

ENGINEERING DISTANCE EDUCATION COURSES UNITING EUROPE AND THE UNITED STATES

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Abstract *This paper reviews three related projects with a common denominator: collaboration through distance education among universities in Europe and the US. This collaboration includes: the transfer of technology between universities for online content creation and delivery; the creation of faculty teams through the collaborative production of courses; and the development of exchange programs between universities using online courses. After a brief description of earlier related projects developed mainly at Christian Brother University, during the last four years, three specific collaborative projects are described: the France Project, which aimed to teach live courses with the instructor in France and the students in the US; the development of a first online course at ESIGELEC, France; and the development of an English course in communication networks design, created by faculty in France and the US, and to be offered to students in a engineering school in Barcelona, Spain.*

Index Terms *Distance education, inter-university course development, Internet based video-conferencing.*

INTRODUCTION

After some initial experiments of using the Internet as a medium for the live and on demand delivery of audio and video signals [1-3], a large group of universities with an existing infrastructure of video content production for their distance education programs began incorporating these new technologies into their classrooms [4-8]. For the last four years, the number of universities mainly in the US, but also elsewhere, using the Internet as a medium to extend their educational services has increased considerably.

The three projects described in this paper represent part of the activity that in this area is being implemented, and that is allowing the collaboration between universities in three countries, the US, France and Spain [9-11]. This collaboration has its foundation in the use of Internet as a medium for communication and delivery of education, the development of online courses to allow course-sharing among different programs, and the use of English as the common language.

As additional collaborative projects begin to produce a critical mass, and new project funding is obtained, mainly through US and European grants for online course development, institutional and permanent collaboration between universities could become a reality.

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PRECEDENTS

Christian Brothers University had begun its work in the area of distance education with the design of an infrastructure to incorporate new technologies, specifically internet delivery of video and audio, into its engineering programs.

This initial work included three phases: Phase 1: Video Technology - Fall 1997 (Ability to record, store, and transmit large quantities of high quality digital video, and to systematically incorporate new technologies; Phase 2: Distance Learning Classrooms - Spring 1999 (Ability to produce electronic versions of traditional courses, with quality, reliability, and in large scale; Phase 3: Internet Presence - Fall 2000 (Ability to support the Internet delivery of these courses - lectures, transfer of documents, faculty-student communication, inter-student interaction, etc.)

Figure 1 illustrates the format selected for the production and Internet streaming of several engineering courses. A classroom was equipped with multimedia tools to allow the recording and real-time delivery of the class. The equipment included several video cameras, audio system, projector, and encoding and streaming servers. The size of the transmitted signal was 680x480 pixels, allowing the easy reading of the computer based white board used by the professor.

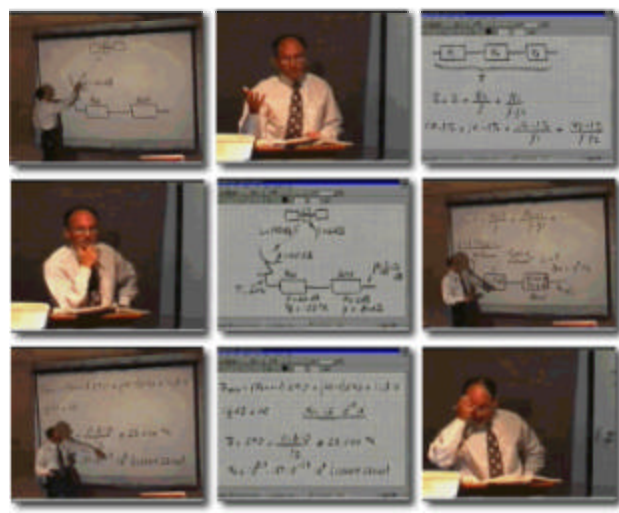


FIGURE 1
CLASSROOM FOR ONLINE COURSE PRODUCTION AT CBU.

The experience gained during these years, both in the area of hardware and software infrastructure, and in the area of course development, is the origin of the three projects described in this paper. These projects are intended to facilitate the transfer of technology between universities for online content creation and delivery; the creation of faculty teams through the collaborative production of courses; and the development of exchange programs between universities using online courses

THE FRANCE PROJECT: FRANCE-US

Christian Brother University is one of many universities of the LaSallian community. This community of educators, created in France over 300 years ago, counts today with 90,000 faculty and staff in over 900 cities of 86 countries around the world, serving one million students.

With the opportunities offered by these new technologies, the collaboration between geographically disperse institutions became a valid proposition.

between distant institutions. In this project, the instructor was in Paris, France, and the students in a classroom in Memphis, TN.

The class material was prerecorded in high-quality video segments of about 10 minutes each. An Internet video conference, using netmeeting, connected the classrooms in France and the US. Before each lecture segment the instructor introduced the topic using the video-conference link. After each segment the students asked questions through the same media. A real-time white board was used to elaborate on answers that required its use.

Other features of the project included the implementation of office hours via video-conference, the transmission and grading of homework in electronic form, and a project specific evaluation.

The first year experience of the project showed a very reliable performance of the technology, very positive response from the students, and an almost immediate process to duplicate the system in other partner institutions.

Figure 2 shows a moment during a lecture. The students in Memphis viewed the prerecorded segment projected in a large screen, while having access to the instructor on a separate workstation.

AN ONLINE DATABASE COURSE IN FRANCE

This project is an example of collaboration between two institutions for the transfer of technology (CBU in the US, and ESIGELEC in France,) and between faculty of different universities for the design, production and delivery of online courses.

The goal of this project included: testing the infrastructure created at ESIGELEC for the production and delivery of online courses; designing an integrated format for online courses (including audio, video, and high quality copies of the instructors materials,) and evaluating the response of over one hundred students to this new method of accessing course content.

For this project a database course was selected. This course included three types of traditional meetings: lecture, problem sessions, and laboratory session. Only the ten hours of lectures were made available in an online format. For the problem and laboratory sessions the students had to meet with the instructor in their traditional settings.

Online Lecture Format Design

The design of the format for the online lectures was based on the integration of several multimedia sources that would allow the student to feel close to the instructor, follow her explanations, both spoken as well as graphical, and to self pace the flow of the class by including links to the different segments of the lecture.

The format selected includes three separate windows, as illustrated by Figure 3. This format, which is used by several universities, such as Stanford, includes a window with the video-audio signal of the lecture, a second window

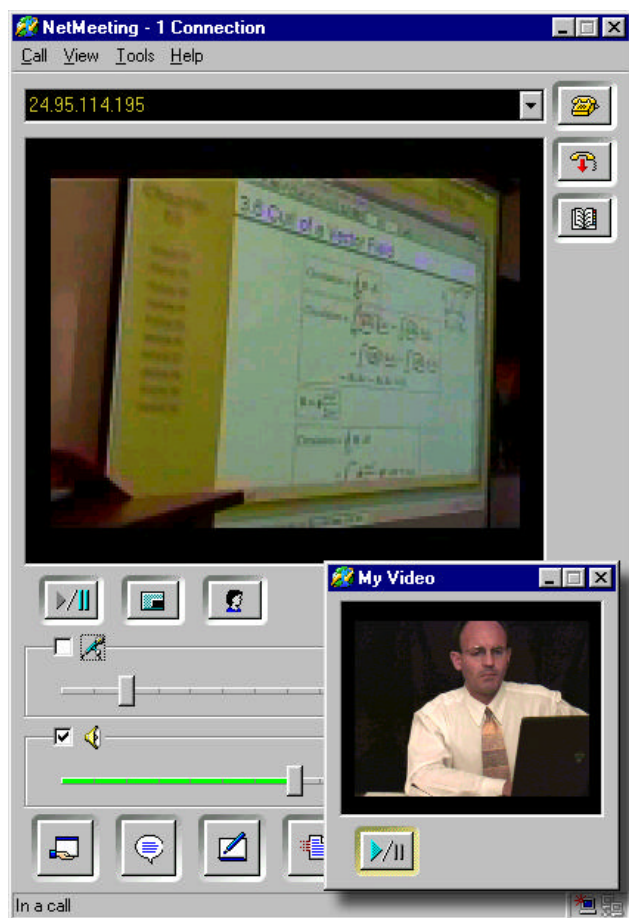


FIGURE. 2

VIDEO CONFERENCE LINK PARIS-MEMPHIS FOR A LIVE LECTURE.

The goal of the France project, was to develop and test the technology that would allow the live delivery of courses

for the indexed access to the different parts of the class, and a larger window with a static copy of the material used by the instructor, including her added hand notes.

The size of the video window was selected to obtain two of the established goals: to bring the professor close to the student, and to allow the student to follow the explanations during the lecture.

Traditionally, since video is by far the largest user of bandwidth, this window was made fairly small, providing some sense of the presence of the professor but little else. This window was primarily intended to offer some additional context to the always important audio signal.

By selecting a larger window size while maintaining the bandwidth within realistic limits (150 Kbps,) thanks to new improved compression algorithms, and by selecting an appropriate set of close-up views of the instructor, it was possible to provide the students with a personal experience of teacher-student communication.

One of the video inputs recorded was obtained from an electronic white board that the professor used to add her personal notes over the class viewgraphs to elaborate on her explanations and to illustrate further the concepts being introduced. Given the size of the video window, the recording frame rate, and the recording bandwidth, it is possible for the students to follow on the electronic white board the commentaries of the professor as she adds comments, highlights relevant sections of the viewgraphs, or explains the meaning of tables, diagrams, figures, etc.

A larger window to the right of the video window contains a perfect quality copy of the class viewgraphs, including the professor's added comments, diagrams, etc. This window includes a highlight tab indicating the number of the active viewgraph, giving the student information with respect to the moment within the lecture.

A third smaller window, below the video window, contains active links to all viewgraphs used during the lecture. These links are synchronized with the video signal above it, and the corresponding viewgraph to its right. This feature allows the student to review particular segments of the class, or to continue the study of a lecture beginning at the point at which it was left in a previous session.

Class Support Environment

The environment WebCT was selected as the platform to support access to the online lectures and the teacher-student communication. WebCT was selected for offering a very reliable, well structured, well documented platform. In addition, economic considerations (licensing costs) and online technical support influenced the selection of the platform.

WebCT is a web-based platform that allows instructors to design and operate their own course sites with little administrative support. It includes a set of standard tools specially designed for student-professor communication,

course monitoring and tracking, and regular student evaluation and feedback.

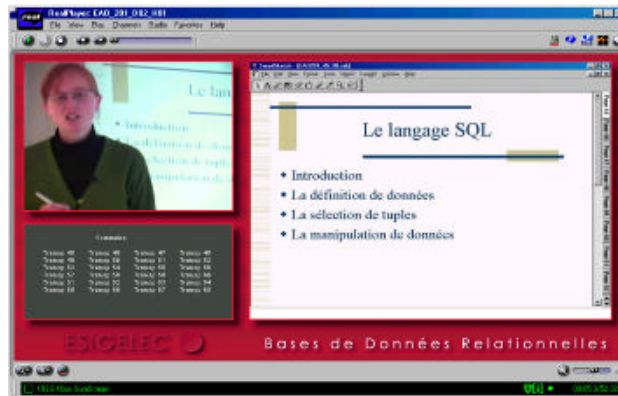


FIGURE. 3
INTEGRATED MULTIMEDIA FORMAT FOR THE ONLINE LECTURES.

For this first online course at ESIGELEC, the WebCT structure selected included the minimum set of elements that would give the students all the information required, and it would demand from professor and students as little additional work as possible.

Many online courses, although well designed, require both from students and faculty an immense amount of time and dedication. Although for some short and selected trials this is a valid proposition, for an online course to compete with traditional courses, it needs to offer the advantages of anytime-anyplace, providing equivalent or better academic content, but without demanding unreasonably large amounts of time and dedication. Figure 4 shows the main WebCT window from which the student would select to view the lectures, communicate with the professor, etc.



FIGURE. 4
DESIGN OF THE MAIN WEBCT WINDOW.

The elements that were included in the main page of WebCT, and that appear in Figure 4, include the following:

- **Video Lectures:** from this link the students access an index of all the lectures of the course. The links allow students to access the data from a video server via the Internet, or access the data from a local CD provided to those students with an Internet connection of insufficient bandwidth for the transmission of the signal.
- **Transparencies:** from this link the students access an index of all the transparencies of the course, organized by lectures. This links allow the students to print copies of the viewgraphs used in class, including the professor's comments, and add their own comments and notes.
- **Polycopie:** This a text document which serves as comprehensive support of the concepts described in the course. It plays a very similar role of a textbook adopted for a course.
- **Syllabus:** This is a short description of the course, its goals, structure, and schedule.
- **Devoirs:** Usually this tool is used to collect assigned homework from the students. In this project the tool was used to collect valuable feedback from the students regarding their experience with this, their first online course. The incentive of a small grade credit was included with this feedback, not intended to bias their feedback, but to guarantee maximum student participation.
- **Calendar, email, chatroom:** These are traditional tools used to highlight special events, or to allow communication between professor-student, or among students.

Course Implementation and Evaluation

This first online course at Esigelec was offered to over one hundred students of the second year during the Spring Semester of 2001.

To guarantee access to the content to all students, several delivery methods we devised. For those students who wanted the regularity of time scheduled events, there was a weekly projection in the classroom of the modules corresponding to that week.

A computer laboratory equipped with individual headphones in each station was made available to students who preferred to access the lectures individually at their own time. This laboratory was reserved exclusively for this project.

For students who preferred to access the lectures from the comfort of their home, a video server containing all the video lectures was linked to the WebCT server. Given the bandwidth requirements for an optimum transmission, this option required the students to have a good Internet connection, either cable or ADSL.

For those students with a moderate Internet connection, while maintaining the Internet link to the WebCT server, a

separate link to the video lectures was created. This link pointed to their local CD drive, where the students inserted the provided CD's with the video lectures.

The results of this project are quite positive both academically as well as technically. The task of providing reliable access to video lectures to over one hundred students with very different Internet connectivity required inventive solutions but proved very positive.

The performance of the students in the final examination showed the effectiveness of the selected methodology.

Based on the experience of the five weeks of the course, with all the unexpected implementation incidents, and the comments obtained from the students in the three feedback requests, a set of guidelines to improve both the production of the course as well as its delivery in its next implementation has been identified.

AN ONLINE COMMUNICATION NETWORKS COURSE: SPAIN, FRANCE, US.

This project consists in the creation of an online course in English language to be offered in the new online program at the School of Telecommunications Engineering LaSalle in Barcelona, Spain. LaSalle Barcelona is one of the Universities of the LaSallian group of institutions around the world, and therefore this project provides a specific area of collaboration between sister Universities, in which institutions and faculty collaborate in the area of online education using the Internet as their main communication link.

The Engineering School LaSalle, beginning during the academic year 2001, and in a period of three years, will create an online program that includes the complete second cycle (4th and 5th years) of their Telecommunications Engineering degree.

The online programs will have a common structure, which includes a basic undivisible unit named session. A session corresponds to about two hours of lecture time, and it may require additional student time to accomplish other goals associated with the lecture.

The integrated software to access the different elements of each course and each session is e-Campus, an environment developed by the Engineers and Faculty of LaSalle. This software offers all the services of equivalent platforms, namely course access, student progress tracking, and student-faculty communication.

To incorporate the use of the English language as an integral part of the education of an engineer, a set of English courses will be included in the online program.

The third project presented in this paper corresponds to the creation of a course in English language in the area of Communication Networks Design and Simulation to be offered during the academic year 2001-2002 in LaSalle Barcelona. This course was developed by faculty at Esigelec, France, and Memphis, US. In addition to developing

the course, these faculty will communicate with the students in Spain during the academic year to monitor their progress, respond to their questions, evaluate their performance with quizzes and tests, etc.

General Format of the Course

Following the structure adopted for all courses of the online program in Barcelona, this course is divided in 45 sessions of two hours each. The content of the twelve chapters of the textbook in which the course is based was divided into sessions of approximately equal duration, with very few exceptions made only to prevent splitting or merging contents that should be presented as a unit.

The students access the main page in which a list of the studied sessions is marked as such, and the still not review sessions appear not marked.

Within each section the student is reminded of the previous sections that relate to the current one. The session begins with a brief list of specific objectives and expected results, bibliography, and summary.

Each session is subdivided into subjects, and the subjects in turn are subdivided into modules, which are the smallest units for with the systems keeps records of whether they were studied or not.

To incorporate not only the written English language but also the spoken English language, each section is associated with one or several multimedia lecture modules.



FIGURE 5
VIDEO INTRODUCTION TO A SESSION.

Each module begins with a video introduction of the professor in which the goals and structure of the module are described. This video presentation is often brief, lasting less than five minutes. Figure 5 shows an example of the professor's introduction.

To improve on the video quality of other projects described in this paper, for this English course on

Communication Networks, the main sections of the lectures were implemented with a new format. The three window model described in an earlier section was substituted by a single window format. The video window is only included during the initial presentation of the professor.

The new main window in this model includes a video screen capture of the professor's presentation of the lecture. This new format includes several advantages. The first one is the perfect quality of the recorded signal. Since this is not a video signal which is later compressed, the quality of the viewed signal is the same as the original, that is, a computer generated, digital video signal.

The second advantage is that this whiteboard can now incorporate any computer program as a didactic tool. Since it is the computer's monitor signal that is recorded, any computer program execution used during the lecture is recorded with perfect quality.

To allow access to different segments of the lecture, these recordings have been made in shorter segments of about ten minutes. This allows the student to pace his/her review of the lecture, and it allows the professor to include in each module concepts that should be studied as an indivisible unit. Figure 6 shows a screen capture during one of the lecture segments.

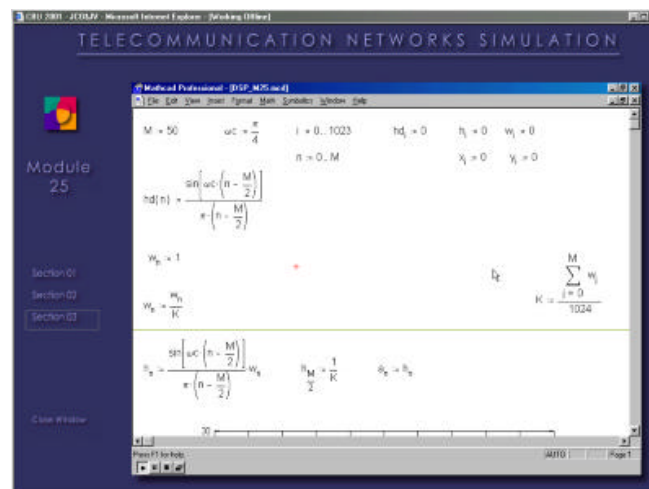


FIGURE 6
VIDEO LECTURE BASED ON A COMPUTER GENERATED SIGNAL.

This course will be completed by June, 2002, and it will include a technical and academic evaluation, as well as a student evaluation.

SUMMARY

This paper has reviewed three projects related by the common denominator of collaboration through distance education among universities in Europe and the US. In this

collaboration special emphasis was set in the areas of technology technology between universities for online content creation and delivery, the creation of faculty teams through the collaborative creation of courses; and the development of exchange programs between universities using online courses.

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