INTERACTIVE COMPUTER OPERATING SYSTEM CUSTOMIZATION: PROMOTING NEW EXPERIENCES IN EDUCATION

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INTERACTIVE COMPUTER OPERATING SYSTEM CUSTOMIZATION: PROMOTING NEW EXPERIENCES IN EDUCATION

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Abstract

The Information and Communication Digital Technologies insertion in education has widely modified several learning spaces providing a greater interactivity among student, teacher and school contents. Based on these technologies, the interactive computer is pointed out, which presents itself as a tool able to provide and intensify students' involvement on their own learning process. The Federal Government of Brazil, through the Ministry of Education and the National Education Development Fund, offers the possibility to take an interactive computer to public schools, which is composed by computer, projector and interactive whiteboard. This board provides the students' interaction either considering didactic resources and content throughout classes, through its dynamic projection, similar to a large touch screen. This equipment is used in educational environments by teachers who routinely face technical issues related to the educational software installation. The interactive computers model, purchased by the Ministry of Education, has an operating system that does not allow definitive software installation, summarizing, the system returns to the manufacture patterns despising any of the realized installations when the equipment is restarted. The municipality schools in Fortaleza, Brazil, makes use of educational software, such as Luz do Saber, Gcompris, TuxMath, among others, and also the interactive computers as a didactic resource in the teaching learning process. In each initiation of these interactive computers it is required that teachers perform a new installation of the desired software. Therefore, this article aims to report the customization process of a Free Operating System, which allows the permanent installation of educational software used in the School Units in Fortaleza, in order to simplify teachers' routine when using the interactive computer. Thus, a partnership with the Technical Advisory Committee on Computers in Education was settled up, which takes care of teachers' training courses, taking as a subject of the course the educational software and technological resources, such as the interactive computer. So, right after the operating system customization, a presentation consisting of a demonstration and practice were performed and a satisfaction survey evaluation was conducted by the mentioned staff. As a result, some improvements regarding the factory system were pointed out, such as, permitting permanent installation of software, stability and usability, among others. The customized system met the expectations and sorted out the mentioned problem in this research allowing more time for the teachers' pedagogical interventions.

Keywords: Digital Didactic Resources, Interactivity, Free Software, Education.

1 INTRODUCTION

The Information and Communication Digital Technologies (ICDT) are increasingly used in the classroom and also several education levels. That's happens because it's necessary to encourage digital natives [1]. They were born in a digital world where technology is a prevalent key in many areas.

Notebooks, datashows, tablets, smartphones, netbooks, ultrabooks and interactive computers are ICDT that excel in education. Interactive computers deserve special attention because it is a computer, a projector and a digital whiteboard that changes vertical spaces, such as whiteboards or walls, into interactive whiteboards. A projection, on a blackboard or wall, creates a touchscreen "screen" that allows student/student, student/content, and student/teacher interactions.

The interactive computer presents itself as an important ICDT in education, and thus it should be better exploited to promote teaching and learning, mediated by the teacher's action. For [2], contemporary students are no longer interested in exclusively expositive classes, then a question rise up from this issue: why is it important to modernize the classroom by exposing materials in an interactive way?

The National Program for Continuing Education in Educational Technology (ProInfo Integrado) was created by the Brazilian Federal Government, through the Ministry of Education (MEC) and the National Fund for Education Development (FNDE), which aims the use of the ICDT in education, either didactically and pedagogically, enabling public schools to acquire lightweight and portable interactive computers to be used in the classroom by teachers and students [3].

Thus, the Municipal Department of Education (SME) of Fortaleza in Ceará acquired 374 interactive computers, Daruma PC3500wi model, by Positivo, through the 71/2013 session of the FNDE. These equipments were acquired by the municipality public schools to be used as technological resources to support the educational process.

These computers have a Free Operating System available from factory mode with limitations concerning to the installation of new softwares. In order to use educational softwares, teachers have to install the required softwares at each boot.

In the Brazilian context, teachers are experts in various areas and have served the city council for many years. They have little experience with ICDT. This scenario turns it difficult and also reduces the use of this device as a didactic-pedagogical resource.

This article aims to study the possibility of the permanent installation of educational softwares in the interactive computer, aiming to stimulate, thus, the increasing use of this ICDT by teachers.

So, this article is organized by 6 sections, presented following: Section 2 will be approached the theoretical basis. Then, in the third one, the description of the methods is presented. In section 4, the results will be presented. In Section 5, a discussion of the results is performed. Finally, section 6 deals with bibliographic references.

2   THEORETICAL FUNDAMENTALS

Interactivity, according to [4], is related to a computerized communication system that enables interaction with the user. For [5], we are at the Age of Interactivity, which, in fact, is an evolution of the Information Age. The Information Age focused on the provision of digital information and in the era of interactivity, information is seen as the goal of interaction, that is, "something which and around people interact with" [5].

The changes brought about by interactions in communications and relationships have a profound impact in Education, both professional and social spheres, "since learning occurs only when there is motivation and interaction" [5]. It is essential that the students participate in this interaction, with teacher's support, in order to make them active participants in their learning, since regular education, in which the teacher is the centre, is no longer sufficient for this new scenario of emerging and contemporary interactivity.

An education based on interaction and interactivity requires the student to be the focus and autonomous, so "with the introduction of active learning methodologies, the student develops the ability to learn to learn, that is, to become an independent learner" [5].

According to [6], "teachers see in the use of teaching material opportunities to provide an active participation of students during classes." The author affirms that, in many times, the speech of teachers is not strong enough to provoke the interest in students. The teaching materials are efficient resources, because "they break the excess of verbalism and concretize the subject explored by the teacher, facilitating the student's learning, reducing the teacher's efforts" [6], making the class more enjoyable and useful for teachers and students

For [7] the student is not a passive receiver in the meaningful learning. He must take advantage of the purchased content to grasp the essence of educational material. In addition, the student's willingness to learn and the potentially meaningful material are fundamental aspects for meaningful learning, in which this material can encourage students in their own learning and also assist in the transition between new and prior knowledge.

Monteiro et al. [8] state that "it is possible to realize that the theory of meaningful learning extends the efficacy of the use of a digital learning object since it considers the cognitive processes and the formation of concepts in the cognition of the learner."

In this way, it is possible that Educational Software and Learning Objects can be considered as potentially significant materials when accompanied by interactivity within ICDT, since in meaningful

learning the learner is not a passive receiver, but the one who has a prior knowledge, and that the active learning encourages autonomy.

Therefore, the digital whiteboard is capable to provide classrooms a potential for learning and interactivity, since it is a touchscreen device where its projection is displayed, generating a large sensitive screen, in which teacher and student can interact in a direct way. A digital whiteboard is composed by a projector, a computer and a sensor which is able to detect touches in its projection. There may be variations from one model to another, making it necessary to use a digital pen. Then, the interactive whiteboard can be turned as a software, that can be installed in the own digital whiteboard or in the computer depending on the model [9].

The interactive computer consists in a portable computer, projector, and digital whiteboard. It was developed to provide new experiences in the educational field and to facilitate the use of the digital whiteboard as an interactive resource in classes.

The Ebeam Uboard digital board, which makes up the PC3500wi interactive computer, uses the Mint Interactive program to make the digital whiteboard a truly interactive ICDT. This program bringing new functions to the touches of the digital pen that also operates as a mouse and adding tools, such as, Geometric drawings, pencil, marker, brush, rubber, navigation, access to the main menu, among others.

The following topic deals with the technical specifications, operations and capabilities of the interactive computer, main target of this study.

2.1   Interactive Computer: technical specifications and operation

The Government of Fortaleza has acquired, at 2015 September 29, through the FNDE, 374 interactive computers. It was distributed in the Educational Units according Table 1 to meeting demand of the schools.

Table 1. *Equipment per Educational Units*

Educational Unit	Amount	Interactive Computers
Municipal School	270	1
Fulltime Municipal School	17	3 or 4
School Extension	9	1
Early Childhood Education Center	27	1
ASTEINF (for training)	1	2
Total	324	374

Interactive Computer Daruma PC3500wi (Fig. 1) was conceived by FNDE 71/2013 trading and mounted by Positivo. It incorporates INTEL® Celeron® 1007U de 1,50 GHz processor, 4GB DDR3 memory, hard drive SSD SATA 16GB, Optical disc writer / recorder (CD / DVD RW), compact keyboard and optical mouse. It access Internet by Wired (Ethernet) and wireless (WiFi) network interface. It has connectors for USB, Audio and Video devices.

The interactive computer has a built-in projector of EPSON EB-W03, yellow colour, with contrast ratio 10000: 1, resolution WXGA (1280x800), projection size from 33 to 318 inches. For a projection of 60 inches, the distance between 1.60 and 2.00 meters it is ideal.

Its lamp has a lifespan of 5,000 hours in high brightness and 6,000 hours in low brightness. The PC3500wi contains an interactive whiteboard, an interactive digital pen and the Mint Interactive application. Interactive whiteboard is a Bluetooth Transmitter / Receiver system installed next to the projection screen with a maximum operating distance of 5 meters away from the device [10].

Fig. 1. Interactive Computer Daruma PC3500wi.

The next session explores related works.

2.2   Interactive Computer: technical specifications and operation

According to [11], the digital whiteboard is an example of technological advancement that brings contributions for teaching, since it provides interactivity, the author also proposes a mini-course presenting the interactive computer (Daruma PC3500wi) offered by MEC, emphasizing the necessity of the use of Learning Objects to provide interactivity with the content of the classes in With the Digital Whiteboard.

Pereira and Schneider [9] analyse and highlight applications of the digital whiteboard in the classroom that allows the digital literacy. In his work, called The Interactive Digital Whiteboard that provides digital literacy at municipality public schools network in Aracaju-Brazil, simple applications are proposed in order to facilitate the introduction of these new practices in daily life, such as simulating the same characteristics of chalk, eraser and the traditional blackboard.

Navarro and Kalinke [12] present the teachers' unpreparedness to deal with new technologies as a problem. The Digital Board kit, at the school that was the target of his research, was used only as a projector, when it was used. Through appropriate training, this barrier was successfully broken by bringing the digital whiteboard into the classrooms (Fig. 2). Teachers began to use the digital pen, internet, educational softwares and Learning Objects to support teaching, encouraging the student to participate as an active character of his own learning process.
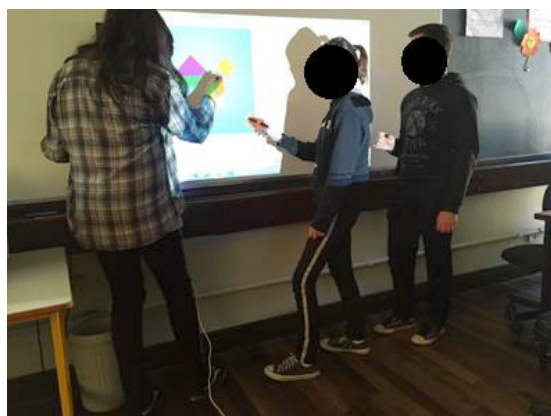

Fig. 2. Use of Tangram at the digital whiteboard.

The following section shows the method of solving the problem.

3 OPERATING SYSTEM CUSTOMIZATION

This section describes working method for the free operating system customization and installation in the 374 interactive computers of the municipality of Fortaleza. This process happened in five stages: Analysis of the problem, list of software, choice of a Linux distribution according to the requested programs, installation of the Operating System and installation of software and drivers.

With the problem identified it was necessary to do a detailed analysis of the problem seeking a list of possible solutions. The factory operating system of the interactive computer has been studied in detail. It is an educational Linux provided by the Ministry of Education (MEC) based on Ubuntu 12.04, which in turn has been modified to meet the overall demand for the equipment. This demand would be to provide a free, stable, high-usability OS with basic functionality in perfect operation, such as internet access, access to the office pack, software and drivers required to use the interactive whiteboard - Ebeam Uboard - which is part of the interactive computer.

The factory operating system is designed to use a temporary file system. This is to prevent the user from making major changes and providing stability to the system. The user can install software only temporarily, that is, when the interactive computer restarts the installed software will no longer be present in the list of OS programs. Some changes are allowed, such as connecting over wireless networks, saving files in the user's folder. These changes remain intact after OS reboots.

When the teacher wants to use educational software on the interactive computer, he needs to install this software before each use, because with each reboot all the installed softwares are lost. After several tests it was observed that the permanent installation of educational software was not possible, because the factory OS file system cannot be changed because it is a temporary file system.

The factory operating system cannot be changed because it is a live-HD system. This type of system uses a portion of the RAM for loading the file system, a kind of ramdisk or ramfs. This memory when disconnected loses all stored information [13]. The factory OS is installed on the 16GB solid state disk (SSD) of the interactive computer. When you turn on the machine, the file system loads the Linux files into RAM. Based on this analysis, it was concluded that SO provided with the interactive computer does not meet the pedagogical demand of the City of Fortaleza.

Based on these facts, the Information Technology Coordination (COTECI) of the Municipal Department of Education (SME) of Fortaleza (Ceará) and the Technical Advice of Educational Technology (ASTEINF) of the SME decided, in common agreement, to install and customize a new Linux. ASTEINF is a department responsible for the creation and standardization of digital educational resources and for the training of municipal education teachers. The software list used in training is shown in Table 2.

Table 2. Educational Software used in the Municipal Schools

Educational	Multimedia	Production
Luz do Saber	Audio player	Mint Interactive (digital whiteboard)
GCompris	Video player	Text editor
TuxMath	Disc recorder	Spreadsheet editor
Tux Paint	Sound editor	Presentation editor
KTuberling	Sound mixer	Document reader (pdf)
Marble		Browser (Firefox)
KStars		Image viewer
KGeography		KolourPaint
KmPlot		
Kalzium		
Geogebra		
Calculator		

According to the list of softwares available in Table 2, the Linux Operating System Ubuntu 12.04 (32 bits) was chosen because it is an LTS (Long Term Support) Operating System which is characterized by being a stable version with extended support [14]. It has long-term support, for 5 years,

guaranteeing this support is the canonical that provides software update only after widely tested bringing greater stability. This type of system is suitable for equipments that do not need regular updates [15].

The compatibility of the programs used in the municipal network, including the software of the Ebeam Uboard Digital Board and the support to offline installation of the software Luz do Saber, were also decisive factors in the choice of Linux Ubuntu 12.04.

Luz do Saber is a didactic free resource, available online on the website of the Secretariat of Education of the State of Ceará (SEDUC). This software is important in municipal education because it is literacy software for children that promote inclusion in the digital culture [16], and that is why the availability of this software in offline version is important.

In order to make Luz do Saber offline, it is necessary a Web Server (apache) and a database server (postgresql), both installed by means of scripts provided by SEDUC. Mint Interactive, Ebeam Uboard Digital Slate software, provided on the manufacturer's website also needs to be installed and the Operating System updated. Drawers®, software chosen to group by categories and easily configurable, was installed using developer's Personal Repository (PPA), by Berke's [17].

With these three functional programs, the other ones were installed through the apt-get command using the default Source List of Ubuntu 12.04. To facilitate the use of the interactive computer was created a teacher user, who has all the permission to install programs. The login is automatically done on this user, and any user wishing to make changes will be authorized simply by typing the "sudo" command before the program installation command, without even requesting a password for that.

Three solutions have been integrated into the Operating System to extend the service life and improve the usability of the system, reducing the need for technical intervention for maintenance: exclusion of user files saved in inappropriate places, operating system restoration and optical removable disk system backup.

At login time a routine developed in ShellScript is executed to delete all files from the user's folder, including the icon and shortcut settings. The installed programs and the Documents folder are kept intact to allow teachers to save offline activities or installing new educational softwares.

A restore partition, with an image created using the Clonezilla software, is done as prevention in cases of compromising the stability of the Operating System due to some program installation, for example. This partition is available on the interactive computer HD and can be accessed using Grub, an operating system loader created by GNU project. From this anyone with proper instruction or a step-by-step tutorial can restore the operating system of the interactive computer.

If any advanced configuration made by the user compromises the integrity of the restore partition, an ISO image for optical disks has been produced to be capable of completing installation or restoration of the interactive computer that will be provided for each school on 2 DVD's.

The evaluation of the results was performed with ASTEINF, through a structured questionnaire, and answered at the time of the official presentation of this new operating system for the team responsible for interactive computer training. Written forms were used to collect satisfaction with the new operating system.

The following section presents the results and a satisfaction survey discussion, highlighting the relevance of the research performed.

4   DISCUSSION OF RESULTS

For technical and pedagogical evaluation, the ASTEINF training team was invited, which selected two training teachers to present the new resources implemented in the interactive computer, from the working area personalization up to the maintenance routines of the system stability and usability.

At the end of this presentation, a satisfaction survey was applied to determine the satisfaction of the trainers with the old operating system of the interactive computer, making a parallel with the satisfaction with the new one. In the second phase there was a presentation for the entire team of ASTEINF who, in turn, had the opportunity to respond to this research.

The evaluation form took into account technical aspects and the facilitation of pedagogical praxis in the daily use of the interactive computer. It was initially answered using printed form and in sequence

was replaced by a Google form. Nine ASTEINF trainers agreed to participate in the satisfaction survey and the results of their responses are compiled below.

Table 3 shows the satisfaction of the trainers with the new system in a comparison with the factory system. In addition to the questions asked showed ate the same table, the questionnaire covered questions regarding specification of improvements, the use of the tool, suggestions for new softwares and future improvements.

Table 3. *Comparison: satisfaction with the new system with the system factory.*

	Yes	No
Factory system attends the demands of the school	66.7%	33.3%
Factory system has got all the Educational Softwares required	77.8%	22.2%
Teachers need Educational Softwares in class	100%	0%
Personalized system presents improvements	88.9%	11.1%

In terms of the factory system improvements, stability and usability were qualities indicated by 55.6% of those who answered the questionnaire (Table 4). Allowing the installation of softwares was chosen by 100% of the participants; among other qualities it is highlighted: "organization of icons in the working area, customization of the operating system, reduction of digital pen shadow and interactivity between software with the whiteboard".

Table 4. *System improvements.*

Qualities	Percent
Stability	55.6%
Usability	55.6%
Allow Software Installation	100%
Performance	44.4%
Other	44.4%

The interviewees agree (77.8%) and fully agree (22.2%) that the above improvements function as a facilitator for the use of the interactive computer in the classroom and that the pedagogical practice of the teacher will be favoured with the use of this tool.

Proposals are presented for future improvements by the trainers in the satisfaction survey, such as inserting a folder with Learning Objectives, dictionary, and Portuguese games. The importance of a system that allows modifications and customizations is emphasized, since each teacher will be able to install their defendant programs in addition to those which were chosen by ASTEINF, and, therefore, the system continues within the context of free software.

5   FINAL CONSIDERATIONS

This work aimed at meeting the technical and pedagogical need reported by the Technical Advice of Educational Technology of SME. The problem is the operating system of the interactive computer Daruma PC3500wi does not allow permanent installation of educational software. This problem was solved by customization of the Ubuntu Linux Operating System and development of development of quick installation techniques to spread this new system to the 374 Interactive Computers of the city hall of Fortaleza.

The new system of the equipment allows the use of the interactive computer in the classroom of the schools of the city hall of Fortaleza without the necessity of installing new additional software. It has all the software recommended by SME. When the teacher wants to install other software, the system will keep the modifications made. The new system facilitates the daily performance of the teacher.

The interactive computer can promote classroom interactivity using an active methodology. The student participates, performs practical activities and acts as an active in his / her learning.

Educational software and learning objects in association with the digital whiteboard and interactivity can be scored as likely potentially significant materials. These materials associated with students' prior knowledge can enable meaningful learning.

It was observed that the customization of the operating system of the interactive computer contributes significantly to the municipal schools. This customization facilitates the use of equipment by teachers and makes available all educational software off-line. The off-line version is useful when Internet unavailability occurs.

Future work proposes a set of training for the teachers of municipal schools and an evaluation of the use and impact of this system by teachers and students in school units.

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