

Interactive learning with multimedia CD and Web : a case study

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Abstract

Computer Based Training technology is a promising tool to integrate and even substitute traditional learning methods. The main goal of the work presented in this paper was the development of a multimedia courseware which could be used equally in CD and WWW environment. Web standard tools are the core of the developed solution, allowing to access the course via a simple browser, both in local and in remote mode. While HTML and Cascading Style Sheets are used to designing the user interface, JavaScripts and Java functions realize all the functionalities needed for self-learning process like session saving and testing. The multimedia courseware was utilized to deliver a course of "Geometry" to students of the first level of the Electronics Engineering Degree for self-learning sessions . Finally a field evaluation is carried out.

INTRODUCTION

In the present evolution of new methodologies and techniques for education and training the use of computer-based tools are increasing considerably, integrating and often even substituting the traditional methods of teaching.

Computers can automate many tasks generally carried out by teachers or tutors, like the choice of the learning path or the evaluation of student progress by proper tests, allowing to implement a real self-learning process

Many studies and experiments demonstrated the effective advantages offered by the Computer Based Training technology and by the innovative didactic methodologies developed for improving performance of the CBT technology. [1]

Some of the most widely experimented opportunities offered by the innovative techniques and methodologies can be summarized below: [2] [3]

- the interactivity transforms the learning

process from the traditional passive acquisition of knowledge to an active, participating and more intriguing one

- an individual and personalized learning is possible : the introduction of didactic paths customized to the need of the learner allows to overcome lack and weakness in the cultural knowledge of the learner
- the contents can be presented in a more direct and effective way with the aid of different media
- tools for self evaluation and testing can be introduced allowing the fine tuning of the learning process during the course itself
- the space and time limits can be got through by the use of distance learning tools and self learning time independent techniques
- the educational contents can be structured and organized in a more flexible and productive way, introducing key topics, deepening sections and so on.

All of the above features and advantages can be realized with the support of a suitable methodology and the employ of adequate software technologies and tools. [4] [5]

From the point of view of technology the first experiments of courseware were realized designing multimedia interactive applications and presentations using suitable powerful authoring tools i.e. Macromedia Director and Authorware for Windows and Macintosh environment or Asymetrix Toolbook for Windows, or object oriented programming languages like Visual C ++ or Visual Basic.

The applications designed and developed with such tools constituted the basis of the CD-ROM self learning technology.

The worldwide diffusion of Internet and Web technology changed sensibly the perspective of the computer based training; the demand of multimedia interactive courses available on Internet and accessible from remote has increased dramatically and has promoted the experimentation of innovative techniques and methodologies to exploit the features of the networking.

The actual trend in the field of CBT framework is toward designing of Web based multimedia applications and courses, browsable in distance learning sessions through Internet, eventually downloadable on CD-ROM standalone format.

Two techniques can be approached to implement such features:

- the use of traditional authoring tools as the above mentioned ones to design the structure of the course and the container of the media and interface the Web environment by mean of existing or designed on purpose software adapters and plug-ins.
- the use of programming languages specifically created for design Web based applications, integrating and exploiting the native HTML, core of the WWW environment.

This paper presents a case study about the design, implementation, delivery and evaluation of a multimedia web based course. The course selected - "Geometry" - was

experimented in academical environment by the students of the First level of the Electronics Engineering degree of the University of Florence.

The innovative issues of the experimentation were the implementation of a mixed technology integrating the multimedia CDROM self learning features and the flexibility of the Web environment and the introduction of new didactic functionalities to enhance the traditional learning techniques.

The design approach was the realization of a course in WWW environment, remotely accessible through Internet, eventually easily downloadable on standalone CDROM for self training employ.

The core of the application was implemented in HTML standard but several functionalities have been added through the extensive use of Javascript code, Java Applets, Dynamic HTML pages and Cascading Style Sheets.

The media were introduced in the courses by mean of the Macromedia Shockwave technology which allows to insert animation and movies in a web based user interface.

All of the above tools structured the Human Computer Interface that allows the user to browse the contents of the course and benefit the specific functionalities offered by the application.

OBJECTIVES

The objectives of the work were :

- analysis and design of innovative multimedia-based tools for teaching and training in the area of Electrical and Information Engineering (EIE).
- design of flexible educational programs and the development and handling of static and dynamic didactical contents
- fostering of internet based courseware integration in the University educational system
- set-up of proper techniques to validate multimedia tools for learning

THE COURSEWARE

1. Technical solutions

One of the main goals of the project was the development of an instrument which could be easily used to provide educational content via both CD-ROM and the World Wide Web (WWW). Moreover the course should look the same independently of the providing medium and all the functionality should be available in both cases.

Such a severe constraint oriented us toward the typical Web platform constituted by the browser and a information provider software. Obviously, in the Web case (remote mode) the provider is an HTTP server, while in the CD case (local mode) it is the local operating system. That is to say the browser fetches the required information through an HTTP connection in the Web case, or reads it directly from the local CD-driver in the local case.

Some basic functions of course management such as session tracking or learning progress testing require a great amount of interaction between the student and the course server. Such an interaction cannot be provided through a technique involving an HTTP server (as for the possible CGI solution) because the server is not available in the local mode. Thus we utilized the Dynamic HTML (dHTML) which can be defined as the sum of the basic HTML, a script language for local processing and a style sheet language for a better presentation. Specifically, we chose JavaScript as the script language, due to its better portability compared to its main competitor, the Visual Basic Script, which is limited to Windows-based platforms. The Cascading Style Sheet (CSS) was our referring standard for implementing style sheets.

Due to the limitations of scripts, some function required a real programming language. The obvious choice for our web-like platform was the Java language.

In summary, our courseware is entirely realized through the use of Web de-facto or de-jure standards: HTTP, HTML, JavaScript, Java and CSS. The lack of a standard for web

animation forced us to use a non-standard tool. Our choice fell on the Macromedia Shockwave Flash product, due to its powerful and easy programming. Moreover the easy installation of the required browser plug-in was determinative.

Such a choice of tools allows the user to access the course via a typical web-client, provided that it is equipped with the Shockwave plug-in. This solution is very appealing because it allows the provider to give access to courseware via the WWW without any need of new software installation.

The different behavior of the two main commercial browsers, Microsoft Internet Explorer (MS-IE) and Netscape Navigator, in respect of CSS and JavaScript functions forced us to design different algorithms for different browser platforms. Such distinction is realized at software level providing identical functionality and interface for the user in both the environments. This is one of the most remarkable results of the projects.

2. Course structure

The course of “Geometry” is implemented in a three-levels course structure. Each level corresponds to a logical entity named respectively paths, modules and didactical units. In our project the course is organized in didactical modules each of them self consistent and presenting a specific part of the whole course. A module corresponds to a lessons and its comprehension is evaluated resorting to an interactive test.

The modules are grouped to form the didactical paths. Though the modules could be browsed autonomously, the paths are designed to provide wider set of knowledge to the student.

Finally the didactical unit is a page-like lesson content. To avoid annoying scrolls, a page can be divided in sections so each section is entirely contained in a browser window. However a section is not a logical entity.

3. The Human Computer Interface

The core of the application was implemented in HTML standard but several functionalities

have been added through the extensive use of Javascript code, Java Applets, Dynamic HTML pages and Cascading Style Sheets.

The media has been introduced in the courses by mean of the Macromedia Shockwave technology which allows to insert animation and movies in a web based user interface.

The main functionalities implemented in the Human Computer Interface are below outlined.

Guided and free access to the course

Two methods have been designed to control and direct the learning process. In the first approach (called “learner approach”) the contents can be browsed only following a fixed path. To go from a section to the next one a test must be passed. This functionality was implemented to avoid confusing approaches to the contents by the learners: the learning process is guided by the contents organization designed by the teacher.

In the second approach (called “teacher approach”) all of the course sections are freely accessible. This feature was designed for learners to carry on recap sessions and for teachers to ease the upgrade and revision of the course contents.

Saving and loading of sessions

The user can exploit the feature of saving the actual session and reloading it subsequently. In this way the learning process can be stopped and started again later according to the need of the learner

Extensive use of hypermedia links

All of the sections of the course present various types of links such as: deepening, glossaries, cross-reference links, pop-up windows showing media and others

Self evaluation test

Each section of the course is followed by specific tests related to the section itself for an immediate evaluation of the level of learning reached by the student. Each time the test is run the questions are randomly selected among a set of pre prepared ones. The student can choose one or more among given answers. A mechanism has been implemented to allow the examination of all the questions in the test

and the correction of the wrong answers: if more than half of the answers are correct the passage to the next chapter is gained.

Figure 1 shows a sample screenshot of a test session.

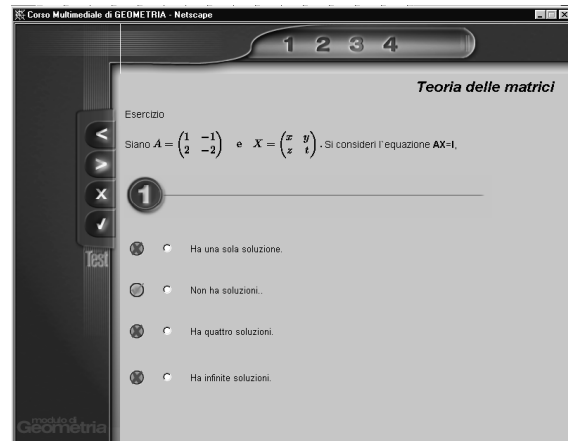


Figure 1. Test session. The upper frame shows the number of and give access to the test questions. The left one contains the features to correct the test.

Tracking of sessions and Statistics

Information on the current session are made available such as: number of hits of each pages, time of browsing, results of the tests. Such information can be monitored by the teacher for didactic evaluation of the learning process of his students

Figure 2 shows the statistics window.

Operazioni tra matrici		
unità	accessi	tempo
Somma fra matrici	0	0' 0"
Definizione di somma tra matrici	0	0' 0"
Prodotto per uno scalare (1/2)	0	0' 0"
Prodotto per uno scalare (2/2)	0	0' 0"
Proprietà di somma tra matrici e prodotto per uno scalare	0	0' 0"
Prodotto tra matrici (1/3)	2	0' 15"
Prodotto tra matrici (2/3)	3	16' 23"
Prodotto tra matrici (3/3)	2	0' 10"
Proprietà del prodotto tra matrici	1	0' 2"
Matrici invertibili (1/2)	1	0' 5"
Matrici invertibili (2/2)	0	0' 0"
Test di fine modulo	(0 / 1)	0' 51"
tempo totale modulo		17' 44"

Figure 2. Statistics window. The application performs an analysis of the log file and extracts information about the hits, the tests results, the session time etc.

Navigation features

The user interface is equipped with several tools to ease the navigation through the course. The GUI was designed according to user-friendly principles of usability. During

the course browsing the user has two sets of control buttons available: the main functionalities, (like the course table of contents, the chapter maps, the “turn page “ and the “go back” features) are accessible from a graphic menu always active beside the content window.

Further functionalities (like tracking of sessions, statistics, glossary) are made available by accessing a secondary set of control buttons.

Figure 3 shows a sample screenshot of the course.

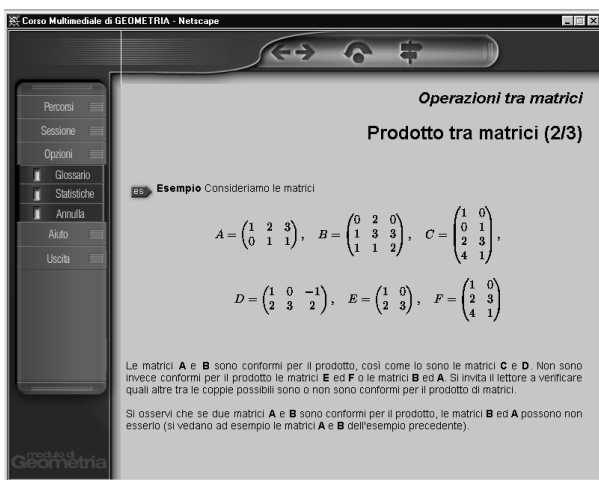


Figure 3. Course didactical unit with the application GUI. The upper frame contains the navigation features while the left frame gives access to the didactical functionalities

Flexibility and scalability

All of the above feature have been implemented to produce a human computer interface independent of the contents, flexible and upgradable. Thus it is possible to add new sections to the course, eventually shifting the order of the existing sections, insert new pages or remove obsolete ones, include more questions into the quizzes, add new deepening or glossary items.

EVALUATION METHODOLOGY

Experimentation involved classes of about twenty students: one class from the first level and the other from the master of Electronics Engineering degree. The last one was also

involved in this project for a better evaluation of guided tours didactic capacity.

Experimentation was carried out meanwhile both classes were attending traditional lessons, which allowed us to evaluate effectiveness of integrated training.

The course was thus compound by traditional learning sessions and tutor assisted sessions using the self learning tool.

During self-learning sessions, students were invited to use the guided tour burned into the CD that doesn't allow free access to the whole courseware. Access to the following chapters is granted if an evaluation test on the current chapter is passed.

The free access mode was also used under the tutor supervision, when students completed the guided access.

At the end of the course students were invited to compile a form that involved evaluation of integrated course effectiveness and of the following aspects in self-learning sessions:

- software reliability
- user interface
- contents
- evaluation tests
- multimedia material
- guided tour

Furthermore a focus group between tutor and students was held.

Results of these investigations show that traditional lessons were improved by self learning sessions, which are characterized by:

- Satisfactory performance of user interface and software flexibility
- Good quality of contents, even if more integration between theory and evaluation tests is needed
- Evaluation tests with multiple answer are preferred with respect to those with one answer
- A correct and balanced use of multimedia material
- Guided tours effectiveness, especially in choosing the best training for classes of different study levels

- Effectiveness of tutor presence for didactical support during self learning sessions

Intranet, 30th October - 4th November 1999, Hawaii Honolulu.

CONCLUSIONS

The project allowed to experiment innovative multimedia technologies to develop and delivery courseware for high level education. The attempt of resorting to standard web tools made the application potentially cross-platform and though the courseware is tailored for Windows platform, experiments to support also Unix platform are being taken.

From the point of view of didactical evaluation we experienced high acceptance of the application by the learners while the teachers showed wide interest in exploiting such new teaching techniques.

Further applications are planned to experiment the platform and tools with different curricula and subjects for higher education in Electrical and Information Engineering.

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