MOBILE DEVICES IN SCHOOL IN TEACHING / LEARNING PROCESS – THE ROADMAP

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Abstract

Mobile devices, particularly tablets and smartphones, have achieved tremendous popularity in recent years because of their versatility and multi-functionality and are naturally used in the daily life of any individual and especially adolescents. Since 2010, with the launch of the iPad, the sales market for mobile devices has not stopped growing. This is justified by the fact that these devices present many advantages and few disadvantages; having as strengths usability, portability, versatility, adaptability and ability to customize individual experiences. In the context of the teaching and learning process devices allow to overcome the temporal and physical boundaries of the classroom, since the information is omnipresent and no longer limited to a specific time and place for learning, that is, it enhances m_learning. M_Learning is presented as an approach to the teaching and learning process that allows to acquire any knowledge (anything) desired by the user, regardless of the time (anytime) and the place where you are (anywhere). Students who currently attend the education system, as mentioned, belong to a generation that live every day, in all situations and places, with this type of technology and expect their integration in the classroom, where they spend much of the day. Living with these devices is so intrinsic to these individuals, that teaching without the use of such devices can be considered a wastage to the learning process. In Portugal, the use of m_Learning is little promoted despite subjects as problematic as mathematics can benefit from this new step of technology unlike other countries. This paper presents the state of the art of the use of mobile devices, tablets and smartphones in the teaching/ learning process.

Keywords: mobile learning, education, mobile devices, tablet, smartphone.

1 INTRODUCTION

Technology is deeply rooted in today's society [1] and adolescents in particular, accept and adopt new technologies quickly. Consequently, several researchers encourage their integration in the classroom [2] aiming to capture their interest with something that is familiar, since several studies indicate a positive correlation between the use of technology and learning [3]. Therefore, we would expect that teachers would use technology in the teaching-learning process in order to capture the interest of students [4]. However, though the new technologies provide many tools [5], teachers are usually very slow to adopt them [1]. The evolution of ICT (Information and Communication Technologies) and in particular of mobile technologies has revolutionized the world as we know it, and devices, such as tablets, have gained popularity so quickly in the general public and in various age groups [6] that it is impossible not to try to imagine what such devices can lead to when used in education. Mobile technologies, and in particular tablets and smartphones, with their innate versatility are presented as an opportunity to progress in the teaching-learning process contributing to the success and also to minimize learning difficulties [7]. The rest of the paper is organized as follows. In the next section, a background of the addressed subjects is presented. Mobile devices (tablet and smartphone) and their market evolution is described in section three. In section four is presented the ICT role in the classroom. Finally, in the last section, conclusions are discussed.

2 M_LEARNING

2.1 Generations

Under the generational diversity currently observed, it is pertinent to understand the generations in the current classroom - teachers and students. It is possible to consider the existence of five generations: Traditionalists, Baby Boomers, Generation X, Generation Y e Generation Z [8].

Table 1 – Generations and its relationship with technology.

	Year of Birth	Current Age	Technology
Traditionalists	1922 – 1945	69 - 92	They do not have great links with technology, using it only when it is absolutely necessary.
Baby Boomers	1946 – 1964	50 - 68	They have accepted a large share of technological advances in their lives but they reveal some difficulty in integrating so many "advancements".
Generation X	1965 - 1979	40 - 49	They grew up with technology and the changes caused by the introduction of computers, mobile phones, internet, among others.
Generation Y	1980 - 2000	14 - 34	They grew up with information technology, and be "on" and loving technology is something that is inherent in them. These individuals are equipped with the latest mobile technology and are in contact with it 24 hours a day, 7 days a week, 365 days a year (24/7). They feel constantly attracted to anything that is related to the new technologies.
Generation Z	Depois de 2000	0 - 14	Born at a time when technology plays a central role in people's lives and is present in almost everything.

There is unevenness in terms of familiarization and use of technology among the various generations. As the school is attended by individuals from different generations presented with different interests before technology, one used to dealing with technology every day [9] and others, who despite having grown in parallel with the constantly evolving technology, do not "dominate" it.

2.2 m_Learning – anytime, anywhere… anything

Mobile Learning or m_Learning can be considered as an evolution of d_Learning and e_Learning [8]. Historically d_Learning (distance learning) has over one hundred years of existence [10], since the early days of "teaching by correspondence" with the text printed to support the provision of content and postal mail as communication support [11]. Its main feature is that the geographical distance and / or time availability dictates the separation between the teacher and the student [10].

E_Learning (electronic / digital learning) also provides distance learning but with the possibility of using network environments (Internet) to distribute content in hypermedia format and the possibility of using multiple synchronous communication tools (where a teacher / trainer provides support in real time, using, for example, video conferencing) and / or asynchronous, individual or group (email, chats, discussion forums, etc.) [12]. From technology point of view, e_Learning is intrinsically associated with the Internet and the WWW (World Wide Web), by the resulting potential in terms of information access regardless of the moment in time and physical space, ease of quick publication, distribution and updating of content, the variety of tools and communication services and collaboration among all stakeholders in the teaching and learning process and the possibility of developing "collaborative hypermedia" support learning [11].

The evolution of mobile technology provided, in the last decade, the emergence of m_Learning as a natural consequence of the development of new forms of digital communication society, allowing the occurrence of new forms of learning in different contexts [13], [14]. With the development of wireless networks, m_Learning presents itself as a new benchmark in distance education [15] and allows access to any information (anything) [16], at any hour of the day (anytime), in any location (anywhere) [17]. The physical boundaries of the classroom and time for learning ceased to exist because the content is ubiquitous (can be accessed from anywhere), students can communicate with teachers, other students and anyone else [9] to satisfy their need for knowledge using the new generation of mobile devices (Smartphones, Tablets, etc.).
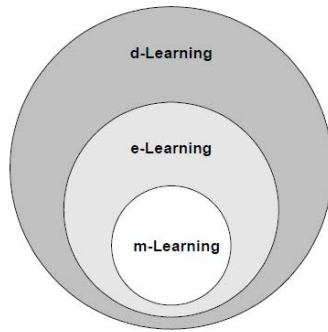
Figure 1 - m_Learning as part of e_Learning and d_Learning [10].

The "always-on" individuals (permanently available for digital communication via mobile devices) [18] are the "target" of m_Learning. Teens learn in school but also learn in many other places - "Stolen moments for learning" [19], as in buses, in their homes, when they go to walk down the street [19] or even in museums, where mobile devices can be used as guide / consultant to answer questions on any subject. If teachers manage to take advantage of mobile devices and all the technology that surrounds them, its possible to shape the educational content to every student [9].

The user / student can shape their learning experience according to your preferences, both physical and temporal and basically learn what they want. The teacher's role is to plan and guide the student's activity so that they acquire the expected competences (and even others that the student may find relevant to their own experience) according to your pace and preference. M_Learning may be considered as an approximation of the teaching-learning process that allows any user to acquire the desired knowledge, regardless of time and location they are in.

The different generations who currently attend the Portuguese education system relate in different ways with this new way of learning, due to the large and rapid evolution of technology in general. Individuals belonging to generations that have grown up and live daily with technology, accompany these developments with ease but individuals of previous generations may prove difficult due to the rapid evolution of technology in general (almost every day new devices and software are presented).

3   MOBILE DEVICES

ICT developments and especially mobile technology, have revolutionized the world as we know it, and devices such as tablets and smartphones have, gained a great popularity among the public and in various age groups [6]. The main features of mobile devices are portability, ease of access to content, learning opportunities anywhere, connectivity (convergence with other devices, networks and technologies), individualized and personalized experiences [20]. Another key feature is that the interaction with the device is performed using a common stimulus: fingers in multi-touch screen using the innovative GIT (Gestual Interface Technology) [6] which provides a natural means of interaction [16] using simple gestures (tap, drag, swipe, move away and join the fingers [21]), eliminating the need for peripherals required for its operation, namely, the keyboard or the traditional mouse [20].

Table 2 - Advantages and Disadvantages of mobile devices.

Advantages	Disadvantages
Possibility of being used in any location [22], [23], [24]	Unable to view certain content [28], [29], [30]
"Start up time" is almost non-existent [22]	Insufficient screen size in certain models of tablet [31], [32]
No need for keyboard or peripherals	Need to charge the battery and its duration [32]
Requires less maintenance than traditional computers and laptops [25]	Limited storage capacity and processing power [32]
Encourages the concentration of students, improving the behavior [26], [27]	Data link cost required for these devices to access the Internet when the WiFi connection is not available [32]

3.1 Tablet

Tablet - in very simplistic terms, it's a computer that has a touchscreen interface. It's not a smartphone, or netbook, or a PC or a computer tablet, but has features of all of them [33], [20] and in physical and functional terms lies between the smartphone and the computer [34] but without the disadvantage of the smartphone screen size and computer weight [20]. It's a very light device (some weigh less than 250 grams) that can store all the books that students use every day, together with all existing books in the school library and can still be the driver of new forms of learning and teaching [35]. With the popularity of educational tablets like Aakash, many communities in developing countries use such devices to access the Internet instead of using the traditional computer [36].

When it was released in 2010 [37], the iPad was considered pioneering because it was the first of its type [33]. The iPad is regarded as the third generation of computers (the PC being the first and laptops the second) [38]. Despite representing the pinnacle of current technology, the tablet seems the updated version of the traditional wood and slate blackboard but adapted to modern times. Like any other device, it has advantages and disadvantages.

Some tablets are considered the "Swiss Army Knife" [32] of our time as they bring together several features: camera / video, lantern, accelerometer, gyroscope, compass, alarm clock, music player (MP3), game console, GPS, microphone, connectivity to the internet, phone, voice recorder, post-it, schedule, TV, among others. Table 3 is a summarized result of some relevant studies on the characteristics of tablets in general and the iPad in particular because there are a number of studies geared especially for the iPad, between the period between 2010 and 2012. In 2013, a more general attitude towards tablets was adopted which also corresponds to the decline in orders for the iPad and the rise of the Android system.

Table 3 - Case studies of the main features of tablets and particularly the iPad.

Group	Ref	Affordable price	High Price	Size	Interface (Touch Screen)	Low price of apps	Abundance of apps	Intuitive design	Weight (Light)	Portability	Connectivity	Evaluation facilitator	Energy Independent (after loaded)	1:1 Interaction	Processor Speed	Storage Capacity	Battery capacity (autonomy)	Low Maintenance	Durability	Fast start up	Integrated Camera
Tablets in General	[39]	X				X		X	X	X											
	[36]								X	X		X	X	X							
	[40]								X	X						X					
	[6]	X								X											
	[41]	X		X			X		X	X	X				X		X	X	X		
	[42]	X								X							X				
	[43]				X		X		X	X					X		X			X	X
	[44]		X	X				X		X	X				X		X				
	[45]		X	X			X			X							X		X	X	
	[46]				X	X	X		X		X						X			X	
iPad	[47]									X											
	[48]		X	X			X			X	X										
	[27]				X					X	X										
	[1]								X	X							X			X	
	[23]				X		X														
	[38]	X		X	X			X	X	X							X				
	[22]				X			X		X	X				X		X				
	[16]				X				X	X	X						X		X		
	[49]	X		X	X					X											
	[50]				X					X							X				
	[51]			X						X											
	[34]		X			X															
	[52]	X		X													X		X		
	[53]	X		X			X								X	X					X

3.2 Smartphone

A smartphone is a mobile phone with advanced features. The first smartphone with some of the features that today basically equip every smartphone was the IBM Simon model unveiled in 1992. But

it was only in 2007 with the introduction of iPhone in the market, that this device has become truly popular, because until then this type of device was used only as a work tool. The widespread presence of the smartphone in people's lives has changed significantly the lifestyles of today's society. As in the case of the tablet, once again one of the significant aspects to note is that great progress in recent years and the convergence of several devices on a single device [54], because the smartphone brings together various functionalities of various objects and each new model reveals something new such as blood pressure monitor present in the Samsung S5. Smartphones feature a smaller battery duration than their predecessors due to screen size and numerous features such as camera / video, GPS (Global Positioning System) and ability to use specific software for certain features (eg creation and editing of documents, use of social networks such as Facebook, Twitter and others), by installing specific applications. Like the tablet, it has a multi-touch screen, which is larger than a mobile phone (to enable web browsing and viewing multimedia content) and designed keyboard. Internet access is accomplished by WiFi or 3G network (which may incur additional costs for the user) and has storage capacity for files (photos, videos, documents and multimedia) [55].

In 2006, this type of devices had already become one of the fastest growing communications technology and today, the smartphone is arguably the most popular device worldwide [56].

In 2009, the presence of teenagers was inseparable from the presence of the smartphone predecessor - the mobile phone - and the vast majority had at least one, often used [54]. Almost all teens (13 to 15 years: 96.6%; 16-18 years: 99.0%) had a mobile phone [57]. Currently, the situation is similar to the smartphone and this creates an opportunity for learning [9] that can, and should, be taken advantage of as studies in formal learning contexts indicate that the attraction that this type of device has on teenagers can It is used to increase motivation in schools [58].

Portability allows students to explore their interests for a certain content, regardless of where they are [59], [33]. Internet access, at any location the user is located, is currently not free of costs (limits its use) but in the near future, and the trivialization of these services, of course the costs will be much more affordable, boosting m_Learning. However, with the great diversity that currently exists, the user can access the Internet via WiFi (Wireless Networks) existing in multiple locations.

In informal learning contexts, teenagers use these intensive and multifaceted devices, using different features, managing different media and different representations of information, often collaboratively [54] and its use in learning environments has no negative effects ie, does not prevent the acquisition of new knowledge [60]. Of course we cannot forget the prohibition in Portugal of using mobile phones in classrooms requiring the smartphone to be used in an extra-class environment as possible tablet supplement.

Smartphone use by adolescents in informal contexts includes multiple digital practices such as managing multiple sources of information, handling of various types of media and collaborative working network. However, the school remains one of the unique contexts of teen life where the smartphone is almost always prohibited [54]. It is the last stronghold in the resistance to the use of smartphone, despite the pleasantness of the idea of students using smartphones in the classroom context [54] and its enormous potential for learning and exchange of information [61].

Limiting their use is, also, legislated in the Student Statute, Law No. 51/2012 of September 5, Article 10, paragraph r, which reads: "Do not use any technological equipment, namely, cell phones, equipment, programs or computer applications in places where arising classes or other training activities or meetings of organs or school structures in which you participate, except when the use of any of the aforementioned means is directly related to the activities to develop and is expressly authorized by teacher or person responsible for the direction and supervision of the work or ongoing activities;". The vast majority of schools at the European level, prohibits the use of mobile phones in classrooms, but increasingly evident that teenagers use them covertly [62], [54].

3.3   Evolution of the mobile device market

Due to its immense versatility when compared to desktop computers or even laptops, tablets and smartphones, have caused the community at large a growing interest has led to a significant increase in sales and the mass of this type of device. As seen in Fig. 2, the percentage of individuals who use the internet anywhere is overwhelming and the average percentage of users is over 70%.
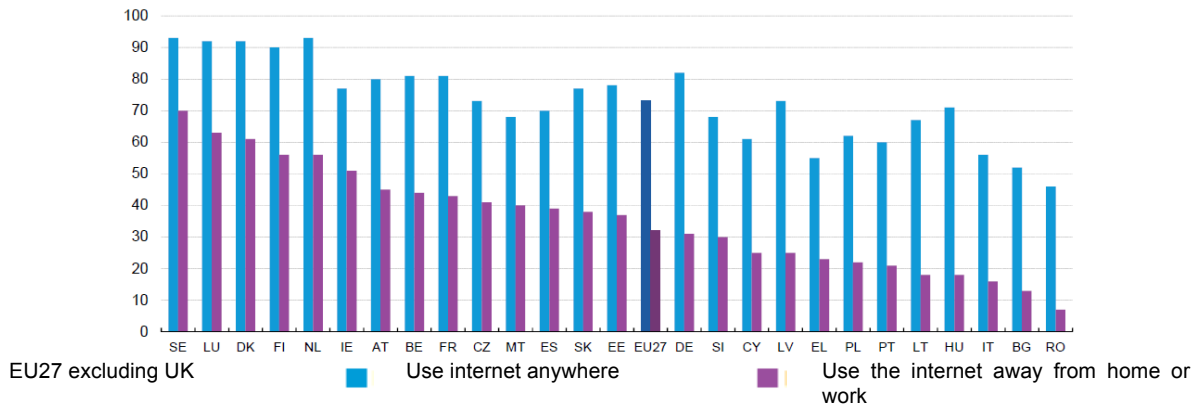
Figure 2 - Individuals (in percent) who use the internet anywhere and out of home and work [63].

The use of mobile Internet has become more popular, especially among teenagers, with the market introduction of new mobile devices such as smartphones or tablets [63]. In Fig. 3, you can check that individuals between 16 and 24 years are the ones who use the Internet anywhere. It is also observed that in the age group between 16 and 54 years, mobile devices are more used than laptops.
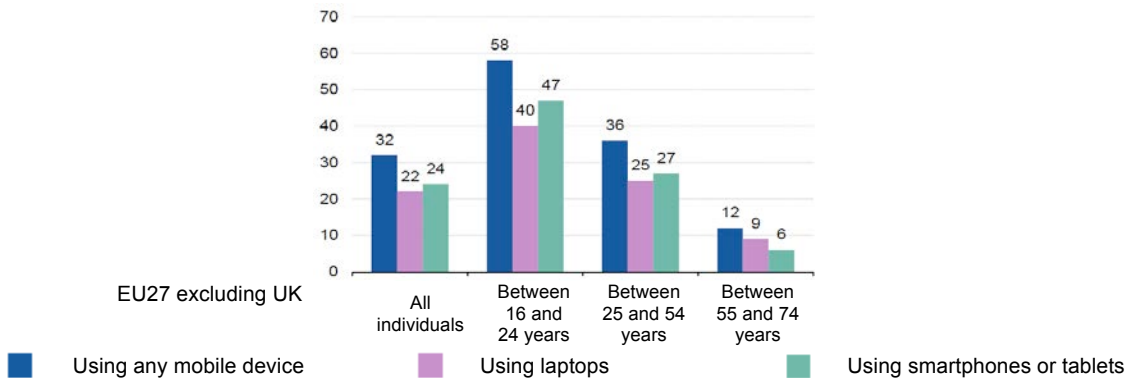

Figure 3 - Individuals (in percent) who used the internet away from home or work in 2012, by age group and type of mobile [63].

Tablets continue to stimulate the growth of the SCD (Smart Connected Devices) market and in the third quarter of 2013 the sales volume increased by 87.7% year on year [63]. In 2013, it was expected that the sale of tablets reached 650,000 units in Portugal, an increase of 78.9% compared to 2012. Regarding smartphones, they remain the segment with more volume, representing more than 60% of all SCD, totaling 570,000 units sold in Portugal in the third quarter (equivalent to an increase of 26.4% over the same period) [64].

Table 4 - Top 5 Vendors: Portugal SCD – 3rd Quarter 2013 (Thousands of Units Sold) [64].

Manufacturer	Units Sold 3Q' 2012	Units Sold 3Q' 2013	Market Share 3Q'12	Market Share 3Q'13	Growth 3Q'13 vs 3Q'12
Samsung	239	254	33,3%	29,1%	6,2%
LG	18	88	2,6%	10,1%	379,8%
Apple	61	84	8,4%	9,6%	38%
ASUS	48	58	6,7%	6,6%	20%
Acer Group	25	52	3,5%	5,9%	105,2%
Outros	327	337	45,5%	38,6%	3%
Total	**718**	**871**	**100%**	**100%**	**21,3%**

Internet penetration via smartphone grew 5% last quarter and in the first quarter of 2014 about 32.8% of respondents had Internet via the mobile phone (Fig. 4) [65]. Teenagers aged between 15/24 and

25/34 years, living in Oporto and the North Coast belonging to the higher social classes, contributed most to the increase in Internet penetration via smartphone verified in the second quarter 2014.
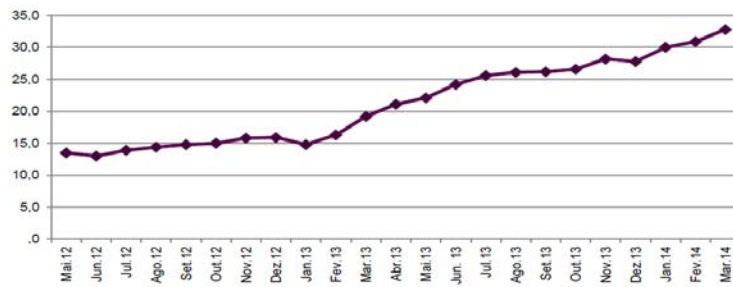

Figure 4 - Internet Penetration (percentage) via mobile phone (Marktest) [65]**.**

The battle for the higher volume of sales of mobile devices not only involves the device manufacturer (with regard to the quality of materials), features and price, but also the OS fitted to, because there are big differences among them in terms of stability, safety and apps availability. Only in the second quarter of 2012 devices equipped with Android OS surpassed for the first time (in number of orders) iPad sales (and hence the iOS) due to a lot of brands to start using Android OS (Fig. 5) [66].
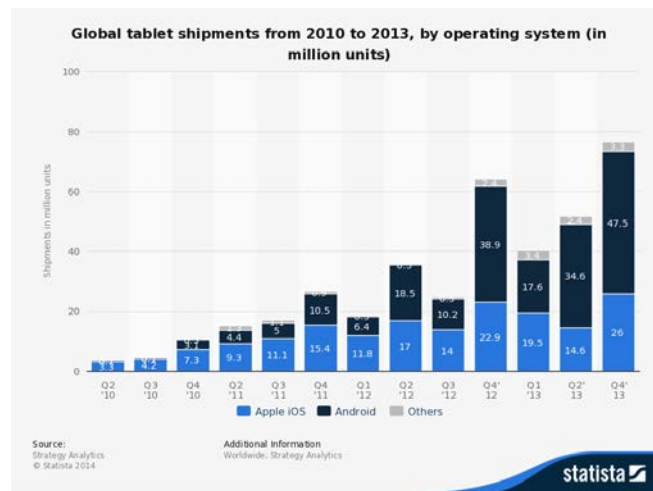

Figure 5 – Orders of tablets between 2010 and 2013, by OS (in million units) [66]**.**

There have been several studies of the iPad use as an educational tool since its introduction on the market [67]. But the main focus of attention has been on this device because of functionality when compared to tablets that use other OS, the amount of apps available and the attraction of teenagers by the iPad. Despite the existence of numerous tablets with the Android OS, they are still far from the quality and usability that an iPad can offer. Although in terms of sales Android tablets clearly dominate regarding the use of the tablet for internet navigation data is significant different because Apple's tablet users use the same substantially more users than any other tablet [68].

4   MOBILE DEVICES IN THE CLASSROOM

Several studies indicate that ICT is rarely used by most teachers in their teaching practices [69], despite the fact that today's students live since birth with digital information and the Internet, even being called "digital natives"[70], ie the potential of students is not being used to their learning.

Currently, in the Portuguese educational system, 74% of teachers are over 40 years [71] and this fact restricts the use of new technologies in the classroom by this age group because although they have grown in parallel with the technology constantly evolving, they do not "dominate" it. When they use it, their use is sporadic, limited and trivial, because the student has no central role, the teacher uses and manipulates (traditional lecture with technology only serve as auxiliary) for student disappointment that value their personal experience to acquire new knowledge, therefore ultimately it has no significant

impact on their learning [72]. Teenagers are used to dealing with technology every day [9], and expect their inclusion in school in general and in particular in class [73], where its full effectiveness is achieved with activities that meet students, according to their interests, skills in problem solving, in the conceptualization and critical thinking, rather than the mere acquisition of knowledge [5], [69]. The traditional teaching manual is now considered unattractive [73] (58% of students prefer digital manuals), when compared to other media currently available (internet, multimedia, educational software) that students use every day. Digital technologies facilitate collaboration and creativity in activities and this happens because students manage their own devices (unlike the usual, where the teacher uses and the student notes) and consequently their learning [74]. By combining the "tools" used and strategies carefully planned by teachers, students can experience an alternative way to achieve the goals, making links between content, solving problems together, rehearsing and modifying their work to search for other views. Such strategies enhance the development of organizational strategies and scientific rigor in students [75].

Several researchers believe that the future of classrooms, will be tailored to each individual to enable differentiated instruction according to the interests and level of learning [76]. Devices with so many features, and easily configurable to the tastes of each, are presented as an opportunity to improve and monitor the process of teaching and learning [77], for both teachers and students, as well as inside and outside the classroom.

In Portugal in 2012, Acer and European Schoolnet have undertaken a pilot study on the use of tablet in strengthening teaching and learning practices. Acer has equipped 263 teachers in 63 schools in eight European countries with tablet computers Acer Iconia W500. Participating countries were Estonia, France, Germany, Italy, Portugal, Spain, Turkey and the United Kingdom [78]. Some schools in the UK and Spain, also received some tablets to equip their students, however, the study carried out in Portugal, this did not happen. The tablet was used in a variety of subjects and there were no indicators that the tablet was more suitable for a particular subject than another [78]. Most teachers used the tablet mainly for browsing and searching the Internet in order to gather learning materials or Apps to prepare presentations and used a variety of different teaching methods with tablets, alternating between the front teaching and methods that promote collaborative and individual activities with students. In September 2013, in Cuba, Portugal, a three year pilot project was started with seventh grade classes. When students complete their ninth grade, it will be evaluated to see if it is an option that, besides reducing the weight in the backpacks of students (by replacing the manual), it improves the teaching-learning process.

5   CONCLUSION

In current times it is impossible to ignore the enormous proliferation of technology in even the most basic realities such as India and Thailand, where there are considerable investments. The need for individuals to be "always on" led to the natural appearance of mobile devices. These allowed the number of individuals who use the internet anywhere to increase daily. Mobile devices have a number of features that impart an unprecedented versatility and have few drawbacks, compared with others that perform the same tasks, has led to a proliferation sweeping worldwide. The worldwide sales domain is coveted by many manufacturers and also in OS and apps the dispute is enormous.

However, in the school environment, when technology is present, it is used as a support to traditional and expository teaching, and there isn't a real innovation in the teaching practice of teachers. Normally, the teacher shows the contents using the internet or graphical presentations but the student doesn't get to use the technology that exists in the classroom (usually limited and not permitted for students use), not allowing thus the goal of having a personal and unique experience with content.

In recent years mobile devices have had a great evolution that boosted sales of these to the millions of units. The development has resulted in great advances in terms of hardware (via the miniaturization allowed for the convergence of several devices in one) or software (whose features put these devices in terms of some computers), which resulted, in time, an unprecedented acceptance around the world due to its various advantages, potential and ability to customize individual experiences. Due to the great usability, versatility, adaptability and number of users of such devices it is inevitable to expect this "phenomenon" to be shortly introduced in schools as several pilot studies showed a positive correlation in the teaching-learning process of students. In countries all over the world, there are schools that gave tablets to their students and teachers and show significant changes in terms of achievement and engagement of students. But none of these outbreaks is comparable to Steve Jobs

School in the Netherlands, where the iPad is already used daily and mandatory use, dazzling the possible future of mobile devices. Is this the future?

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