The future of digital textbooks

1. Digital textbooks?

Revising the world entering from our screen, and absorbing the information around us, we are driven to put a question mark at the end of the bi-name “Digital Textbook?” The reasons are part of the reflexive exercise we present here.

We start by acknowledging the complexity of the term, and therefore, of our reflection. By adding the "digital" part of the bi-name, we have to look at all parameters that allow us to access the "textbook". Once an ended product, ready to be used, now, a complex mean which requires radical an expensive changes to the whole educational system.

Let's start by observing our daily life. Most of us have today what is being called a "digital identity", which provides a feel of control over our "digital face" and of powerlessness over the rest of our "digital information". By opening the computer, personalized with our schedule and mail, we search at Google, intelligently selective according to our residence and search habits, we buy at Amazon that offers us the latest on subjects we are interested in, etc, etc… following the "one never fits all" paradigm, the "intimate and personal" device life style. However, contradictory as it can be, this paradigm has not yet reached the School System; a system socially built and specialized for the youth, generation to whom technology is a natural part of their world. "While many adults think about technology as separate from humanness, kids tend to think of it as fundamentally human. "It comforts us; it keeps us company; it helps us learn and grow; and, in some cases, it can fulfill certain emotional needs more reliably than other people" (Robots@School). Kids ability to adopt emerging technologies needs to be a central concern on the development of any educational environment, if we do not want to lose this generation to much more useful natural learning environments.

To understand this new learning space, we navigate through the virtual web and helplessly encounter an emergent “digital rush”, overwhelming educators with information (indistinguishably professional or amateur) of new releases and trials of all aspects related to the digital textbooks, from the content, to devices, digital infrastructure, cost and etc. The number of novelties being released via internet is endless, allowing us only to grasp the “latest shifts” of the latest month, as for example the amount of articles on the “cloud-based technologies” as “the fuel that is now powering this comet toward its educational rendezvous”, allowing for extending learning beyond the boundaries of the school.

Recently, the “digital giants” (Intel, Apple, Google, etc.) have turned their attention to the educational system, however all their developments’ impact on the system is still on trial and the current studies being published are strongly
supported (biased) by the products’ developers. Thereupon, very little significant data is available resulting on a wide spectrum of opinions and speculations about the future.

The information revolution created a cultural earthquake in terms of how we create, consume and collect information. The power of this revolution can be described in three areas: accessibility, ability to retrieve information, and ways of organizing information.

2. What is the impact of digital textbooks on the educational system, today?

Textbooks, designed as a specific tool for the school teacher (as revealed by the Hebrew word for school, the "house of the book" בית הספר), are being inserted inside the screen as an attempt to keep up with the computer revolution! Realizing they are being forced into a system which "speaks a different language", and trying to absorb the digital novelties, the "digitized textbooks" (digitalization of paper bound textbooks) are enriched with animated pictures, videos, and interactive exercises.

In 2012 the "digital textbook" comes into the market, claiming the need to offer a textbook conceived with the digital language and for the virtual world. Examples are Apple's "Life on Earth", a biology textbook for high school, Ibooks 2 or the cloud-based 'Techbooks' from Discovery Education for high school science, and middle school social studies. However, few innovative experiences are truly meeting the digital textbook challenges, especially in offering different pedagogical paradigms better suited for the young generation.

A massive number of products are being released exploring the virtual open space, which "breaks" the school walls, creating new educational environments. They answer well schools' difficulties of affording all the paraphernalia necessary to enter the digital age, the important need of reaching students geographically isolated, and they amplify the learning space and possibilities of the student.

Today, most schools which have digital infrastructure facilities and capable teachers are adding to the regular textbooks, instruments offered mainly by Google or Microsoft (Apple entering strongly at this market) to diversify their classroom activities. Flexbooks, opensources, video-based learning, are invading, specially the English speaking market, due to their flexibility and free-of-cost offer. These new environments, however, run the risk of taking the "digital textbook" to become a collection of digital items, missing the main educational message of offering a meaningful educational learning environment. Some even try to disrupt (intentionally or not) the essence of what constitutes a textbook, as a "defined unit of content" with a clear message.
3. **A new pedagogical paradigm?**

There is no doubt that the information and communication revolution is shaking the basis of the educational system, whose main approach will have to be revised before it becomes totally obsolete! If we understand pedagogy as the body of concepts and practices that determines the way the educational system is built, a new pedagogy paradigm has to emerge to define an educational system suitable for the 21\textsuperscript{st} Century.

Moreover, we are facing an era where kids dictate the “how”; the digital world became a natural learning space for them, barely touched by the educational system. The interaction with technology allows for an autonomic acquisition of knowledge, where they get hold of their learning process. **Education is not imposed from outside, but engaged through kids’ relationship with technology. The understanding of this relationship is what should determine the practices of the educational system**, and help us understand the new pedagogical paradigm.

What have we learned from the last decade of kids emerging talents to deal with the fast development of the digital world? The literature points out to a few aspects which are becoming very relevant; most have only acquired new weight, but a few are apparently emerging as new skills:

1. **Autonomy:** As emphasized by Piaget\textsuperscript{12}, intellectual autonomy should be at the heart of any educational system. Today, more than ever, the digital world requires autonomy as a basic and essential skill.

2. **Ownership of their learning process:** “Kids are more interested in what they can do with technology, than with what technology can do for them”\textsuperscript{13}. When students assume an active role about their learning, their motivation and engagement gain a substantial boost. Their ability to move and explore the digital world, leads them to the “in charge” position over their learning capacities.

3. **Self-esteem strength:** the possibility of changing and acting upon the virtual environment in search of possibilities that fit each individual’s needs, strengthens one’s feeling of “Yes I can”.

4. **Curiosity and Exploration** are natural learning mechanisms, which have gained an unprecedented environment with the digital world. They can be stimulated by Inquiry-based learning methods which has been a pedagogic goal, however not easily taken into practice in traditional educational settings. Project/research-led teaching is finally entering significantly schools and higher education (Prof. Jenkins, University of Oxford).

5. **Collaborative problem solving:** Specially used at the digital gaming world, kids today, through their own initiative, are actively collaborating with "others" as a way of attaining their goals. Group work became meaningful (not merely a task produced by several people), allowing for a diverse contribution towards a common goal.

6. **Critical thinking** (peer review, and exposition on social networking). The collaboration naturally embedded in most virtual activities, is developing a much more natural acceptance and even need for peer review.
Schools are observing how kids naturally search peer help and comment in any activity. Social network is an important causing factor. "By posting content online, writing becomes much more important and relevant to the students. Writing activities suddenly take on a new life. You couldn't incorporate the social aspect of writing at this scale without technology."14

7. Relevance: Bringing the world inside the classroom has impacted significantly school activities. Not only theoretical concepts can be contextualized by daily examples, examples can be experienced inside the classroom but moreover, relevant others (peers, family) can participate actively in students’ life.

8. Diversity as a plus: Not only students' diversity can be much easily dealt by the wide range of possibilities of the digital world, but moreover, can be perceived as an added value within a diverse world which requires a wide range of skills. Instead of struggling to fit into an specific pedagogical model, with the consequent feeling of self-inadequacy, a much more varied environment may provide a positive motivation to search for each one's suitable fit.

9. Freedom of choice. An old “jargon”, becomes a must and very important skill within a world of endless possibilities. The development of kids’ ability to prioritize, select, and choose is vital for them to navigate and reach their goal.

10. Environmental flexibility: The whole concept of educational environment is being amplified to meet the different educational models, and the different individual needs. Schools are being designed according to new pedagogical concepts as collaborative group work or learning resource centers, or interest-based community as the framework instead of the classroom.

11. Virtual mobility: Teachers are now realizing that students that did not respond at schools settings (kids that cannot cope with school environment, many times wrongly perceived as having learning or behavioral problems) are now being able to perform significantly better when they can choose when and where to complete the assignments. An assignment group can be formed with students physically far from each other, narrowing distances. The concept of reaching out everywhere is a natural mobility for students' today, R. Buliung calls it "digitally augmented metageographies nm16

12. Interactivity: Interactivity allows for the practice of important cognitive skills. It stimulates several cognitive functions related to the learning process. The motor activity accompanying the cognitive one towards the same aim, leads to a faster and more efficient learning. When Geometry students can visualize and manipulate problems with 2D and 3D diagrams, their cognitive, motoric and emotional system are working together allowing for a complete learning experience." To potentiate cognitive skills we should potentiate active interaction within the digital world (not merely interaction of use of software), the same way we tried to potentiate comprehension of a text and not merely listening.17

13. Multi stimuli exposure: As students are reading, interacting, listening, viewing, and analyzing content, they’re practicing skills that are critical for success in tomorrow’s workforce.

14. Personalization: “Students, perhaps without realizing it, are already seeking out ways to personalize their learning. Looking to address what they perceive as deficiencies in classroom experiences, students are turning to online classes to study topics that pique their intellectual curiosity, to message and discussion boards to explore new ideas about their world, or to online collaboration tools to share their expertise with other students they don’t even know. Students now expect in their learning lives the same types of personalized interactions that adults already experience in our everyday lives.” (SpeakUp 2011 report18)

15. Connectivity: The possibility given by internet of connectivity and exchange of ideas facilitates the learning process, not only engaging and motivating the students, but allowing the student to find common grounds to his knowledge (association) transforming it in something new (adding knowledge and creating ideas).
Internet can be overwhelming and distracting, at the same time that it enriches by allowing learning and creativity\textsuperscript{19}.

16. Diversifying the Knowledge Source: The teacher has been the main source of knowledge, role which demanded too much from the teacher, especially as information became much easily accessed by the students. Many teachers embraced this added resource, allowing students to contribute actively (raising their motivation). “Rather than feeling threatened, the best teachers will see this as an opportunity to move to the next level and understand their authority differently. They’re not merely conveyors of data, but conveyors of meaning. They’re now free to help students connect these data points, make sense, and develop context. This goes to the heart of what media specialists do. And these are the kinds of insights that occur between people in the real world, not between avatars on a server\textsuperscript{20}.

4. How is the world adopting such educational changes?

There is a clear interest towards digitalizing the educational system all over the world, or at least, this is the content of most politicians’ discourses\textsuperscript{21}, and a growing interest of publishers on digitalizing textbooks\textsuperscript{22}. Today we can find significant changes mainly at Universities (\textit{Geographies of the World's Knowledge} at Oxford\textsuperscript{23}, MIT Online Free Courses\textsuperscript{24}, \textit{Molecular Movies} at Harvard\textsuperscript{25}, Tufts University Sciences Knowledgebase (TUSK)\textsuperscript{26} or Minerva Project, the 1\textsuperscript{st} elite online University\textsuperscript{27}) or particular areas or districts (Florida in the U.S.A.) or schools (CET’s Virtual High School in Israel). The overall agreement of benefits surpasses the conservative positions, being the infrastructure difficulties (provision of devices, bandwidth capacity, development of appropriate material, etc.) the only clear obstacle, requiring strong investments from the pertinent institutions (mainly collaboration between device or publishing companies and the school or district). Teachers’ training is a mentioned issue, however receiving less and less relevance. The problems arising from the 5-years’ experience of the South Korea\textsuperscript{28} and other\textsuperscript{29} national projects of schools using only digital textbooks emphasizes the need to take these changes as a pedagogical and environmental challenge\textsuperscript{30}. A Stanford Study in 2011 showed a significant drop out in virtual online courses in 8 schools\textsuperscript{31} which questions the "digital rush", are schools ready? Are the educational methods being used suitable to the virtual space? Countries like the U.S. are producing an important amount of documents which emphasize the need to develop new educational standards, better fit for the recent social and economic changes\textsuperscript{32}.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{map.png}
\caption{Map showing the countries discussed in the text.}
\end{figure}

An overview about the digital impact on students was offered by the OECD study survey (2011 report) that tested how 15-year olds use computers and the Internet to learn. It showed that of the 16 participating countries (not Israel or US), most students’ results in digital reading were broadly in line with their performance in the PISA 2009 print reading tests. But in South Korea, Australia, New Zealand, Sweden, Iceland and Macao-China, students performed significantly better in digital reading than print\textsuperscript{33}.

No doubt that the interest for advanced education go in parallel to each countries’ major economic outcomes, for example South Korea and Finland are
examples of educational excellence, but only the first one is strongly investing in education technology, due to its clear interest in developing a generation of leaders in HighTech.

Below, a few examples are mentioned of countries which have taken the decision to invest on school (up to 12th grade) digital education. For organizational reasons, three groups are defined according to their public education digital developments: (GROUP 1) countries with ongoing strong investment on the overall infrastructure (software, hardware, city planning for digital usage, professional training, community support, financial support); (GROUP 2) countries which understand the need for an overall development, but due to different reasons, cannot afford a fast pace; (GROUP 3) countries which express their desire to enter the digital era, however can only acquire partial developments. The latter are being strongly targeted by the digital giants as potential markets.

GROUP 1:

1. U.S.A.: A good example of the importance being given to the move towards digital education is *The Playbook* (Feb 1, 2012), a document (collaboration of government and major companies) which provides detailed advice for educators and administrators in planning the transition. Data on the national use and cost are provided by reports such as *The Keeping Pace with k-12 Online Learning 2011* or Central for Public Education, where we can see that during the academic year 2010-11, 250,000 kids were enrolled on full-time virtual public schools (5% of public school students), 40 of the 51 states have passed significant online learning policies including educational funding (70 to 100% courses on public schools, depending on state). Some states like Florida are producing and offering their own digital courses free for their students and with tuition for outsiders. Since the project *NetSchools* (1996), the first to provide 1:1, numerous projects have been developed by companies with national or local cooperation. Florida is the first state to mandate, from 2015, the adoption of all instructional materials in electronic or digital format in all public k-12 schools. Alabama will be the 2nd one, with all highschool kids with digital textbooks & tablets. Maine adopted a 1:1 laptop initiative for all middle school students in public schools (2002), expanding its reach to high school students by providing wireless network infrastructure to schools. Indiana, Utah, Washington, West Virginia, Texas and California have implemented plans facilitating the use of digital platforms (devices, textbooks, etc.) to any school which requires. A few examples of many of the districts in other states are: Mooresville, N.C., began providing 5,000 laptops to every student and teacher in grades 4 to 12 in 2009; The San Diego Unified school district, CA, embarked on a five-year journey to transform more than 3,500 classrooms - Interactive Classroom Initiative (i2I), distributing some 78,000 netbooks and other mobile devices to teachers and students; Auburn City Schools, Ala., 10-year project for creating a 1:1 learning environment, using robust digital tools; Arizona's Vail School District, one of the first districts in the nation to move to an all-digital curriculum, used its textbook money to buy laptops forcing the teachers to learn how to instruct differently.

2. South Korea: *Smart Education* is a national project which, until 2015, will provide only digital textbook environment for all elementary, middle and high school students (including wireless networks and using a wide range of devices). South Korean students have been increasingly using digital textbooks since 2006, as part of a supervision digital credentials plan. Fifty schools have been digitalized and the experience is being
evaluated. The Korean government has now announced some step back, due to recent worries of the impact of “all digital” on students, having decided to return to the use in lower grades of paper text books.\(^4\)

GROUP 2:

3. European Community Countries:

The economic crisis is strongly setting back the digital development of schools in Europe. Countries like the U.K, which up to 2008 had being strongly investing on this sector, had to slow down the pace.

4. Singapore:

*Future Schools* project, has started on 5 schools and should reach 15 by 2015, initiated to “allow local schools to enhance the diversity of educational offerings to cater to students' needs, and provide possible models for seamless and pervasive integration of IT including interactive digital media, all aspects of the learning environments, from school design to management to teaching and learning”.\(^4\)

5. Australia:

In 2011 has invested significantly on high speed broadband connections to individual schools and homes. In February 2012 the government announced that more than 911,000 computers had been installed in schools together with several other initiatives to support their ongoing *Digital Education Revolution* project. Depending on need and preference, schools can purchase netbooks, laptops, tablet computing devices, install more desktop computers or deploy a mix of mobile and stationary devices.\(^4\)

6. Japan:

Since 2010 have been trialing electronic textbooks in primary schools, enhancing the role of IT in the classroom. Under the *Future School* project, 10 elementary schools gave all their under-12 pupils tablet PCs and have fit their classrooms with interactive electronic blackboards.\(^4\)

GROUP 3: On this group it is exemplified countries with important economic growth, therefore regarded as potential markets by the Digital Giants, countries with significant socio-economic needs where philanthropic initiatives are helping and countries struggling and willing not to be left behind.

7. China:

China is the main market being target by all Digital Giants, especially from Middle School upwards. The Chinese educational system is public from 1\(^{st}\) to 6\(^{th}\) grade, when national examinations start distributing students according to academic achievement. Investments on digital developments are focused on the "best schools" and usually through collaborations with a big company as for example Pearson's collaboration with the Beijing government: "The project is aimed at providing a learning management system. It provides a way to develop a learning community that teachers can turn to when in need of help from their peers. For students, this community can be of assistance at school and at home; they can have more access to the information they need and at the same time their parents can get involved as well. This way parents can see what their children are doing and help them out a little when they need it. The project is currently being
tested in some pilot schools across Beijing City," according to Engkvist, Pearson. He also mentioned that if the project turns out to be a success, it will be accessible to all students in Beijing's public schools.45

8. Others:

A philanthropic initiative of the organization "Worldreader" has managed to recruit Amazon to a "kindle to each student" project in Uganda elementary schools. This helps the students to learn how to read, and also enables access to an endless amount of reading books.46

Many governments are investing on large scale projects of buying devices mainly for students (with no apparent national projects for the development of other infrastructure), as for example Uruguay, Spain or India. The latter is starting the first large scale national project of handing out an estimated 6.8 million free laptops to schoolchildren in the southern Indian state of Tamil Nadu.47

It is interesting to notice the 2011 plan in the Caribbean Island of Antigua where the government is providing laptops for all teachers.48

Thailand is investing on buying tablets for 1st graders.49

Israel:

Israel could be included in Group 2, due to its national interest and investment (not only financial, but the number of school and professionals entering the digital age is very significant). Below are examples of national and local programs that focus on infrastructures, end-devices and teacher training.

1. MK Einat Wilf is promoting for the last year (since summer 2011) a bill, which will obligate all the publishers to issue a digital format to every textbook published in Israel.50 The bill was approved in a vast majority in the preliminary reading, and is currently being prepared for the first reading.

2. The National Computerization Program - Implemented and funded by the Ministry of Education. The goal: a computer, projector and Internet in every classroom.51 The program began in the periphery - in northern and southern Israel (north of Haifa, south of Ashdod). In Phase A - computerization of 200 elementary schools - this phase was completed. In Phase B - another 800 elementary schools will be computerized. In Phase C - The initial plan was to begin computerizing the elementary schools in the center of the country, but instead it was decided to remain in the periphery, complete equipping the elementary schools in those areas and then move on to the junior high schools. We are currently in Phase B. The program is supposed to be funded entirely from the 2012 budget, based on the understanding that the 2013 budget will evidently not allocate economic resources for this purpose. The program also includes professional training for all the faculty members (teachers, principals etc.)52

3. Local authorities - Local authorities that have the financial means to do so, particularly those in the center of Israel, decide to equip schools with computers, whether using the Ministry of Education's model (computer and projector in each classroom) or the computer for every child model. Generally speaking, the costs are distributed as follows: parents purchase the actual device, and the municipality funds the infrastructures and provides assistance for students who cannot afford to purchase such devise.

• Tel Aviv - The municipality decided at its own initiative and funding to computerize schools following the Ministry of Education's model. At this point, 22 elementary schools in Tel Aviv (out of 58) have been equipped with computers and projectors. Next year, 20 more schools are supposed to be equipped, and
the rest the following year. The program was allocated a budget of approximately NIS 120 million for six years of activity. The program will include: wireless networking of the entire school; three mobile labs per school (including 35 laptops and a laptop charging cart for 35 computers); an online teacher's station that includes a laptop, interactive projector, access port and a pair of speakers; homerooms that are equipped with a docking station for the teacher's computer, interactive projector, access port and a pair of speakers as well as laptops for all teachers at the school (approximately 700 teachers). Next year an attempt will be made for a pilot at three-four schools (elementary and one junior high) that will have a computer for every child, and perhaps one with tablets.

- Bat Yam - An agreement was signed with Blieger, which was supposed to provide the tablet, technical support and content, as a mediator. The project began last year in 7th grade classes, and in about seven junior high schools of the ten that joined the project. The package included: tablet (NIS 700) + content (NIS 350) + insurance (NIS 250). Parents paid for the tablets, and the response was very strong. The Welfare Department of the municipality needed to provide very little funding.

- Haifa - Virtually none of the schools are digitized. One of the reasons for this may be that for many years now Haifa has run a book borrowing program in the schools. The municipality includes a fee for borrowing the books in the city taxes, and parents actually do not perceive it as an additional expense.

4. KATOM (Computer for Every Class, Student and Teacher) Program - Parents purchased the laptops with a subsidy received from the municipality's Welfare Department. The program provides an online educational setting in which every student has a laptop that is connected to the Internet. The program is implemented in Ashdod, Yavne, Kfar Sava, Karmiel, Migdal Haemek, Rosh Ha'ayin, Ra'anana, Yokneam, Kiryat Ata and Kfar Vradim (a total of close to 17 schools). In Ashdod, all 7th grade classes became part of the project.

5. The Athena Fund along with the Union of Local Authorities began a project offering a computer for every teacher + training on how to work with the computer. Approximately 35 local authorities, 177 towns from northern to southern Israel, have already joined the project. The project was initially funded through charitable donations and today is increasingly funded by the Ministry of Education. A connection was made with the project to upgrade infrastructures in the schools, and this added a great deal of momentum to the project. The problem is that up until only a year ago, the training offered to teachers was at a very low level, more "introduction to computers" than training on how to teach and impart content better and more effectively. The project has recently begun expanding to kindergarten teachers.

To have a better understanding about teachers' reaction, a study was carried out which compared between the influence of openness to change and attitudes towards ICT implementation on technology use for communication and searching information by 97 Israeli secondary teachers. The comparison was done between (1) teachers working in "laptop per student" (1:1 laptop) classrooms (2) "laptop per teacher" project, and (3) teaching without technology. The results indicate that teachers' openness to change in their professional life and their attitudes towards ICT predict 22.3% of the variance in online personal and professional communication and 35% of the variance in information searching for personal and pedagogical purposes.

5. Digital textbooks and educational software:

As mentioned before, the development of the digital world is erasing the boundaries of the textbook. Notebook, text, labs, writing tools, teacher's lesson, etc.... all can be included in one package.
On 2011, the textbook digital market was “attacked” by the “digital giants”. Apple, Amazon, Google and a host of smaller firms such as Inking have all set their sights on the textbook market, which last year was worth an estimated $8.7 billion in America alone. Google and Apple’s development of specific educational tools (text editor, data management, course builder, lectures’ download, etc.) have challenged Microsoft which has dominated the educational market for a long time (Google Docs has taken a significant portion of Microsoft Office place on the educational world, in 2012 Microsoft tried to come back with a new version). Equipped schools and/or technological knowledgeable teachers have embraced these new tools, facilitating tremendously their daily practice and allowing them to be creative and to make a much more relevant and interesting use of existing textbooks. Digital textbooks make use of text editing possibilities, videos, animations, simulations, and all the technical advances in illustration and design.

A few examples of digital material offered today oriented to k-12 are:

1. Cloud-based ‘Techbooks’ from Discovery Education including high school science, middle school social studies which they claim is freed from the linear page format (instructional model guides the path instead of a page), allowing for a platform specifically designed to promote inquiry-based learning. It is cloud-based and platform “agnostic” (can be used in any device). The content is updated in real time and schools can use for Social Studies from 2012.

2. Apple has jumped into the digital textbook market, launching:
   a. iBooks 2 in January 2012. The new software supports diverse multi touch interactivity (ex.: tappable images linked to maps, or to videos), textbook of main publishers with constant update, authoring tool oriented to independent writers, variety of text tools, etc.
   b. The iTunes U service, provides free online downloads of lectures, creation of lectures, course materials from top universities, etc.
   c. Ipad digital textbooks: Richard Dawkins "The Magic of Reality" is an introduction of science for children exploring the possibilities offered by the digital world to the educational system; E. O. Wilson "Life on Earth" is a biology textbook for high school.

3. Inking smart Textbooks, the leading platform for interactive learning content for Higher Education, is developing textbooks for high school in collaboration with Classmate.com.

4. Science fusion textbook is developed by Houghton M. Harcourt Publishers and offers a research based digital science curriculum, including video lesson, virtual labs, students’ notebook, etc.

5. Samsung Electronics Learning Hub is an educational content platform through which around 6,000 exercises for all age groups are provided. Users can download the service on their tablets.

6. Amazon Kindle Print Replica Textbooks: students can buy thousands of print replica textbooks to read on Kindle fire (60% off price of the print textbook) including possibilities of notes, highlights, zoom, etc.

7. Free Open educational online sources: To minimize the high cost of entering the digital era, educators make use of the advantages offered at the market by using webs which provide all sorts of educational tools (textbooks, video lessons, activities, flash cards, etc.).
   a. Khan academy, a site which offers more than 3,000 video-lessons for free, including a wide range of subjects. It has impacted significantly the English speaking educational world, being used not only in the classroom, but mainly by students at home.
   b. Flipped learning has been developed to make the best use of video-lessons within the school context. The lecture is prepared by having the students previously watching the video-lesson, so class time is dedicated to further explanations, exercise and tutoring, allowing the teacher to be
much more efficient and dedicated to the student needs during class hours. Flipped classroom stands for reversing the traditional activities by receiving the lesson at home and doing the homework at school!

c. Flexbooks (CK-12 Foundation), a free of charge site offering a wide range of text, interactive exercises and multimedia curriculum-based material which can be arranged by the customer (“customizable bite-sized textbooks”). Flexbooks site is being used in many U.S. schools mainly because is free. Since it provides the content in parts, allowing for anyone to ensemble according to taste, it runs the risk of missing the pedagogical framework of well written textbooks.

d. Online Professional Learning Communities increasingly recognized way for educators to improve their knowledge and practice as for example EdWeb.net, a platform which provides a professional social network for teachers.

8. TED: This online free conference platform launched TedEd, which produces and publishes original videos with educational content assembling education, technology and design. The site was launched with Adam Savage’s lecture, offering a very interesting pedagogical approach of a lesson which includes the lecturer guiding knowledge, animation, the power of interdisciplinarity as giving relevance to a concept, presenting the author behind the theory (as theories arise from human curiosity), reality examples (making concepts relevant), generalization, the use of different resources, all in 18 minutes, provoking curiosity and insight.


10. Gaming & gamification: The potential of digital games in educational settings is gaining space both among developers and researchers. Their popularity among kids and their learning skills’ requirements (collaborative problem solving, social strategies, communal based knowledge source, social impact, role playing, discovery and goal oriented learning, etc.) are taking educators to seriously look at this powerful tool for sparking learning and creativity, and to develop skills believed to be major at the 21st Century.

There is no doubt that digital gaming is a major digital activity regardless of age, and the main one among children (main activity of kids using tablets according to Nielsen study, 2011). Eventhough these data can lead to worrying thoughts, studies are demonstrating the effect of gaming on the development of cognitive skills, as “bolster their decision making processes because, while playing the games, they constantly calculate to determine their next move. Action game players make more correct decisions per unit time. If you are a surgeon or you are in the middle of a battlefield, which can make all the difference.” And it can even improve participants’ eyesight.

At Universities such as MIT, this subject was taken as an important part of the latest developments. “Serious gaming, as it’s commonly called at colleges and universities, involves computer games that maintain some entertainment value—enough to grab and keep students’ attention—while presenting scenarios that challenge theories, strategies, and research that is often discussed during lectures, but rarely applied. This is about making choices, being confronted with the reality of a situation. We should put that reality in a classroom and go to work on it.” Using serious video games and encouraging students to apply their knowledge in a digital world designed to simulate their future workplace, is gaining traction on college campuses, Alexkon said, but is far from an accepted learning practice. Game-based learning is on the mid-horizon, explains the report, because games are starting to become even easier to integrate into the curriculum, while also providing engaging content for students and allowing for collaboration, creativity, and critical thinking.
Individual initiatives can be found as for example teachers that introduce collaborative online games like "Minecraft" as part of their instruction methodology, games being offered for the educational system, and as "Computer games and learning" a handbook to help schools use games to support learning at school.

11. Personal Learning Environments (PLEs): collection of resources and contents that students can chose to use in directing their own learning, at their own pace. The only barriers to adoption is that PLEs rely on systems of enabling technologies, such as cloud computing and mobile devices that make the PLE environment portable, networked, and personally relevant—components that schools might not have yet.

12. Collaborative teaching environments: Online spaces, often cloud based, especially useful for group projects with students not physically close (across country or international projects). It potentiates efficient ways for students to work together pulling information from a wide range of sources.

13. Animation/Simulation/Augmented Reality: Animation and simulation are being widely explored by most digital textbooks on the market. The use of animations to explain systems (body functions, plant growth, etc.) is impacting significantly the teaching methods on Higher Education and starting to impact the k-12 market as well. The use of simulation as a "digital laboratory" is being introduced by most Science Digital Textbooks. Augmented Reality is slowly being introduced, especially via mobile devices and apps. AR is an environment that includes both virtual reality and real world elements (for ex. wearing goggles one can see the real world with added virtual elements), it allows for students to construct new ways of understanding based on interaction with virtual objects that bring underlying data to life. Examples are: students can play around with objects adapting the size to their personal space; students can visit historic sites that overlay maps and information about how the location looked in different times.

14. Apps for mobiles and tablets: Today the market offers an endless amount of applications for mobile devices to be used at school settings. On the next section (Devices) we talk about the strong impact of this latest technological approach.

15. Raspberry Pi: It is a cheap, credit-card-sized, programmable computer to help kids learn about computing and programming. According to its creator E. Upton "Children were learning about applications, which are pretty low-value skills. They weren't being properly equipped to think about how computers are programmed, about how they're built and how we make them work". Allowing kids to program on a fairly simple computer, not only help them develop cognitive skills but also stimulate their technology abilities and knowledge.

16. Pearson Education has also absorbed digital education technology and has published a tidy amount of digital studying systems. Those systems include Versant, a way to test your English speaking skills, MyMathLab and MyStatsLab, featuring comprehensive online education as well as an interactive teaching/learning system, and Mastering Platform, a college-level homework assessment system.

6. Devices:

Even though the educational system today is still predominantly using projectors (a few smartboards) and 1:1 PCs to introduce digital educational material, there is a strong suggestion that they will be substituted by tablets, and even mobiles, as it is already happening by Internet users. A report by the International Data Corporation forecasts that by 2015 the impact of smartphone and, especially, media tablet adoption will be so great that the number of users...
accessing the Internet through PCs will first stagnate and then slowly decline. Western Europe and Japan will not be far behind the U.S. in following this trend.

The use of tablets in education is becoming especially significant in 2012 and data is starting to be released. A study by Nielsen\textsuperscript{105} suggests that kids under 12yrs of age like and use tablets for educational purposes. Tablets' mobility and versatility have caught the imagination of educators (influenced by the impact of the Ipad in 2011-12), surpassing other devices as PC-tables and e-readers, due to their screens, richer gesture-based interfaces, adaptation to any learning environment and the tens of thousands of educational applications\textsuperscript{106}. SpeakUp 2011 report on Project Tomorrow 2012 reports that in 2011 the use of Tablets doubled from 2010 (almost 4000 students in the USA), the "always on" presence "depth and variety" "personalization", self-directed learning through students sophisticated use of social media and internet resources. For many educators the use of mobile devices is defined as the glue to connect disparate systems for students is the embodiment of that glue!

It is argued that the use of mobile phones (for search Google & Wikipedia) at educational settings is a daily habit of kids, and "because they've become so accustomed to using these devices, students are increasingly expecting to use them in the classroom setting"\textsuperscript{107}. Smartphones ownership and Tablet use are on a significant rise, according to Google\textsuperscript{108}. Apps and Platforms (the latter especially advocated by Blackboard\textsuperscript{109}) for integrating mobile devices into the classroom are rapidly entering the picture. Examples of apps are constantly appearing on the net, such as 3D chemistry periodic table\textsuperscript{110}, the ability to graph complex mathematical equations, or storing and sharing notes and eBook annotations, use as embedded sensors, cameras, and GPS technology\textsuperscript{111}. The power of apps adding to the portability of mobiles, is causing schools to rethink their restriction policies\textsuperscript{112}, and benefiting from BYOD advantages\textsuperscript{113} as enhancing in and out of class learning experience.
http://www.gamescanteach.com/home?page=1
http://thejournal.com/articles/2012/01/04/personalized-learning.aspx
http://www.flatclassroomproject.org/
http://www.elanguages.org/
http://www.authorstream.com/Presentation/k3hamilton-478823-augmented-reality-in-education/
http://www.digizyme.com/about/team.html
http://www.guardian.co.uk/education/2012/jan/09/raspberry-pi-computer-revolutionise-computing-schools
http://www.china.org.cn/china/2012-05/28/content_25496647.htm
http://www.idc.com/getdoc.jsp?containerId=prUS23028711
http://mashable.com/2011/05/16/tablets-education/
http://googlemobileads.blogspot.com/2012/01/new-research-global-surge-in-smartphone.html
http://www.youtube.com/watch?v=nHiEqf5wb3g
http://www.eschoolnews.com/2012/05/23/six-technologies-that-soon-could-be-in-your-classrooms/
http://www.zdnet.com/blog/igeneration/school-considers-byod-phone-use-in-class/15583