to obtain the maximum effect and to keep the necessary focus and direction for the duration of the project.

### 2.3 ICT is necessary, but not enough...

*"Despite the enormous potential of computers to make fundamental changes in how we learn, everything suggests that we are not yet at a magical effects technology. Computers provide a number of potential undeniable values. But its use is not enough reason for learning to change in depth."<sup>17</sup>*

In this section, we want to show a series of ideas and highlight some paradoxes that we consider crucial to understanding exactly what we mean by a digital school: first, is the idea that we too cautiously try and experiment with new educational models and new organizational models and teachers' constant learning formulas. Second, we need to lose the fear of making mistakes and overcome the fear that teachers are no longer the center of knowledge and the teaching-learning process itself. Third, it needs to be clear that a digital school, as we try to define it metaphorically to adapt it to our days, does not place ICT as the protagonist, but as a resource that facilitates, above all, the relationship between teachers, students and family.

#### 2.3.1 *Experimenting, being daring and doing research at school: signs of new days*

A digital school is also that one that naturally incorporates and takes into account having a laboratory to demonstrate to the teachers the possibilities of the different technological tools, test routines for their classes and work with and experiment with technological tools they want to use in the innovation process with the support of ICT. Furthermore, having an available space separate from daily classes that allows any teacher in his/her free time to go in without the need to interrupt a class and feel free to experiment and discover the tools he / she wants to innovate with. In short, this trial and error lab is established as a simulation area to carry out and successfully impliment any curriculum unit in a normal class.

We think that one of the great problems of ICT training in schools is that it has always been based in courses about the instrumental use of technology, but without any real innovation purpose in classrooms. It is thought and believed that only the knowledge of the instrumental use of the tools, which is certainly important and crucial, is enough to innovate and integrate technology in the classrooms. And this has been and is, in many cases, the main mistake, from our point of view.

The main objective should therefore be a change in the pattern of training, advising and research at schools, based on analyzing and evaluating both the *implementation process* of these new interactive media in classrooms of different stages, and the most significant *pedagogical innovations*, which can be developed more creatively and efficiently with the support of technology. Changing this pattern from a broad concept of educational transformation that takes into account the different agents, the different instruments and the different areas involved, as well as the dialectical relations between them.

A training pattern based on a continuous advising to the educational innovation with the support of ICT is a pattern that listens to the teachers and knows the way they really work in the classroom, in order to give the best answer for its incorporation. It is an ICT training program that is not interuptive or fragmented, but rather socio-constructive and coherent as a whole related to the faculty and the school educational project. In short, thinking of a new training pattern that wants to accompany innovation from the collective construction of the innovation itself.

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<sup>17</sup> Martí (1993)

*"Most American children do not know the difference between the Baltics and the Balkans, or who the Visigoths were, or when Louis XIV lived. So what? I'll bet you don't know that Reno is west of Los Angeles."*<sup>18</sup>

With this we want to emphasize that there are many classroom situations where teachers and students can work collaboratively. For instance, asking them for help in technological questions when we are in class; learning and letting them show us some technological features that are hidden to us; letting them teach a technological session on how to solve an exercise; letting them prepare on their own the digital material for their classmates. On different matters, we believe that it is important to keep in mind that teachers, in a metaphoric way, do not have to spend their time on creating and making websites, but finding applications that enable them to generate hypertext documents simply by pressing a button, that is, teachers need tools and applications that simplify the technological complexity and that allow them to create material and educational resources without many technical obstacles. Technology exists to serve the individual, and not the other way around.

### 2.3.2 *ICT as an excuse, justification and opportunity for educational innovation in school*

Innovating, educationally speaking, does not only mean introducing computers, laptops, pda's or interactive whiteboards in the classroom. ICTs themselves are not change generators. They are the pretext and excuse for change, but they are not the change on their own. And it is very important to bear this in mind if we really want to be innovation generators at school. As stated before, we must avoid those positions so naïve that takes any technology in without reservations, and in the same way, we must avoid being afraid to implement change. When innovating with the support of ICT there needs to be an initial diagnosis of needs, ie: listen carefully to teachers and students and then provide as many facilities as possible (technological and pedagogical) in order for them to use, and introduce them into the classroom as smoothly, discreetly and invisibly as possible.

However, we believe that to achieve an educational model that no longer sees ICT as the exception, it is necessary that schools become gradually digitized, that is, that schools break out and become transgressive with space and time, and besides, rely on the adequate people - *"modem teachers"*<sup>19</sup>, *"router teachers"*<sup>20</sup> and *"gps teachers"*<sup>21</sup> - able to motivate their peers and generate complicity dynamics in the school. It will be at this point where we can say that ICT becomes invisible. Thus, understanding education under a digital paradigm will mean, among other things, an open door to infinite possibilities, building learning in multiple stages and fully flexible as allowed by the ICT.

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<sup>18</sup> Negroponte (1995)

<sup>19</sup> A modem is an electronic device capable of converting a digital data signal to analog signal and vice versa and that it can be transmitted through a channel designed for analog signals. Thus, the two main functions of this device are demodulation and modulation of a data set, that is why it is called: *modulator-demodulator*. Seeking a parallel with the functions of this device with that teachers motivated to innovate in schools we believe that it is necessary a teacher able to motivate his / her peers and to translate to a simple language all those computer acronyms and words that, without knowing their meanings, can turn the introduction of technology in the classroom into a real nightmare.

<sup>20</sup> A router is a network device that allows to connect one type of network to another one. In the same way, and looking for this analogy between technology and education, we believe that it is also necessary a teacher profile who becomes specialist in finding those educational "ways" with the use of technology, that is to say, who seeks and finds applications or electronic resources suitable for the group class, the teaching unit,... and who shares them with the rest of the teachers, provoking this way the "oil stain" culture.

<sup>21</sup> The Global Positioning System, commonly known as GPS (originally NAVSTAR Global Positioning System or NAVSTAR GPS), is a satellite navigation system that allows you to know very precisely your own geographic location and the reference hour of almost everywhere in the Earth or in an Earth's orbit. The GPS works through a network of satellites orbiting around the Earth. When we want to determine the location, the gadget used to do it automatically locates at least four satellites in the network, from which receives signals indicating their position and their clock. Similarly, the school system also needs those figures or "leaders" who have an overall vision interesting enough to innovate, progress, coach and support from a little farther perspective.

<i>Digital School Pattern</i>	
<b>System or organization</b>	It wants to be autonomous
	It has diversified ways of learning programs, curriculums
	It has a flexible - hybrid organization time
	It has a diversity of environments and stages
	Networked, seeks involvement with other centers or institutions
	Open to the community
<b>Classroom and learning pattern</b>	Based on active learning from exploration activities and research
	The students are the protagonists
	The transaction of ideas or negotiation of meaning between students working in small group dynamics
	Discursive, encouraging critical thinking
	It has the support of technological multimedia (IWB's, Tablets,...)
	Encouraging cooperative work in the classroom
	Utilizes the resources of collaborative work (Social) Internet (Web 2.0)

**Table 1:** *A digital pattern of understanding the school*

In conclusion, summarizing the metaphorical idea of digitization applied to school, we could state that the digital school is that one capable of providing itself with mechanisms, tools and dynamics to meet the challenges of pedagogical innovation. We would like to make clear that, beyond the technological devices or instruments, a school can become digital without them, because in the end we are really talking about an educational transformation, and not about a technological invasion.

The concept of digitization refers to reinvention, flexibility and all the tools (technological or not) to serve the students. Obviously, to respond to today's society and be responsible and committed to quality education involves, not the aforementioned technological tools and/ or resources irruption, but the training of teacher teams, spaces and dynamics devoted to innovation, improvement, evaluation and reflection on the teaching-learning process with the support of ICT.

We would also like to make clear the importance of understanding the ICTs not only as mere instruments or tools serving the individual (logically they are), but, above all, we have to understand the ICTs as new languages and new spaces for communication and access to information. Understanding the ICTs as languages (new scripts), tools (new equipment) and spaces (new virtual environments for accessing information) makes way for better comprehension of today's society, and makes it feasible to predict the possible demands or requirements of society in the future and to take measures for its proper use at home and school.

And finally, it must be noted, and it is important to remember that, with these challenges of educational innovation with the support of ICT there are obviously a number of advantages and potentialities (access to large sources of information and documentation; possibilities of knowledge management; facilitate collaborative work; promote participation and communication between different members of the educational community,...), as well as risks and limitations "infection"-poisoning by excess information-; the need to contrast the information found on the web; new technological tools that require a knowledge of their rules of operation -email, sms, chat,...-; control tools in web browsing; abuses and perversions of communication - webcams,...). We believe that a digital school model that does not work with a critical view of new technological tools when incorporating them into the school would be absurd.

### 3 Some recommendations to make digital school a close reality

*"We now find ourselves precisely at the moment when it is necessary not only to create new ways of working, but also new ways of organizing information and communication in the educative community"*<sup>22</sup>

Based on what we have discussed so far we would now like to present some recommendations that will define strategic lines and allow us to progress from a model of an analog school to a digital one.

1. Read again our pedagogical history and enrich it with new opportunities provided by the current technological tools.
2. Provide a staff devoted to educational innovation with the support of ICT to schools. The staff should consist of teachers who help and sensitize the rest of the educational community:
  - a. They know how school teachers work.
  - b. They investigate, experiment and bring new educational resources in digital form to the "idiosyncrasies" of the center.
  - c. They help manage the knowledge within the school.
3. Provide schools with classrooms and spaces for experimental simulation with technology.
4. Design new models of assisting teachers throughout the different stages of implementing educational innovation with the support of ICT in the classroom; based on a case study of the school, classroom, and group context itself, rather than in closed training courses.
5. Design new models for teacher training and accreditation which could be based on technological literacy (basic digital skills) and its use as applied to various curriculum disciplines which would lead us to achieve a certain level of digital autonomy:
  - a. Operating System skills (units, files and folders administration)
  - b. Office applications skills (text processing, database, spreadsheet, graphic presentations and personal organization)
  - c. Multimedia skills (basic sound, image and video editing)
  - d. Internet skills (information search and selection, communication and group collaboration tools,...)
  - e. Didactic skills in the use and application of ICT in the classroom (specific software, digital tools and resources, main psycho-pedagogical theories, specific gadgets, videogames, classroom control and management tools)
6. Encourage the possibility of creating pilot centres that work from a strategic plan of educational innovation with the support of ICT.
7. Guarantee and ensure technological resources (Projectors, Laptops, PDA's and classroom control panels) and digital resources (good educational online resources), as well as the quality infrastructure for connectivity (broadband and Wifi) and available for all school organizations.
8. Create affordable policies for investing in technological equipment for teachers and students.
9. Provide schools with a qualified technical service with the vision of educational innovation with the support of ICT.

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<sup>22</sup> Adell i Gisbert (1997)

10. Provide schools with the technological tools that allow them to facilitate the everyday school and academic management and, above all, the dialogue and communication with the families.

*"The main problem is not just to introduce computers in education, but to build a computer-driven educational model"*<sup>23</sup>

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