New Tools for Education in a New Age

Eduardo Díaz Delgado, Rafael Fernández Mateos y José Angel Bernal Bermejo
Departamento de Algebra (Arquitectura y Tecnología de Computadores)
Universidad de Sevilla
Facultad de Informática, Avda. Reina Mercedes s/n. 41012 SEVILLA (SPAIN)
E-mail: ediaz@computer.org ;Tfno: +34 95455 7963.;Fax: +34 95455 6938

1. Abstract

Today, the use of the Information Technology is exponentially growing. In the Technical School, we are forced to introduce the use of the new tools in order to increase the student's knocwledge. The new technologies are expensive most of the times, but we think that the university must adopt them when ever it's possible. By looking for the options with lower costs, we can do it.

Our proposal is the use of the free operating systems, instead of the official (and more expensive) operating systems, and the freeware and shareware software. With them, we can use the ultimate technologies without excesive costs. The new movement in Computer Science is going to it. We'll analyze several options, offering a vision of what we can offer in teaching.

The new tendences contribute to the low costs for teaching and learning, using free operating systems and free (or low costs) tools.

In this way, the Linux operating system is a serious alternative to the Microsoft's operating systems. It is free, it is obtained through Internet and it has many tools for several teaching areas: Physics, Mathematics, Enginering, Chemistry, etc.

We have also free software for the commercial operating systems and for free operating systems. This software has a good quality and, in some cases, is better than the equivalent commercial software. There are many sites in Internet for downloading them. Using them, we can configure a free teaching and learning tool assigning our money for hardware, and obtaining a final low cost system.

2. Introduction

The Engineering curriculum and the means for transmitting knowledge to the students are changing. For the last three decades, the four primary ways of transmitting information to students have been the textbook, the chalkboard, the overhead projector and the instructors handouts. It is clear that there is a need to modernize these methods to prepare today students for a more competitive working environment.

The computer (and its use) makes a useful teaching tool that includes a combination of text, graphics, sound, video and animation sequences. All of them can be used together in order to present any information. The information systems based in interactive multimedia are a good way for supporting education and training, for serving as a reference tool, and for providing dynamic presentations.

The new computer technologies enable the instructor to provide a dynamic lecture that links and presents information in a nonlinear format. A nonlinear format of presenting information means that the related information is associated with a central topic of concern in a modularized way. The associative links allow an instant access to any modules of information, thus enabling cross-referencing and browsing.

3. The Free Software Philosophy

The start point should be: "the digital information thecnology contributes to the world by making it easier to copy and modify information".[1] The system of copyright gives owners to software programs. The copyright system grew up with printing and it is in front of the digital technology which is more flexible because the information takes a digital form, and you can easily copy it to share it with others.

The "free software" concept includes either the freedom to run programs, to study how the programs work (adapting them to your needs), to redistribute copies, to improve the programs, and to release your improvements to the public.

The free distribution also implies the copies redistribution with or without modifications, gratis or charging a fee for distribution (never for programs), to anyone anywhere. In order to have freedom for making changes and to publish improved versions you must have access to the source code of the program.

There are many kinds of free software clasified in the following categories:

Free software: it is software that comes with permission for anyone to use, copy and distribute, originally or with modifications, either gratis or for fee (handling and posting costs).

Open Source software: this name is used by some people to mean more or less the same thing as free software.

Public Domain software: it is software that is not copyrighted. Some copies or modified versions may not be free al all.

Copylefted software: it is free software whose distribution terms do not let redistributors to add any additional restrictions when they redistribute or modify software. This means that every copy of the software, even if it has been modified, must be free software.

Non-copylefted free software: it comes from the author with permission to redistribute and modify, and also to add additional restrictions to it.

GPL-covered software: it is one specific set of distribution terms for copylefting a program. It is used by GNU Project.

The GNU system: it is a complete free Unix-like operating system. It consists in many programs by accumulation since 1984.

GNU software: it is software released under the auspices of the GNU Project. Most GNU software is copylefted, but not all. However, all GNU software must be free software.

Semi-free software: it is software which is not free, but comes with permission for individuals to use, copy, distribute, and modify for non-profit purpose.

Freeware: this term is commonly used for packages that permit reistribution but not modification (and their source code are not avalaible).

Shareware: it is software which comes with permission for people to redistribute copies, but anyone who continues to use a copy is required to pay a license fee.

Some free software developers make money by selling support services. Cygnus Support, with around 50 employees, estimates that about 15 per cent of its staff activity is free software development. Some other companies, like Intel, Motorola, Texas Instruments and Analog Devices, have joined together to fund the continued development of the free GNU compiler for the language C.

Several companies provide commercial support for the free software of the GNU system. This is the beginning of the independent software support industry, that could become quite important, as soon as the free software would increase (in some fields).

The free software gives many advantages:

- Wider use of every program that is developed.
- The ability to adapt existing programs for customization instead of starting from scratch.
- Better education of programmers.
- The elimination of duplicate development effort.

4. The Linux Operating System

Linux is a free, Unix-like operating system, developed originally for home Pcs, but which now runs on other platforms like Alpha, SPARC, PowerPC, MC680x0 based systems and others.

Linux is a multi-user, multi-tasking operating system whose technological heritage hails from the mainframes and supercomputers for which the Unix model was developed.

Linux is also the birthplace of the open source methodology which, derived from the free software piloshophy, has spawned a revolutionary proliferation of free software, from compilers to word processors and GUIs.

Today, with more than 12 million users worldwide, Linux continues to grow exponentially, as programmers, enthusiasts and end users are cooperating between them.

The name of the operating systems come from Linus Torvalds, who developed the earlier versions of the kernel in 1.991 using the Minix operating systems as basis[2]; the first kernel was made in a Helsinki University project, in Finland. Today, this operating system is under development around the world, making enhances and adding functionalities.

This operating system includes a compiler for many programming languages (C, C++, Smalltalk, Fortran, Lisp, Java, ...), text editors and several utilities, tools for internet connectivity by ethernet, modem, parallel port, etc., and many more.

Because the Linux OS is based in POSIX standard, the Unix compliance is granted. That means that the programs written for other Unix systems may be recompiled for Linux with a minimum work.

This operating system is used by Goverment Organitations and industries [3][4][5].

In communications, Linux has the advantages of the Unix systems: flexibility and fiability. Therefore, the net use is completely integrated in the operating system, avoiding the costs of the additional software for communications.

Another important improvement of Linux is its coexistence with other operating systems, like DOS or Windows, in the same computer: by different partitions or by vitual machine emulation [6].

One more advantage of Linux is its windows system. The windows system for Linux (and other Unix systems), named X-Window [7] is easy to use and, with the appropiated windows manager (fvwm95)(see Fig.1), the Graphical User Interface has the Windows95 appearence. The students come to the University with a little knowledge in computers, generally DOS or Windows95, and so the migration to Linux is quite easy[8].

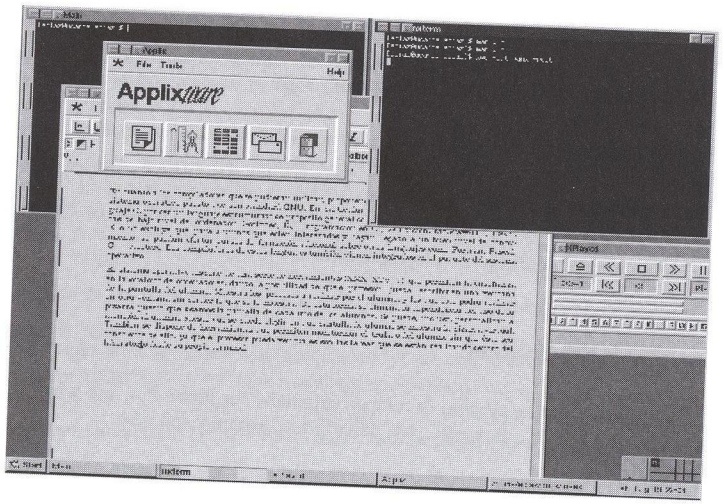

Fig.1.- The X-Window environment

In the figure above we can see the fvwm95 running with several applications. The menu system for it has the same structure that the Windows95's menu: several unfold level of options.

5. The Computer networks

A network is a data transmition system among computers for sharing resources and information. This interconection system allows the data interchange between different kinds of computers, mainframes, personal computers or terminals, without needing the same operating system [9].

The uses of the computer networks are growing in all kinds of fields: education, goverment offices, industries, etc. Particularly in education, the local area networks (LANs) are an efficient and useful tool for teaching (Fig.2). Moreover, we must induct the student to use them, adapting them to his future professional environment.

The uses of the networks connected by Internet is wide: from calification publishing to access to class texts. Of course, there are many tools for it [10].

A simple tool for attending students is the electronic mail (e-mail), a message system for the net users. With e-mails we can solve student's questions, when a fast answer is not required.Nowadays, a great number of students have e-mail address and all proffesors have one. Using them, we have a grateful way of having a Q&A system with a short delay between question and answer. In many cases, the student obtains his answer more quickly than with the normal methods of tutorial attention.

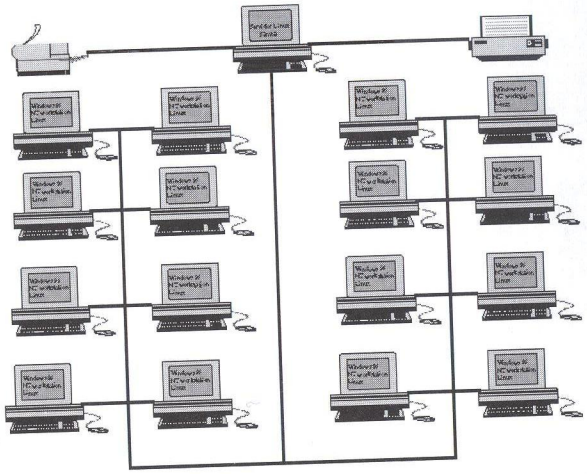

Fig.2.- A network configuration for a computer laboratory

The Word Wide Web (WWW) was originally conceived in Switzerland at the Counseil Européen pour la Recherche Nucláire (CERN) in the late 1980's as a method of distributing hypertext documents internally among physicists at the Particle Physics Laboratory. The phenomenal growth of the WWW outside of CERN started when a student project at the National Center for Supercomputing Applications (University of Illinois - Urbana-Champaign) created the first web graphic browser, named Mosaic. Mosaic was designed for using the specifications and protocols developed at CERN to allow users to exchange, access, view, and manipulate different kinds of information on all plataforms.

The Apache web server is a free software for providing Internet information. Based in HTML language [11], it is a powerful and secure tool for it. The Apache software is available for many operating systems, Linux, NT, etc. With other edition tools, many of them developed for HTML languages (avoiding the need of expertise for web edition), it is an interesting way of giving information to students, such as califications, practice proposals, class texts, etc.

The web browsers (see Fig.3), like Netscape, Explorer or Mosaic, are needed by the student in order to view the information listed above. These browsers are easy to use, very intuitives and wide used for the students at the computer halls and at home.

Since Mosaic's firts released, the number of WWW servers and the volume of WWW traffic on the Internet have grown exponentially.

Eventually, the material will be packaged in HTML format onto a CD-ROM equipped with a local web browser. As a result, students can navigate through the demo presentations, virtual labs, and homework problems with or without a network connection, and the interface will be identical if the same browser is used.

Another communication system for Q&A is the frequently asked questions (FAQ) in the department web server. In this area we can put the most previsible questions of our lessons. It is a very useful tool for avoiding answering to many questions that the students make every year. We can put in this area the test solutions, allowing the students to know how a test or an examination are made.

We propose student's workgroups for adecuating them to the proffesional life. Therefore, we think that we must provide electronic communication ways. The students must consider the use of the information technologies as normal, and they must use the major number of the IT tools as possible.

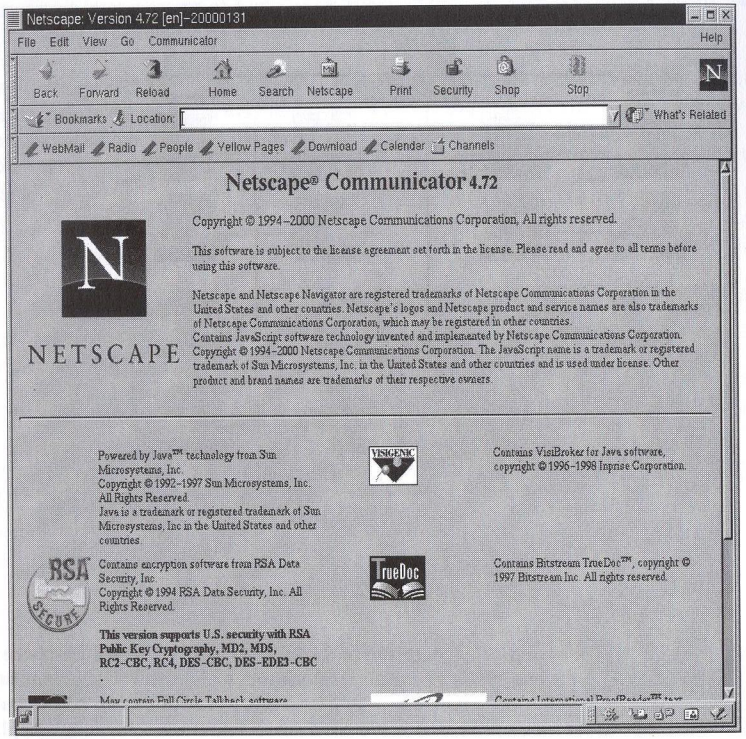

Fig.3.- The Netscape browser interface

An important method of the information interchange is the Internet Relay Chat (IRC). This tool allow the live interrelation of the users as if they were talking by keyboard and display.

Another possibility is the "newsgroups". It is a information interchange system based in a "question and answer" between members: one member makes a question and one (or more) answers him/her. This method has a delay response owed to the time the users to spend in reading the new messages in the news system, but it is more fexible because it allows the students to participe in the question and answer interchange, helping the collaborative work.

We propose the use of the networks, because this it makes possible to create virtual laboratories or to share resources by sharing experiments locally and remotely, allowing to have an unique laboratory equipment. This option brings down the experiment costs per student. The goal with the virtual laboratory

paradigm is to make it possible the students to have their practices without taking away the experience of being physically present in the laboratory [12].

6. Computer Languages for teaching

Several computer languages are useful for making teaching systems, but we will focus to the "Internet languages": HTML, XML, Java and VRML.

The HyperText Markup Language (HTML) is the language for the WWW]. This language is an specification language for graphic and text documents sharing, developed at CERN. It was released in 1990 by Tim Berners-Lee as a common protocol for diferent kinds of documents interchange. Using this language, by HTML editors as authoring tool, we can publish information (like this course information), and anyother text or graphic information. There are many HTML editors, and so many web browser includes a HTML editor, and the language specification is very easy to use for the composition of HTML pages.

The eXtensible Markup Language (XML) is a simple and flexible language based in the Standard Generalized Markup Language (SGML) and an extension of the HTML [13][14]. XML has capacity for metadata use (information about information) making the web use easy, and increasing the quality of the web based application.

Java was developed by a Sun's project, starting in 1991. This is a language developed in order to obtain an independent machine language. It is a interpreted language and the major difussion web browsers have a Java interpreter. The principal advantage of Java in front of the above languages is the possibility of writing programs to be executed by the web browser [15]. This language permits the simulation application development for use in the Technical School Laboratory, and at the same time in the students home via Internet. It makes the autolearning system possible in order to accelerate the student learning process.

We have also the virtual reality for simulation. The use of this simulation method may be performed by programmers using general programming languages or using the Virtual Reality Markup Language, released in 1994. The firts option force to make machine dependent programs, except when the Java language is used, while the second one needs a VRML viewer. A VRML viewer is a VRML language interpreter with a 3D viewer and it is added to the web browser like a plug-in. The advantage is the independence of the machine type, but the execution of the simulation go slow down exponentially when the simulated systems are complex [16][17]. In many cases, the VRML is combined with Java [18].

The teaching system based in the new technologies is a powerful tool for the technical school professor. The use of the multimedia system increase the learning process of the students, and facilites the professor's work [19][20].

7. Conclusions

In this communication we present a vision of the application of the new information technologies in the Technical School teaching, using several low costs options. We propose the low cost systems like PC compatible computers, avoiding, always as possible, the expensive systems adquisition. In case of the high computation requeriments, we propose the cluster systems use instead of the unique (and expensive) computer.

We think that the new technologies give us many efficient tools for teaching combined with the growing of the use of the Internet. This circumstances are favorable: the accesibilty to Internet is easy by the University centers, as well as at home by modem.

The emphasis on information transfer should rely on more concept visualization rather than an text-intensive instruction. The information sytem should use navigation controls that should query and lead the students toward intended responses, closely reflecting classroom instructions, in which questions are ussually directed to students to lead them toward a deeper understanding of the subjects.

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