

AN ONLINE WEB COURSE ENVIRONMENT AND ITS APPLICATION

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Abstract – This paper describes some experiences with online web courses. To manage the courses we developed a system, the “WEB Course Control” (WebCC). This software allows the monitoring of the students navigation over the instructional material, providing important feedback to instructional designer through collected statistics, such as most accessed pages or media, frequency and size of navigation jumps. Some statistics results are shown and discussed.

Index Terms $\frac{3}{4}$ course management, education, online learning, statistics, tools

INTRODUCTION

The communication and data process technology evolution made available the infrastructure for the development, transmission and distribution of numerous multimedia applications ranging from distance education to entertainment. The multimedia distance education application can bring a lot of benefits. The educational institutions will be able to attend a large number of students and these students can stand geographically distributed. In the asynchronous communications mode (e.g., communications without synchronized presence), the remote course user can do it according to his own speed and rhythm. Moreover, if the multimedia material is well employed, it will stimulate the user who can try some useful virtual learning experiences. In order to offer access to multimedia material, the Multimedia on Demand (MoD) Project [6] is being developed at LARC. MoD System brings an environment and its infrastructure for multimedia material production, storage, management and, on demand or real time distribution, applied to distance learning. This project considers several educational services and also the necessary network infrastructure to deliver the multimedia material. The main service considered is Online Web Course.

Although the infrastructure is coming, the multimedia material production for distance learning requires a lot of effort and special care. It is important to establish appropriate and efficient pedagogical methods [1] [2], involving a multidisciplinary team of professional [4]. This helps the professor to place his ideas in the best way and

produce interesting and challenging courses in a dynamic learning environment.

The Online Web Courses were drawn up for browser access integrating video, audio, images, graphics, animations, text, exercises and simulations. This combination resulted in a very interesting educational material producing very good learning results when applied. The students’ performance may be automatically evaluated when online objective questions are applied. Besides evaluation, the system provides the identification of topics requiring further study.

INTERACTIVE COURSES STRATEGIES

Interactive online education uses concepts common to the disciplines of education. The knowledge transmission can have theoretical approach, suited to the learning of **concepts**, or practical approach suited to the learning of **procedures**.

The following strategies can be used in the teaching-learning process:

Deductive – a rule (or principle) is presented to the student that is requested to find examples of the rule.

Inductive – some instances (or examples) of a rule are presented to the student that are requested to deduce the rule.

These strategies can be allied and it must be noticed that both presume interactivity between the student and the education environment. The deductive strategy can be developed in a faster rhythm and results in bigger absorption of the knowledge. The inductive strategy demands more time to be developed but it has the effect to teach the student to learn.

In interactive education, less conventional strategies and resources could be used. Beyond expositive methods and exercises in form of multiple choice tests, where the correction is immediate, it is possible to develop randomly selected comprehensive questions taken from a database. Simulators and games enable constructive learning strategies and workout of the learned knowledge and abilities. The expositive methods may be enriched by videos and animations.

An issue to be faced is how to keep the students motivated to follow the course along the sessions for days or months. Videos will be extensively used in the courses to keep the student attention. It is possible to keep the professor

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present in the screen and conducting the learning through the modules of the course. But besides this, the professor must be present in other ways like scheduled real time meetings with tools like chat.

Development of an Interactive Course

It is important to identify the differences between the development of traditional regular courses (local interaction) and online (remote interaction) courses.

We borrowed techniques and methodologies of video and film production for organizing the development of the course. The development steps are the following:

1 - Identify the objectives and the audience to be reached by the course. In the objectives definition it must be considered the knowledge to be acquired and the behavior changes to be promoted. The target audience defines the concepts to be transmitted and the language to be used in the course.

2 - Define the conceptual modules as well as the way those modules relates to each other. This process results in a diagram like the one illustrated in Figure 1. Modules will be performed sequentially only when necessary and all the conceptually independent modules could be developed without a definitive order.

3 - Detail each module and define the specific objectives to be reached, and which concepts must be transmitted in this module.

4 - Select the strategies to accomplish the objectives identified in the previous step. These strategies must define the most adequate media to be used for the concept presentation and which kind of exercises or games will be used to strengthen the learning. When a media, such as text, picture, sound, animation, simulation, game or video, was chosen, the next step is to define its presentation strategy. This means to write the treatment to be used, and what kind of dramatic action and narrative events will be employed.

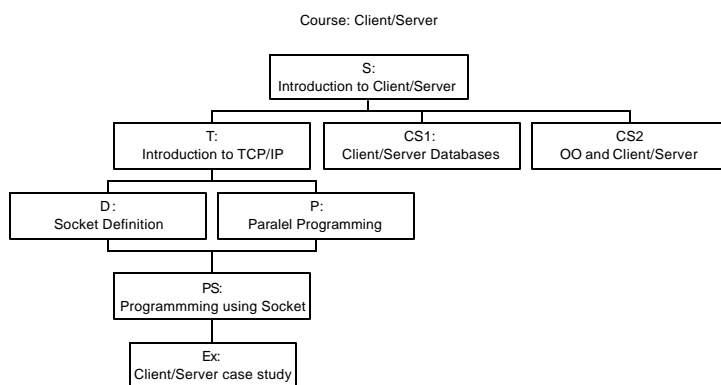


FIGURE 1
ORGANIZATION CHART OF A COURSE

At this step, enough material exists for the establishment of a general course script that is composed by individual scripts one for each of its modules. In particular, if the module will be a video then all the methodologies and techniques known for the video production could be used.

Each one of these steps will suffer the necessary walks through until a final solution is developed.

5 - At the final step, an analysis and evaluation of the process is made to verify if the objectives considered in the beginning had been reached.

When the process is finished, we have in hand a script for the development of a distance course implemented using hypermedia.

The idea is to use the concepts of video production [3], with the necessary changes, to adapt to course module elaboration. Thus, the script structure, in two columns, for example, can be used. A module can be implemented by Web pages that present in each screen, multiple objects in many kinds of media, one of them could be a video. In this case, it is proposed an extension for multi-column script model to include alternative media, like Figure 2. In the same way audio and video demand synchronism, also the other elements, texts, pictures, sound and photos, may be synchronized.

Heading: _____ Date: _____
 Author: _____ Page: _____
 Target audience: _____

Scene #	Texts	Actions	Window 1	Window 2	Audio
1	Text presenting concepts	Simulations, tests, and games	Photos, drawings, slide, presentations, animations, used to clarify some concept.	Video Scene 1: Location : Talent: Action: Plans:	Dialog, narration, music,...
n

FIGURE 2
SCRIPT IN MULTI-COLUMNS FORMAT

At this point we can propose a multimedia script editor with the following requirements:

- The script editor must be independent of the available tools like document editor and Web page editor
- An element in a scene may be synchronized with other. For instance, the audio and the video may be synchronized with the scrolling of the text.
- It must allow the definition of non-linear sequences of scenes. Unlike movie scripts, here we have branches from a scene to other.

Descriptive Model of Interactive Courses

An interactive course is structured as a set of concepts. The concept is the unit of representation of an idea, theory or

rule. The concepts can be organized in **sequences** where a concept is followed by another, creating a dependency chain. Sequences of concepts can be developed in parallel inside a course, when the involved concepts are independent.

Conventional courses in classroom or educative programs in video are formed as sequences of concepts, in spite of interruptions, changes between subjects, cuts, and scenes. An interactive media, like CD-ROM or Internet, can be structured as parallel sequences of concepts allowing the students to choose and follow one of the parallel sequences in any order at their own speed. Junction points can exist where the condition to progress to another concepts is that two or more parallel conditions have been fulfilled.

The representation that suits more closely to interactive courses, reflecting this possible chaining, is directed graph. An interactive course is, then, defined as a direct graph where nodes are linked through directed arcs, indicating the possible sequences to be followed during the accomplishment of the course.

From the course implementation point of view, each concept is defined as a **module** that uses different forms of representation: simple texts, hypertext or multimedia documents with graphics, pictures, applications, sounds, animation, video clips and full video programs. Each module corresponds to a concept and consists of an expository part that presents the concept, a training part that consists of exercises and simulations or games to pursue the knowledge and to develop practical skills. Optionally, an evaluation part may exist to determine if the student absorbed the concept allowing the measurement of his performance.

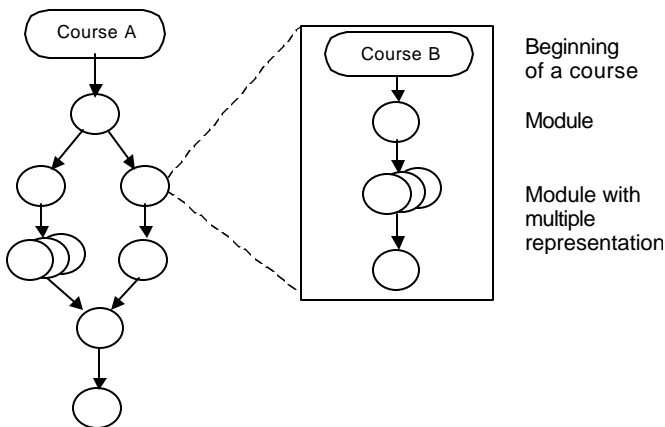


FIGURE 3
GRAPH REPRESENTATION OF COURSES

The concept can be complex. It can be presented in several steps using a recursive definition: a module can correspond to an elementary concept with an auto-contained presentation, or can correspond to a complex concept and, in this case, it is structured as another course or sub-module. This recursive structure allows the modularity property to be present in course descriptions. A module describing a common concept belonging to several different courses may

have its description reused so many times as needed (Figure 3).

WEBCC

To manage the courses we developed a system, the “WEB Course Control” (WebCC) (Figure 4), that allowed to register the courses, the module, the teacher’s and students’ information into a database. Through these informations the students access control (login) and the students performance control are done. The WebCC allows the monitoring of the students navigation over the instructional material, providing important feedback to instructional designer through collected statistics, such as most accessed pages or media, frequency and size of navigation jumps, etc.

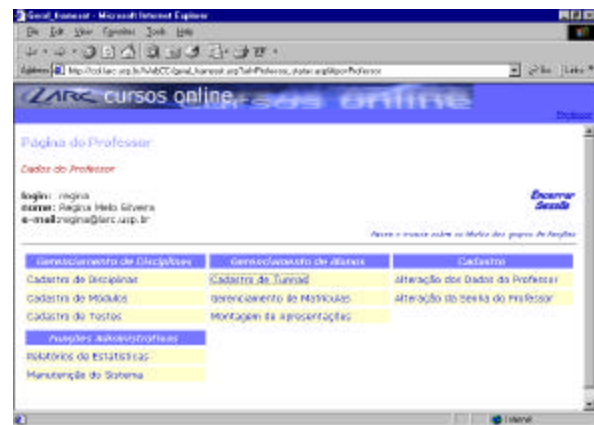


FIGURE 4
WEBCC – TEACHER’S PAGE

The basic unit into WebCC is the module. The teacher can split his course in one or more modules, like previously described. At first, the teacher must register the modules that compose the course into database. After this, he can create the course with the new modules that he has created, and besides this, he can add modules of the other course registered.

While the WebCC’s user adds modules to the course, he can create dependencies between them. If the user created dependencies in his course, he must create tests for the respective modules in order that the student can go ahead into the course.

Modules can be created using multimedia tools like HTML editors or may be generated using the wizard [7], a tool developed at LARC to create a HTML document integrating and synchronizing video, audio and text and presentations.

For the tests’ creation, the teacher can use the TestBuilder [5]. The TestBuilder is a web course tool developed by LARC-EPUSP that permit the teacher to create tests for the modules. With the TestBuilder the

teacher can create multiple choice tests for his modules by difficulty, by subject or by statement. The questions can have more than one correct alternative. Because of this, the tests are more difficult, and the teacher must create them with much more responsibility. The student must be submitted to the test at the end of each module.

Besides the modules and the courses, the WebCC has other entity: the students' group. For the teacher to make his course available into WebCC, he must create a students' group. The teacher can put one or more courses inside the students' group. In this way, one teacher can create, for example, a complete graduation course.

One students' group has characteristics like: the course duration, the maximum number of students, the goal, requirements, etc. This feature improves the online learning, because it increases the interaction between students allowing discussion and information exchange.

Other important characteristic of the students' group is how it can be created. The teacher can choose if the student must pay or not for the course, and enroll or not some students too.

To support paid courses, this system includes an e-commerce module. When the student enrolls to a paid course, the course will be unavailable till he goes to the e-commerce module and pays with credit card, which authorizes the enrollment automatically.

Another feature of WebCC is the possibility of the teacher to create presentations for his students. To do this, the teacher must insert into database a sequence of slides (in real, URLs). Then, the teacher must schedule with his students some day for the presentation. It is possible for the students make questions to the teacher during the presentation.

This presentation feature uses a chat environment with special resources to the teacher. With these special resources the teacher can coordinate the discussion, answer questions, show web pages and the slides.

For the teacher to interact with the students, WebCC has some tools, like a chat, a presentation system information, and the WebDoubt. The teacher can send all kind of messages to his students. He can schedule presentations, for example, using the system information.

The WebDoubt is a tool that allows the students to submit questions, and append questions to another submitted question. The teacher answer the questions, and the selected questions will be available in a FAQ.

The WebCC collects statistics about the courses such as the most accessed pages, in general or by student; and statistics about the tests such as how many times the students make right some questions and how many times the students marked some alternatives of the questions.

All this functions are available through a graphic interface: the teacher's page. The WebCC has an administrative interface tool for administrative tasks, such as: create teacher, delete students, change passwords, etc.

The student has contact with the system using the main page (Figure 5). In this page, the student can find links to description of students' group, to register in a new course and for register into WebCC. If the students had registered previously, the system ask him/her to fill in his login and password in the main page. Other information available in this web site are: news, software's to download, system help, education laws, etc.



FIGURE 5
THE WEBCC MAIN PAGE

The way student registers in a course is very simple. In the students' group page he can find a complete description about the course (Figure 7). In the main page there is a button for the students to register in the system and in a course. To complete the register, he must accept a contract, and must login in the system.



FIGURE 6
COURSE DESCRIPTION

When the student access the Student's page, he can check the courses where he is registered, read the content of the courses, the last news, and the teacher's messages, to participate of the discussion list or chats and to check his marks in the tests.

The system uses a unified login. There is only one basic type of user: the student. A teacher is a student with special rights, such as creating courses, modules, and group of

students, answering doubts, making presentations, and so on. With this feature, the teacher can have assistants, only with some access rights, such as answering doubts and making presentations. The administrator of the system has different access rights that allows him to give permissions to users.

To allow access control and obtain statistics, it's necessary to make some changes in the course's html pages. To make these changes automatically, a content upload system was created. This system receives a file with the html pages, makes these changes, checks the links and writes the pages in the same directory structure created by the teacher. The changes includes codes to write statistics of the page usage.

OBTAINED RESULTS

After developing online courses and WebCC, it is possible to obtain statistics and information to improve the material courses and their environment. In this section we will present some statistics and discuss how they can be useful.

These statistics have been obtained from a "Network Security Course". This course contains several modules that covers:

- Definitions and Security Services;
- Security Policy;
- Symmetric and Asymmetric Cryptography;
- Access Control and Authentication Methods;
- Digital Certificates;
- Secure Protocols, such as SSL and SET;
- Security Tools, such as Firewalls and Intrusion Detection Systems.

The modules use several media, such as audio, video, animations, and simulators. The audio and video are used to explain some important concept, or to reinforce some information. The animations illustrate how some ideas work, such as attacks in a network. The simulators are applied mainly in cryptography, because they make easy to understand some hard and important concepts.

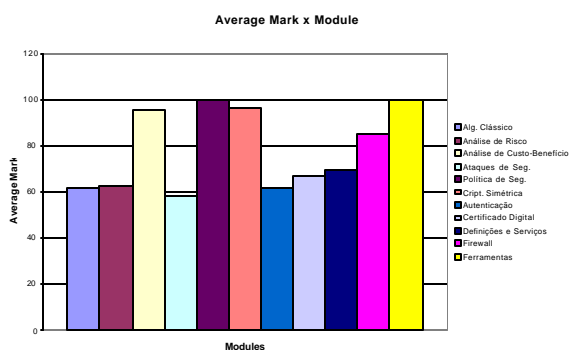


FIGURE 7
AVERAGE MARK OF EACH TEST IN THE COURSE

One test at the end of each module is applied. If the student reaches the minimum score, he can continue through the course. Otherwise, the student is encouraged to study again the module, talk to the teacher to solve his doubts, and then to do the test again.

The use of tests at the end of the module can be hardly criticized, because objective questions are not the best way to estimate the students learning. But this practice makes the students read the content more carefully, use the simulators, and pay attention in the given information.

Once all the students need to make the test, the teacher must use this information. He can see the average mark of each test in the course (Figure 7) and the average time the students took to make the questions in a test (Figure 8).

If a test has many low marks, or low average mark, the teacher must reflect about it. This may happen because one of the following reasons:

- There are bad questions;
- The concepts are not well explained in the module.

Bad questions include writing or logical mistakes. Some kind of writing mistakes are spelling and semantic errors, and this affects the understanding of the statement or the alternatives of the question. Logical errors include a statement that requires positive answer and alternatives that provide only negative ones.

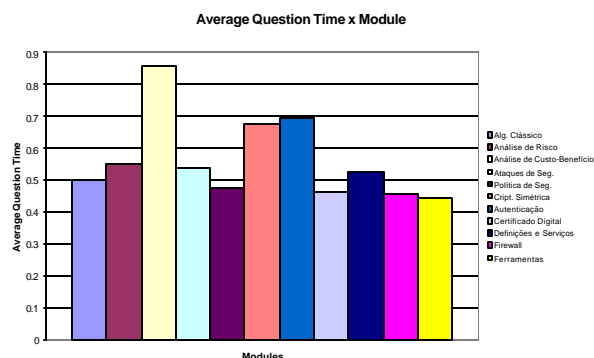


FIGURE 8
AVERAGE TIME STUDENTS TOOK TO DO THE QUESTIONS

If the students take too long to make the tests, the teacher should also review the questions. The goal of these tests is to reinforce the main concepts, not to scare the students.

If one test has low average marks and long average time, this must be reviewed. Low marks point to problems with the test, and long time needed to make it reinforce these problems.

Once the teacher reviewed the questions and if no problem was found, he goes to the next step: the module may present problems. It's necessary to read the whole module, and verify all the explained concepts. At this point,

some mistakes can be corrected or different ways can be used to teach the same concept.

There are also other information displayed in tables that helps the teacher to get along with their students:

- Navigation of the student, backs, time in each page, login, logoff, when he starts tests.
- Marks of each student in all tests of the course (Figure 9).

Aluno	Problemas Resolvidos	Número de Páginas	Atividade de Conteúdo	Atividade de Pesquisa	Atividade de Discussão	Tempo gasto
Isabela	55/100	36/1400	98/100	98	100	86/3:18
Regiane	100	100	90	90	100	100
Alcides	90/100	100	90	90	100	100
Regina	100	98/100	100/100	100/100	100/100	100
Martha	84/100	100	90	90	100	100
Fátima	98/100	100	100	100	100	100

FIGURE 9
MARKS OF STUDENTS IN A GROUP

When the teacher analyzes the table with navigation information, it's possible to see if the student has taken enough time in each concept, how frequently he reads the online material, how many times he made the tests, and so on.

The teacher can see if the student has done the same test twice, and in this case if his performance has improved. This shows that the proposed method works well, besides improving the students' performance.

With the navigation information and students' marks, the teacher can rewrite some content, improving the explanation where the students had more difficulty, indicated by the low marks. This feedback is very important, because the teacher can verify his online course.

These statistics also permit that the teacher reinforce the weakly presented concepts using the presentation tool.

Another important feature in WebCC, that differs from other software, is the dependence feature. The dependence between modules permits that an important concept is presented before others, and it can be set as a pre-requirement. If one module is a pre-requirement, the student must obtain a minimum mark to proceed with the course. Otherwise he needs to study the concept again, and retake the test.

FINAL CONSIDERATIONS

This project have two goals. One is to develop online courses in Computer Networks area. The other is to research

methodologies, tools and environments for online courses development and distribution over a computer network. For this reason, instead to buy a course management system, the decision was to develop one. Each of the presented tools is being improved to go beyond the features found in the products of the market.

As said before, the main goal is developing online courses. To reach this, the necessary network infrastructure was developed [6], besides some tools to help the teacher and the courses. These tools includes an Organization Tool for Distance Education Courses [2], a Synchronization Tool for Multimedia Web Based Material [7], the WebDoubt System, WebTest (TestBuilder and TestTaker)[5] and the system to manage the courses, WebCC.

Others services were also already developed such as Web Support for Traditional Course, Digital Library, Virtual Lab and Seminary Room.

The presented results had helped in improving the online courses quality and also the environment. These data have been important, but they are not enough. More statistics and other different types of data shall be collected. With the students' feedback, it's possible to get a very good Online Web Course Environment, full of interesting courses.

The efforts spend in these project represent our trust that the distance education will be very important way to transmit technical information and intellectual experiences over the world.

REFERENCES

- [1] Bressan, G.; Silveira, R. M. and Ruggiero, W. V.; "A Framework for Distance Learning Employing Video on Web Environment", *International Conference on Technology and Distance Education*, Fort Lauderdale - Florida, June 1999.
- [2] Gonzalez, L. G.; Lemos, F. E. C. and Ruggiero, W. V.; "Organization and Development of Distance Education Courses", *International Conference on Technology and Distance Education*, Fort Lauderdale - Florida, June 1999.
- [3] Kindem, G; Musburger, R. B.; "Introduction to Media Production from Analog to Digital", Focal Press, Butterworth - Heinerman, 1997.
- [4] Margi, C. B.; Silveira, R. M.; Gonzalez, L. G.; Favero, E.; Vilcachagua, O. D.; Bressan, G. e Ruggiero, W. V.; "Projeto Multimídia sob Demanda: Uma Experiência em Ensino a Distância", *VI Congresso Internacional de Educação a Distância*, Rio de Janeiro, Brazil, August, 1999.
- [5] Vilcachagua, O. D.; Favero, E.; Bressan, G.; Ruggiero, W.V.; "Sistema Modular de Avaliação da Aprendizagem Via WEB"; *VI Congresso Internacional de Educação a Distância*, Rio de Janeiro, Brazil, August, 1999.
- [6] Silveira, R. M.; Margi, C. B.; Gonzalez, L. G.; Favero, E.; Vilcachagua, O. D.; Bressan, G. e Ruggiero, W. V.; "A Multimedia on Demand System for Distance Education", *International Conference on Technology and Distance Education*, Fort Lauderdale - Florida, June 1999.
- [7] Stiubiener, I.; Ceze, L. H.; Strauss, K.; Margi, C. B.; Silveira, R. M.; Ruggiero, W. V.; "An Environment for Easy Cross-Synchronization of Multimedia Web Based Material"; *submitted to FIE 2000*.