Pan-European policy experimentations with tablets
http://creative.eun.org

TABLET USE IN SCHOOLS

Luís Valente & Maria João Gomes, Instituto de Educação, University of Minho

February 2015

Creative Classrooms Lab | http://creative.eun.org
The project is coordinated by European Schoolnet and it has has been funded with support from the European Commission.

Table of contents

This project has been funded with support from the European Commission.
Lifelong Learning Programme

WHAT IS A TABLET?

Today, a tablet is a small, thin computer, with a power source of great autonomy. It is light, able to connect to networks through various protocols and has a touch screen, with fingers functioning as electric activators.

The concept of the tablet is associated with the evolution of computing and of science fiction. For example, some researchers attribute the first realistic description of a tablet to Arthur C. Clark, depicted in the cinematographic work of Stanley Kubrick as a "Newspad" (Kubrick & Clarke, 1968).

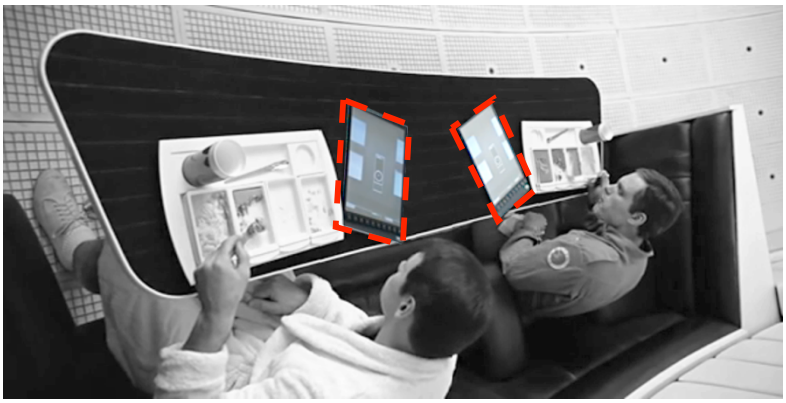

Figure 1 – Identification of the "Newspad" in a still of the film: "2001: A Space Odyssey"

In Clark's novel, published almost simultaneously with the showing of Kubrick's film, we find a curious description of the "tablet" and a reference to its characteristics.

> [Floyd] There was plenty to occupy his time, even if he did nothing but sit and read. When he tired of official reports and memoranda and minutes, he would plug his foolscap-sized Newspad into the ship's information circuit and scan the latest reports from Earth. One by one he would conjure up the world's major electronic papers; he knew the codes of the more important ones by heart, and had no need to consult the list on the back of his pad.
>
> (…)
>
> Floyd sometimes wondered if the Newspad, and the fantastic technology behind it, was the last word in man's quest for perfect communications. Here he was, far out in space, speeding away from Earth at thousands of miles an hour, yet in a few milliseconds he could see the headlines of any newspaper he pleased. (That very word "newspaper," of course, was an anachronistic hangover into the age of electronics.) The text was updated automatically on every hour; even if one read only the English versions, one could spend an entire lifetime doing nothing but absorbing the ever-changing flow of information from the news satellites.
>
> It was hard to imagine how the system could be improved or made more convenient. But sooner or later, Floyd guessed, it would pass away, to be replaced by something as unimaginable as the Newspad itself would have been to Caxton or Gutenberg. (Clarke, 1968, Part II, Chapter 9 - Moon Shuttle)

THE FIRST TABLET

In terms of real technology, Alan Kay was probably the first computing researcher to technically design a tablet, when in 1972, as part of his doctorate, he published a basic sketch of a computer for children (see Figure 2). The Dynabook conceptualised by Kay (1972) would be something that would empower children, "something with the attention grabbing powers of TV, but controllable by the child rather than the networks. It can be like a piano […] but one which can be a tool, a toy, a medium of expression, a source of unending pleasure and delight ... and, as with most gadgets in unenlightened hands, a terrible drudge!". Alan Kay knew that such a computer would be useful for children of all ages and that, even if it did not save the world from a disaster, it would open up new horizons and bring new opportunities and new challenges, just as the printed book did.

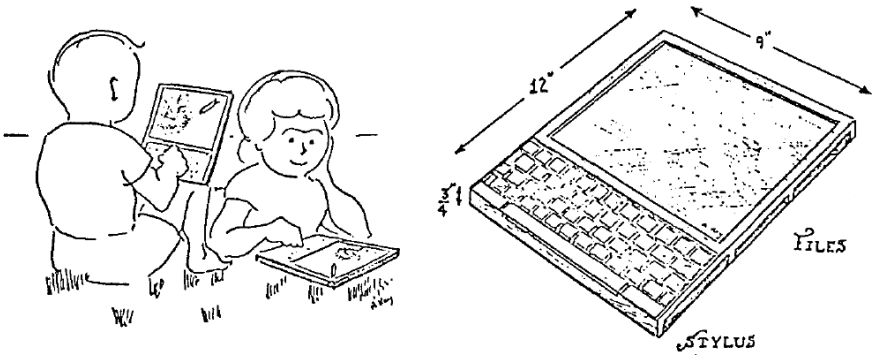

Figure 2 – Dynabook, a computer for children of all ages. Sketch by Alan Kay (1972)

The "dynamic book" was extremely important to Kay, but its visionary clearly moved away from techno-centric concepts, stating that "[w]e do not feel that technology is a necessary constituent for this process any more than is the book. It may, however, provide us with a better 'book', one which is active (like the child) rather than passive." Kay based his convictions on the learning theories of Jean Piaget and Jerome Brunner, which we associate today with the constructivist theories of learning.

The visionary Alan Kay, the first scientist to speak about the concept of a personal computer, would have to wait almost four decades to see the first usable computer with characteristics similar to those he had foreseen at the end of the 1960s become a reality. In fact, the iPhone, presented by Steve Jobs in 2007 (Elliot, 2012), was the closest thing to Kay's idea, in terms of features. However, only with the launch of the iPad in 2010 can we really talk of the realisation of the Dynabook. The iPad adopted the designation of tablet, seeking to distance itself from associations with portable computers, as was the case of the netbooks (Beahm, 2011). In spite of that, the term tablet was already in use, at least since 1986, in connected with the IBM PC Convertible followed by Thinkpads in the 1990s. Still, touch screens are what best distinguish the tablets or PC tablets from other devices, placing them between the Personal Digital Assistant (PDA) and portable computers, in terms of computational capabilities and physical dimensions.

TABLET CHARACTERISTICS

Generically, today's tablets share a vast set of features. Multipoint touch screens (see Figure 3) recognise the simultaneous touch on various points of the surface (multi-touch), which allows for a quicker use of the interfaces with the fingers or combining the fingers with other pointers.

Figure 3 – Multi-touch (source: Wikipedia)

The size, varying between 7 and 12 inches in the majority of models, is suitable for using in the palm of the hand. In 2014, the weight of the main models on the market ranges between 230gr, in the lighter models, and 960gr in the heavier ones, with the average around 450 gr (Černuta, 2014), making it relatively easy to hold the device while interacting with it. This characteristic is very important if the use of the tablet happens primarily in places where it is not possible to support it on a fixed surface, since even just 300gr will become unbearable after holding it in our hands for a few minutes.

Another distinctive aspect of the current tablets is their high pixel screen density, varying between 135 and 359 pixels per inch (ppi), making them high resolution, improving not only the quality of images shown as well as making it easy to read small print text and providing better recognition of other graphic details. Processing, storage and memory capabilities vary significantly between brands and between models of each brand. Resistance to shock, battery life, and performance of current tablets are all directly related to the price.

The architecture of these computers basically includes four distinct operating systems: iOS (Apple), Android (Google), Fire OS (Amazon) and Windows (Microsoft). Taking into consideration the question of the operating system, some architectures make available a wider range of applications than others, both free and open access as well commercial. In terms of communication protocols, tablets generally have the ability to wirelessly communicate over a local network (WLAN) known as Wi-Fi, a trademark of Wi-Fi Alliance. This feature allows for the connection between standardized Internet access points. Many models also use Bluetooth protocol to exchange information over personal communication networks (PAN or WPAN), enabling connection to other devices or the direct transfer of information between paired devices that use the same communication protocol. High-end models often include connectivity to 3G or 4G telecommunication networks, enabling access to the Internet through alternative services or the use of the tablet to complete phone calls using common mobile services.

Another characteristic common to most tablets is the integration of one or more cameras, microphone and speaker, functionalities which, controlled by small computer applications (apps), allow one to record and reproduce images and audio, making them complete and multifunctional multimedia devices.

TOUCH INTERFACE CONSIDERATIONS

A tablet is a computer! Powerful! But at first glance it does not have many of the characteristics that we are used to seeing in a computer: as a rule, it does not have an attached keyboard or mouse or equivalent; it does not have a visible separate input device, nor does it have cables or removable storage drives. It is "merely a frame" with a lighted surface: the screen. But it is a touch screen, capable of "feeling" different touches and gestures. A light touch is recognised differently from a prolonged touch, dragging an object against the surface in a certain direction provides information that is different from what will be given if the dragging occurs in the other direction. Touch screens "recognise" the difference between a finger and another hard object or a pointer designed specifically for interacting with the screen – a stylus. There are basically two types of touch screens on the market: resistive and capacitive. Although it is not possible here to go into more detail on the technical differences between each one of them, it is important to emphasize that resistive screens are less precise than capacitive ones, but the latter are more sensitive to extreme temperatures.

ERGONOMIC ISSUES

From an ergonomic standpoint, using a touch screen does not involve unnatural movements or positions of the fingers or arms, but it does induce abnormal positioning of the head in terms of alignment with the rest of the body's centre of gravity, forcing spinal disequilibrium (see Figure 4) known as "text neck", which can cause lesions in the vertebral column, now a serious concern in medicine.

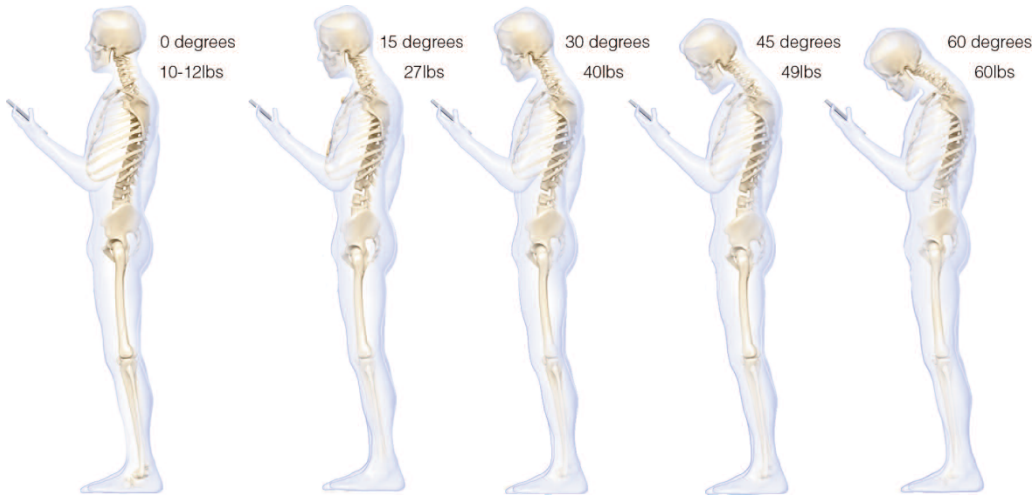

Figure 4 - The weight seen by the spine increases when flexing the neck at varying degrees (Hansraj, 2014, p. 278)

Eye fatigue is another serious problem associated with the use of poorly lit, low resolution, excessively bright, dirty, reflective or flickering screens (Tessler, 2012). CVS - Computer Vision Syndrome, with symptoms including – in addition to fatigue – eye pain, dry eyes, redness, blurry or double vision and head or neck pain, begins as a mere inconvenience but can become incapacitating and subsequently require proper medical attention.

Yan and colleagues, at the University of Albany in the United States, published a very thorough work on computer vision syndrome in 2008 (Yan, Hu, Chen, & Lu, 2008, pp. 2037-2038), in which they recommended a few preventative measures, which we quote here:

1. Computer users should place the computer screen a distance of at least 20 inches away. Distances of 35–40 inches may actually produce fewer complaints of visual strain, because such a relatively long viewing distance will allow the computer users' eyes to relax.
2. Computer users should adjust their computer monitors to a viewing angle of around 15º lower than the horizontal level. This viewing angle will likely reduce dry eyes and neck and back pain.
3. Computer users should follow the 20/20/20 rule, that is, after 20 min of computer use, one should look at something 20 feet away for at least 20 seconds. Regular small breaks improve work efficiency and compensate for time lost on breaks. Frequent breaks are recommended to restore and relax the accommodative system, thereby preventing eyestrain.
4. Computer users should carefully check the screen lighting and room lighting, including glare, contrast, brightness, reflection, and dust. Any luminous source within the computer user's field of view should not exceed three times the mean screen luminance.
5. Computer users should have a good sitting position to avoid neck ache, back ache, and headache. Computer users should pay attention to room conditions including humidity and dust. By using a humidifier, turning down the thermostat, and avoiding smoke, may reduce or eliminate dry eyes.
6. For those who need corrective lenses, it is important to have regular eye exams and have good eyeglasses or contact lenses to correct visual problems. Sometimes even very small uncorrected eye problems will cause substantial eyestrain due to the nature of long and intensive computer work. Those who wear contact lenses should follow all care instructions closely, as contact lenses may contribute to dry eyes.
7. For occupational computer users who need to use computers for more than 3 hours per day, warm eyelid massage every day is important. Computer users might place a warm towel over closed eyes, and at first gently massage the upper eyelid against the brow bone for 10 seconds and then gently massage the lower eyelid against the lower bone for 10 seconds. Such a simple eyelid massage will stimulate the tear glands, increase the blood circulation within the eyes, and reduce the chance of developing dry eyes.

TOUCH SCREENS AND LEARNING

In terms of cognitive contribution, there are not many studies on the impact of touch screens on learning and, considering their recent introduction, neither can we expect to find real studies on the impact on subjects who are not fluent in their usage. On the other hand, it is important to realise that general-use touch devices have an even shorter history. In the United States, for example, a small study included in the evaluation of the Ready to Learn programme from the U.S. Department of Education (Michael Cohen Group & Ready to Learn, 2011) analysed the impact of iPad tablets in children from 2 to 8 years old, concluding that children progress from an immediate sensory experience to an increasingly more concrete, conceptual and abstract understanding: "children's skills develop from novice to mastery when game play includes sequentially progressive levels and

the child's subjective experience is one of independence, autonomy and 'doing it myself'." The touch interface adds a certain degree of curiosity and mystery to the content, but "[i]f the interface of an App is not intuitive or does not readily afford access, children will engage in trial and error efforts, and then quickly move on" (Michael Cohen Group & Ready to Learn, 2011). The MCG study also identified some characteristics that inhibited usage and learning on touch screen devices, highlighting:

- Apps: unclear, unfriendly or unresponsive user interface,
- game play that lacks reward or feedback,
- obscure game objectives,
- too many distractions,
- apps that lack "palm rest", where buttons trigger themselves if accidentally touched within play area. (Michael Cohen Group & Ready to Learn, 2011)

Neumann and Neumann (2014) note that, due to their physical characteristics, tablets help literacy learning "as they are book-like in shape and are in the form of a writing/note pad (…) that detects and responds to stimulation by a finger or hand". Conclusions convergent with those of Neumann and Neumann are given by Ayelet Segal (Segal, 2011), who concluded in the research carried out for his doctorate that touch screen interfaces were more efficient than interfaces operated with a computer mouse and helped children use more advanced strategies. Segal also observed that "action supports thinking if the action is congruent with the thinking" (p. 96), but we also see in literature serious concerns over the use of virtual keyboards (e.g. Pierce, 2012), primarily due to the size that keyboards take up on the screen, the reduced size of the keys, the difficulty of using two hands to input text when it is necessary to hold the device at the same time and the difficulty in adapting to the reactivity of the virtual keyboard and the sense of feel, which significantly reduced typing speed.

With some benevolence and enthusiasm, certain studies seem to see the emergence of literacy in correlation with the use of touch screens, due to the gestural incentive in the interaction (e.g. McManis & Gunnewig, 2012; Murray & Olcese, 2011; Neumann & Neumann, 2014) and their formal similarity to printed books, to which are added the multimedia capabilities and text editable in terms of font, size, highlighting, colour and contrast (Neumann & Neumann, 2014). Other researchers believe that, in order for the technology to be appropriate for the development of children and youth "it should be responsive to the ages and developmental levels of the children, to their individual needs and interests, and to their social and cultural contexts" (McManis & Gunnewig, 2012).

In any case, the technological impact of tablets has positive and not-so-positive aspects, and it is important to understand that their users, primarily young ones, may have different perspectives on the advantages and disadvantages of using them. The "third-person effect" (Davison, 1983) or "web third-person effect" (Antonopoulos, Veglis, Gardikiotis, Kotsakis, & Kalliris, 2015), which claims that people consider others more vulnerable to media influences than they themselves, is a phenomenon that leads individuals to not see in themselves the impact of certain effects that they recognise in others, and this can be also be seen regarding touch screen devices. In light of this effect, Victor Strasburger and colleagues call attention to the fact that media affect childhood "not only by displacing time they spend doing homework or sleeping but also by influencing beliefs and behaviors" (Strasburger, Jordan, & Donnerstein, 2010) seeing that they learn by observing and imitating what they see on the screens, especially when the behaviours seem real or rewarding.

Warnings regarding possible harmful effects from the unregulated use of digital equipment are also issued by the American Academy of Pediatrics (AAP). This organization believes that, in order for an app to be beneficial it must, first of all, be understood by children and interesting to them. Children, however, have difficulty in distinguishing information provided by events in a video and the same information provided by someone in person. The AAP clarifies that children younger than 5 who watch television cannot play creatively or interact with real people for as long a time as those who do not watch television (American Academy of Pediatrics, 2011, 2013). Among its very large set of recommendations, the AAP urges parents to establish a family plan for using all media. "As part of the plan, enforce a mealtime and bedtime 'curfew' for media devices, including cell phones. Establish reasonable but firm rules about cell phones, texting, Internet, and social media use" (American Academy of Pediatrics, 2013). Regarding schools, the AAP recommends that they work in collaboration with teacher and parent associations "to encourage parental guidance in limiting or monitoring age-appropriate screen times. In addition, schools that do use new technology like iPads need to have strict rules about what students can access" (American Academy of Pediatrics, 2013).

Access to Tablets in Education

The governmental programmes and projects that make it possible for all children to have access to a computer have become generalised throughout the entire developed world. Computers, both desktops and laptops, are being gradually replaced by tablets, not only because they are cheaper and more portable, but also because manufacturers' marketing policies actively promote their distribution within the educational environment.

It is easy to see that the concept of a global world is repeated everywhere, being even more evident among countries with economies competing with each other. Let's look at a few examples selected at random. In Israel, one of the first countries to move to the 1:1 concept in 1995 with the programme "A Computer for Every Child", officially changed the name in 2013 to "A Tablet for Every Child" (Israel Prime Minister's Media Adviser, 2013). In Brazil, the National Programme of Educational Technology (Proinfo), started in 1997 and restructured in 2007, had a tablet initiative added to it in 2003 for the purpose of distributing that type of equipment to teachers in secondary schools and to focus teaching on the didactic-pedagogical use of information and communication technologies in everyday learning (Fundo Nacional de Desenvolvimento da Educação, n.d.). In Holland in 2013, the foundation Education for a New Era (O4NT) announced a programme to create "Steve Jobs Schools", basing the initiative on its own teaching methodology built on the 1:1 principle using iPad tablets (Steve Jobs School, 2013). But in Thailand, the One Tablet Per Child (OTPC) programme, started in 2011, is recently said to be at the end of the line and will be replaced by a development programme of Smart Classrooms with the latest-generation technology and interactive software suitable to all children (Intathep, 2014). Reasoning for this decision may be based on the 2012 report from the University of Srinakharinwirot that concluded that tablets were not suitable for young students, but it also pointed to the poor quality and scarcity of content and the poor electrical and communication network infrastructures in schools (Intathep, 2012).

Tablets and the Digital Divide

Today, when we hear of 1:1, we can be certain that it means 1 Tablet per 1 student. However, there are variations on this principle and the concept of motivating students to bring their own devices, known by the acronym BYOD (Bring Your Own Device), has also gained supporters. Considering the various perspectives that allow us to organise the different initiatives that are proliferating throughout the world, we can perhaps recognise a trend toward a growing gap between rural and urban schools.

The digital gap between social strata, between families of different economic levels and between individuals with different levels of digital literacy threatens to become increasingly evident. It is important to be aware that low levels of digital literacy or its absence fosters naïve and extreme opinions regarding the use and potential of technologies. Blind trust in the benefits of using tablets or digital content considered educational may lead to the development of the mentality that "more is better" and lead to serious damages in the development of social and cognitive skills in children, as the AAP warns (American Academy of Pediatrics, 2014). Furthermore, the perception, information and cultural standing of families also interfere with the type of activities done on tablets, specifically in relation to the access and exploration of contents with educational potential. Given that educational contents are increasingly, and almost exclusively, located online, access and connection conditions determine whether or not that content is used, specifically in schools, which bear a significant portion of the responsibility to attenuate or eliminate the digital divide. In the United States, for example, a study by Common Sense Media (2013) noted that 54% of children from high-income families access educational content but only 28% of children from low-income families do, as well. The Common Sense Media study identified internet access conditions as the main obstacle, observing that the gap decreases between children who use mobile devices to connect.

It also adds that, despite the known potential and importance of the BYOD principle in resolving the challenges regarding equipment and computer resource updates in schools, diminishing the time and effort needed for students and teachers to learn how to use equipment, an exclusive adoption of this principle may accentuate inequalities in terms of the type and quality of the devices and the services they access.

Excluding the issue of access, there are many other areas to consider in the digital divide between children, impossible to exhaustively cover in this paper. However, it is worth noting, for example, the concerns that Craig Watkins (Watkins, 2012) had regarding digital media's areas of involvement in culture with the intent of improving motivation towards learning and its results, as observed across different American ethnicities. Watkins equates the digital divide with a phenomenon accentuated by the different areas of interest that Caucasians, Hispanics, and African-Americans show in terms of media and its content and digital topics. At an even more discrete level, psychologist Catherine Steiner-Adair observes that as lives unfold around the light of the screens, a family crisis grows, as a result of the distancing in the family between parents and children. On one hand, children spend their time exchanging messages online with friends or connecting in order to do their school work, while on the other hand, parents, caught in the web of permanent connectivity, also work online. Thus, the borders of family protection are lost, which were in place to maintain a certain sense of safety from the damages caused by easy access to the Internet, media, consumerism and adult culture (Steiner-Adair & Barker, 2014). Because of this, Steiner-Adair appeals to family sustainability, seeing that the family is an ecosystem that is simultaneously strong, diversified, resilient and fragile, where an exclusive, interconnected and mutually supportive environment is created and shared between members, no matter the dynamics of the relationships.

The issues of the digital divide are, therefore, connected to access to technologies and content, to proficiency in their use and to the ability to participate and access support and proximal control.

POLICIES, PEDAGOGY AND EDUCATION WITH TABLETS

Given this panorama, it is understandable that some organisations present proposals, suggestions and directives that seek to reduce digital inequalities. The European Commission, for example, has put forth initiatives to better understand these inequalities and fight them, specifically through European Schoolnet. To that end the most recent "Survey of Schools: ICT in Education" (European Schoolnet, 2013) was prepared, the results of which were summarised in a press release on 19 April (European Commission, 2013), calling attention to the need for immediate action in various fields. UNESCO, after publishing a significant number of documents in 2012 covering Mobile Learning worldwide (UNESCO, 2012a, 2012b, 2012c, 2012d, 2012e), also published more recently a more concise document, in which it covered the benefits of learning supported by digital mobile devices and recommended some pedagogical, educational and governing policies (UNESCO, 2013).

However, and especially in schools or in communities where the issues of access and inequality are a minor problem, there are other areas that start to need attention, primarily from administrators and those responsible for internet safety. In fact, mobile device management at a school, regardless of its size, raises various concerns in terms of users´ privacy, quality of connection and access to the Internet, the physical and technical safety of personal and school equipment, including for example, the size of the electrical network and connection protocols for devices as varied as their operating systems, dimensions, technical characteristics and capabilities, operated by users who also have very distinct skills.

IN SUMMARY…

At least in the short term, tablets seem capable of asserting themselves as the most widely used device to access digital content in educational environments. Their technical versatility and their relatively low cost make them accessible to the majority of the population in developed countries, enabling its widespread ownership. However, various issues arise regarding the real impacts on education and on social justice. On the one hand, having access to the equipment does not mean being able to use them to develop the required 21st-century skills. On the other hand, even if one is able to use tablets to improve digital literacy, communication network access conditions could negatively affect the advantages of their use in education. Educational policies and the promotion of curricula that are more or less "digital" will also affect the real value of these devices as educational tools and their effective contribution in improving education. From another point of view, there is a need to safeguard the interoperability of these mobile device platforms. In some cases, the community of open application developers is very active, providing the emergence of a critical mass that acts retroactively, but in other cases it is very small or inexistent, favouring the appearance of digital ghettos and elites.

Another aspect that deserves our attention is that of ergonomics and the potential detrimental health effects from touch screens, both in terms of resolution quality and in terms of reactivity to user interaction.

We are engulfed in a giant wave of symbiotic relationships of technologies with the cognitive and social skills resulting from their use that has yet to be fully evaluated. The concepts of literacy are perceived in quite different ways by citizens, not only differentiated by gender and age, but also by the cultural and economic background of the corresponding communities. In this significantly complex framework, the school has an urgent and decisive role in research and intervention, with the special task of keeping the digital divide from growing wider.

REFERENCES

American Academy of Pediatrics. (2011). Policy statement: Media use by children younger than 2 years. *Pediatrics, 128*(5), 1040-1045.

American Academy of Pediatrics. (2013). Policy statement: Children, adolescents, and the media. *Pediatrics, 132*(5), 958-961.

American Academy of Pediatrics. (2014). Digital divide: Pediatricians debate whether tots should have access to electronic devices. In S. S. Martin & D. Jacobson (Eds.). Elk Grove Village, IL: American Academy of Pediatrics.

Antonopoulos, N., Veglis, A., Gardikiotis, A., Kotsakis, R., & Kalliris, G. (2015). Web third-person effect in structural aspects of the information on media websites. *Computers in Human Behavior, 44*, 48–58. doi: dx.doi.org/10.1016/j.chb.2014.11.022

Beahm, G. (Ed.). (2011). *I, Steve: Steve Jobs in his own words*. Chicago, IL: B2 Books.

Černuta, S. (2014). Tablet Comparison. [Web site]. Retrieved Nov 2, 2014, from http://www.tabletpccomparison.net/

Clarke, A. C. (1968). *2001: A space odyssey* (1 ed.). New York, NY: Dutton Adult.

Common Sense Media. (2013). Zero to Eight: Children's Media Use in America 2013. San Francisco, CA: Common Sense Media.

Davison, P. (1983). The third-person effect in communication. *Public Opinion Quarterly, 47*(1), 1-15.

Elliot, J. (2012). *Leading Apple with Steve Jobs: Management lessons from a controversial genius*. Hoboken, NJ: John Wiley & Sons.

European Commission. (2013). ICT in schools survey – many children not getting what they need; teachers need more training and support [Press Release]. http://europa.eu/rapid/press-release_IP-13-341_en.htm

European Schoolnet. (2013). *Survey of schools: ICT in Education: Benchmarking access, use and attitudes to technology in Europe's Schools*. Brussels: European Union.

Fundo Nacional de Desenvolvimento da Educação. (n.d.). Proinfo Integrado: Tablets. Retrieved December 2, 2014, from http://www.fnde.gov.br/programas/programa-nacional-de-tecnologia-educacional-proinfo/proinfo-tablets

Hansraj, K. K. (2014). Assessment of stresses in the cervical spine caused by posture and position of the head. *Surgical Technology International, 25*(25), 277-279.

Intathep, L. (2012, 21 February). Tablet study finds city, rural schools need different content. *Bangkok Post*. Retrieved from http://www.bangkokpost.com/lite/news/280760/

Intathep, L. (2014, 27 May). Ministry to urge end of tablet policy. *Bangkok Post*. Retrieved from http://www.bangkokpost.com/news/politics/411934/ministry-to-urge-end-of-tablet-policy

Israel Prime Minister's Media Adviser. (2013). PM Netanyahu Attends Computer for Every Child Project Meeting. Jerusalem: Israel Prime Minister's Media Adviser.

Kay, A. (1972). A personal computer for children of all ages. In J. J. Donovan & R. Shields (Eds.), *ACM '72 Proceedings of the ACM annual conference* (Vol. 1, Article No 1). New York, NY: ACM Association for Computing Machinery.

Kubrick, S., & Clarke, A. C. (Writers). (1968). 2001: A space odyssey [Multiple Formats]. In Metro-Goldwyn-Mayer & Stanley Kubrick Productions (Producer). USA: Warner Bros. Worldwide.

McManis, L. D., & Gunnewig, S. B. (2012). Finding the education in educational technology with early learners. *Young Children, 67*, 14-24.

Michael Cohen Group, & Ready to Learn. (2011). *Young children, apps & iPad* (pp. 13). Retrieved from http://mcgrc.com/wp-content/uploads/2012/06/ipad-study-cover-page-report-mcg-info_new-online.pdf

Murray, O. T., & Olcese, N. R. (2011). Teaching and learning with iPads, ready or not? *TechTrends, 55*(6), 42-48.

Neumann, M. M., & Neumann, D. L. (2014). Touch screen tablets and emergent literacy. *Early Childhood Education Journal, 42*, 231-239. doi: 10.1007/s10643-013-0608-3

Pierce, M. (2012). Typing in the age of Tablets. *THE Journal, 39*(3), 22-24.

Segal, A. (2011). *Do gestural interfaces promote thinking? Embodied interaction: Congruent gestures and direct touch promote performance in math.* (Doctroal thesis), Columbia University, New York, NY.

Steiner-Adair, C., & Barker, T. H. (2014). *The big disconnect: Protecting childhood and family relationships in the digital age* (Reprint ed.). New York, NY: Harper Paperbacks.

Steve Jobs School. (2013). First seven Steve JobsSchools opened in the Netherlands (pp. 11). Amsterdam, the Netherlands: O4NT Foundation.

Strasburger, V. C., Jordan, A. B., & Donnerstein, E. (2010). Health effects of media on children and adolescents. *Pediatrics, 125*(4), 756-767. doi: 10.1542/peds.2009-2563

Tessler, F. (2012). The hidden danger of touchscreens. *InfoWorld,* (Jan 11, 2012). http://www.infoworld.com/article/2618327/laptop-computers/the-hidden-danger-of-touchscreens.html

UNESCO. (2012a). *Turning on mobile learning in Africa and the Middle East: Illustrative Initiatives and Policy Implications*. Paris: United Nations Educational, Scientific and Cultural Organization.

UNESCO. (2012b). *Turning on mobile learning in Asia: Illustrative Initiatives and Policy Implications*. Paris: United Nations Educational, Scientific and Cultural Organization.

UNESCO. (2012c). *Turning on mobile learning in Europe: Illustrative Initiatives and Policy Implications*. Paris: United Nations Educational, Scientific and Cultural Organization.

UNESCO. (2012d). *Turning on mobile learning in Latin America: Illustrative Initiatives and Policy Implications*. Paris: United Nations Educational, Scientific and Cultural Organization.

UNESCO. (2012e). *Turning on mobile learning in North America: Illustrative Initiatives and Policy Implications*. Paris: United Nations Educational, Scientific and Cultural Organization.

UNESCO. (2013). *Policy guidelines for mobile learning*. Paris: United Nations Educational, Scientific and Cultural Organization.

Watkins, S. C. (2012). Digital divide: Navigating the digital edge. *International Journal of Learning and Media, 3*(2), 1-12. doi: 10.1162/IJLM_a_00072

Yan, Z., Hu, L., Chen, H., & Lu, F. (2008). Computer Vision Syndrome: A widely spreading but largely unknown epidemic among computer users. *Computers in Human Behavior, 24*, 2026-2

The work presented on this document is supported by the European Commission's Lifelong Learning Programme - project Creative Classrooms Lab (Grant agreement 2012-5124/005-001). The content of this document is the sole responsibility of the consortium members and it does not represent the opinion of the European Commission and the Commission is not responsible for any use that might be made of information contained herein.

Lifelong Learning Programme