

An experience in UNED on building up a Virtual Campus

C. M. Pérez-Molina, J. A. Rodríguez, C. de Mora, J. Carpio, M. Castro and J. Peire

*Dpto. Ing. Eléctrica, Electrónica y de Control, ETSII, (UNED)
Ciudad Universitaria s/n, 28040 Madrid, Spain,
e-mail: clarapm@ieec.uned.es*

Abstract

The paper describes how the DEMOS project (funded by the European Commission, 4th Framework Programme 1996) will be implanted at UNED. The proposal was born as an initiative of UNED as part of its plan to cover the needs of new distance learning applications to be used in the current and future telecommunication networks. DEMOS intends to design and develop a distributed learning environment for distance education scenarios shaping a Virtual Campus, where co-operation among teachers, learners, tutors and experts is supported in a very flexible way. It is focused on the development of multimedia applications for education over heterogeneous telematics environments. The applications may be adapted to the different kinds of users and the different infrastructures available to facilitate the demonstration and exploitation phases.

Keywords

Distributed learning systems, Virtual campus, Learning scenarios, ISDN lines

1. INTRODUCTION: OVERVIEW OF UNED

UNED is the most important distance learning university of Spain and according to the number of enrolled students is the largest University of the country. Almost twenty-four years of steady, consistent growth in all areas, using its own particular administrative, academic and educational system, have led to many international educational forums referring to the "Spanish higher distance educational model". Initially set up as a "second chance" university, its subsequent development, led UNED to play a far more significant role in Spain than was originally expected.

UNED is nowadays especially committed to continuing education and professional improvement, and to the development of a teaching methodology based on the latest communication and information technologies. The nation-wide nature of UNED is also worth mentioning, as this is an extraordinary feature which has withstood the Spanish decentralisation process, and which is undoubtedly the key to a large part of UNED's potential (Moreno, 1993).

In the academic year 1996-1997, UNED's overall enrolments reached 160,000 students; the number of full-time teaching staff at the Central Headquarters in Madrid is now 1,000. There are approximately 4,000 part-time tutors, working in 60 Study Centres spread throughout the Spanish territory, and nine more so-called "support" Centres located in some European and Latin American countries. UNED offers degree courses in fifteen different fields, including the Humanities and Social Sciences, Mathematics, Physics, Chemistry, Industrial Engineering and Computer Science. Apart from these traditional courses -which in most cases also comprise Ph. D. programmes -, UNED offers Continuing education and "pure" Open courses at different levels and in a wide range.

1.1 Study Centre Network: methods and technology

Two main features of UNED are relevant for the purpose of this paper and the project as a whole: UNED's Study Centre Network and the methodological model that is being used in the teaching-learning process of the University.

The student support system of UNED relies on the Study Centre Network; students make their enrolment there, take care of all administrative issues, have their tutorials, and have access to all other services provided by the Central Headquarters university and by the Centre itself. UNED's Study Centres are autonomous in all areas except in strictly academic matters (for which they depend on the Professors and academic departments of the Headquarters). The fact that Study Centres were set up as a result of both public and private local initiative in medium-sized towns where no traditional university studies were available has enabled them to grow into highly dynamic institutions involved in the local community and its progress. The traditional effects of university education (the exodus of graduates to large urban areas) are thus reversed: the small and medium-

sized towns benefit from the improved academic and professional qualifications of their citizens and workers (García-Aretio, 1994).

As far as distance teaching methodology is concerned, UNED is introducing new technologies in a very gradual and careful way, looking to obtain maximum benefit from and development of "old" technologies, such as printed materials of different kinds, rather than rushing prematurely towards any methodological panacea, the results of which are as yet unclear. Thus, the original UNED methods based on the production and distribution of printed matter, individual attention from the Study Centre and its tutors, and radio broadcasts, have been maintained and developed as the methodological core of the University. To this, have been progressively added the following: the production of audio-visual material, direct attention to students from the Central Headquarters via telephone, daily television broadcasts, distribution of computer-based teaching programmes, and the introduction of a large telematic network using the new electronic technologies -wideband network linking all campus buildings, videotext, electronic mail, videoconference system, etc. UNED has set up an Educational Videoconferencing Network which comprises thirty-eight videoconferencing rooms, three of them at the Central Headquarters in Madrid, and the rest installed at thirty-five Study Centres (Carpio, 1994).

All the above-mentioned means are now used simultaneously at our University, so that methodological plurality has become one of the most peculiar features of our system. This means that the tool to be developed and tried out with the DEMOS project will be taken as one more element to be added to our list; our objective is to increase in number - and in quality - all possible means to give support (administrative and academic) to our students. The number of students, their geographical dispersion, and their tremendously different interests and capacities, do not allow for a single way of providing services and support, no matter how effective that way could be. In short, we are aiming at integrating this DEMOS tool in our system, and probably not so much to overhaul our system around this tool.

2. DESCRIPTION OF DEMOS PROJECT AT UNED

2.1 Different kinds of users

There are a wide variety of students at UNED. Some time ago UNED's average student was a man or a woman in his or her thirties, with a full time job and a family, who just wanted to improve his/her qualifications in order to look for professional promotion or just professional development in general. At the moment, there are many young students coming out fresh from secondary school, and that kind of student represents the majority, but on the other hand, there are also many mature students who are looking for a second university degree.

Many students have other responsibilities apart from their career, so they have little time to study. Students always want to make the most of their learning activities and experiences; at UNED they are used to studying by themselves. However, when they live in periphery areas, even in remote ones, isolation, the feeling of loneliness and the consequent lack of feedback from teachers or other students can be the reason for many dropouts. This is the kind of student we want to deal with in this project; we hope that through this new technology the distance learning methodology at our university will improve.

We have identified three different types of potential users in the DEMOS project:

1. **The home-based student (type A).** Many students have other responsibilities apart from their career, so that they have little time to study. Although he or she lives close to one of the Study Centre, work and family pressures do not allow many visits to the Centre. Therefore s/he works at home and has a computer with average technical characteristics and access to the standard telephone service (PSTN).
2. **The home-based student (type B).** This is just a variation from the previous type. The student is again working alone at home but he or she has more sophisticated computer equipment including multimedia equipment, high-speed modem and, of course, access to PSTN. Considering the evolution of prices for ISDN, this is a student who could have access to ISDN in the very near future.
3. **The Study Centre-based student.** Even though attending tutorials is not compulsory in our University, many students go quite frequently to the Study Centre, especially students living in medium-size towns for whom it is easy and fast to get there. Most Study Centres offer many facilities, including computer equipment, access to ISDN and LAN, etc. Students taking the same course have the opportunity to meet and work together, and to have the support of a tutor at least once a week throughout the academic year.

2.2 Walking down a Virtual Campus

The services provided by DEMOS include a set of tools integrated in a Windows application, so it is easy to use and furthermore it gives an integrated look. DEMOS has been developed taking into account *what* our students need and *how* we can cover these needs with a telematic environment.

Each user will be able to use one or more DEMOS applications with the same basic and cost-effective hardware platforms: PC clients running MS-Windows 95 and UNIX servers. There is an integrated HTML welcome page for accessing the DEMOS applications so only one user authentication will be done.

Next let's specify the way our DEMOS system works in order to achieve the students' requirements. It is like 'walking' through a Virtual Campus, and it could be described as follows:

Information and Administration

Information is provided through Internet access to a centralised information system. Students can visualise and recover information by means of common web

browsers. Topics covered are namely personal data, DEMOS information, public announcements and participants' news space.

Administration involves registration of students and control of activities. Some administration tasks can be performed via the Internet, but not all because of security. In this last case, a special purpose application, the administration manager utility, is developed allowing secure information handling from well-defined client sites, namely local computers belonging to system administrators.

The Information and Administration facilities are supported by a centralised client/server database management system which implements data storage and security control on database access. Stored information may consist of users' data, both students and teachers, as well as system usage such as session attendance and library or bookstore usage. Database edition and updating is performed transparently with the interactive support provided by the user interface, either web browsers or the administration manager utility.

Students can submit registration information via the Internet, which should be confirmed by the administration service. Once confirmed the registration, permissions are granted for the different services. See Figure 1.

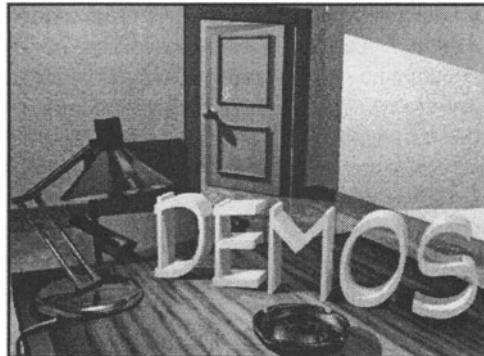


Figure 1. Entrance to the Virtual Campus.

Virtual Library and Asynchronous Study

This facility is very similar to a common Library, in which the user can search and use the didactic materials provided by the teachers and where the student is able to practice self-study. The student is allowed to consult any hypermedia document, navigating through it as well as following stored classes off-line, not only the teaching material but the teaching process itself, including the actions, video image and voice of the teacher.

Virtual Bookstore

This service allows the electronic distribution of didactic material, where it is important to control and register the kind of information distributed (free, restricted) and who it is distributed to, especially if there are copyrights. The solution that has been adopted is an ftp-like asynchronous tool managing a documents database for security permission and accounting, allowing the DEMOS students to search/retrieve multimedia documents from it.

Learning Scenarios

Here we describe a set of applications that simulates the most common learning and training situations between a group of users (teachers and learners). A classroom metaphor is used to develop these situations.

1. **Tele-Teaching:** This will take place at the Distributed Virtual Classroom, where the teacher and the students are connected on-line through their terminals. This facility is the main core of DEMOS and it allows applications, tools and material in all kind of formats (text, programs, images, audio and video) including multipoint videoconferencing to be shared. The teacher's terminal is allowed to play the role of the session's director. See Figure 2.



Figure 2. Tele-Teaching scenario.

2. **Tele-Tutoring:** Through this facility the teacher is accessible to the learners during some time previously agreed (normally 4 hours a week). To handle several requests a queuing mechanism has been required. When a learner has a problem he can call the teacher to put it to him. This tool allows the personal communication (point-to-point) between the teacher and the student: in an asynchronous way (like the electronic mail but with multimedia features) or on-line between both (then, it can be considered as an individual or point-to-point use of the Virtual Classroom). See Figure 3.

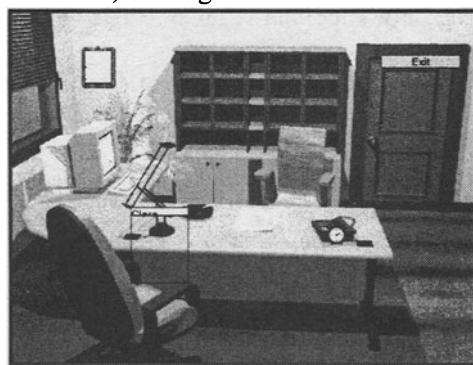


Figure 3. Tele-Tutoring scenario.

3. **Meeting sessions:** This is where a discussion among groups of learners about any question is carried out. They are always able to share windows applications and the blackboard system for working collaboratively on them. In this application all the users have the same role, it is possible to have a chairman but it is not necessary. See Figure 4.

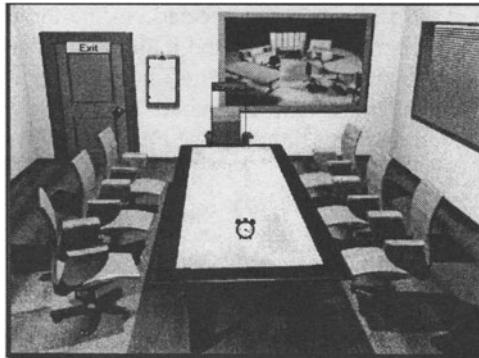


Figure 4. Meeting sessions scenario.

Café Room

This tool is the discussion forum for the students, there the students can get in touch by multimedia electronic mail and create discussion news groups (similar to the ones of the Internet).

3. TECHNICAL ASPECTS OF THE VIRTUAL CAMPUS

From a technical point of view DEMOS is an advanced telematic environment that includes synchronous (on-line) and asynchronous (off-line) applications. It runs on different hardware platforms, based on multimedia PC servers, using point-to-point and multipoint modes.

Demos Distributed Virtual Classroom is very flexible in terms of communication configurations. The only important requirement is to have the TCP/IP protocol. The following configurations are sustained:

- Over LAN: Different users connected to a LAN.
- One ISDN line: One to one or multipoint communication through a basic ISDN line.
- Two ISDN lines: One to one or multipoint communication through two basic ISDN lines.
- The two above configurations plus LAN: In the student side can be a LAN, sustaining not only one but many students.
- PTC connection via modem.

Obviously the quality of transmission depends on the bandwidth of the channel. For high quality in video and audio transmission the two ISDN lines configuration is recommended. For very high audio transmission, an audio codec can be used

which allows mono CD audio quality. Other configurations are however supported allowing a balance between the investment and the available features. In sum the system is affordable to most students.

With DVC the number of simultaneous connections depends on the instructor's router capability. See Figure 5. For the most frequent scenario, which is the distance tutoring activity, eight simultaneous connections are more than enough, which makes the system highly versatile.

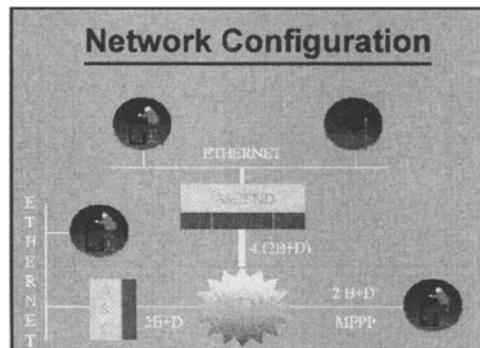


Figure 5. Network Configuration for 2 simultaneous connections through ISDN.

DVC can integrate different market videoconferencing systems since it is almost independent of such systems. Features such as application sharing or application control, do not depend on the videoconferencing system used.

Communication cost is one of the most important criteria of acceptance by users of DEMOS. PSTN can be used as a low cost public access network (mainly by users located in rural areas), but in the majority of cases ISDN access (128 kbps) is used in order to use all video-conferencing and multimedia capabilities without any constraint. See Figure 6.

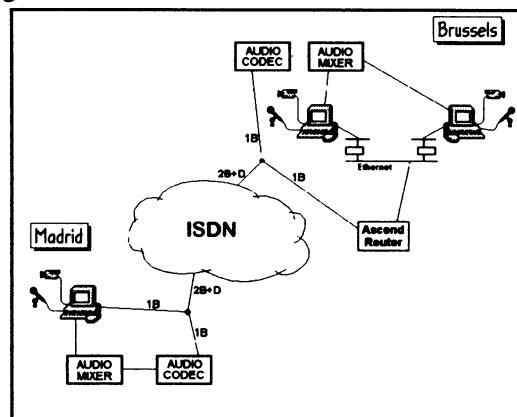


Figure 6. Detailed Configuration for an ISDN connection.

When a connection is opened, the user can send information to all the users of the group, to a single one or to any subset of them. Because of the actual limitations of PCs only one video-window can be displayed, so the user who has the turn (the teacher or the student depending on the case) sends his video/audio signal to all the others and can choose one of them. Basically there are two different modes of transmission: the control data flow requires a protocol like TCP that ensures the correct transmission of the information, however video and audio use UDP because the loss of some information is not too important (Sánchez-Dueñas, 1994).

4. IMPACT AND LAUNCHING

DEMOS could mean a great innovation in distance learning, since through this new system it is possible to allay the feeling of loneliness of every distance student, improving his/her motivation and consequently the benefits from study time. Students are able to meet their teachers as well as their classmates and to establish a personal communication like is carried out in a traditional university.

Owing to the wide diversification of students in our university, all the applications offered by DEMOS have been adapted to the heterogeneous network infrastructure available in each user's site, so flexibility increases the number of potential beneficiaries (Carpio, Pérez, 1996). Also these applications have a friendly interface, using metaphors for minimising the interface learning period, and for helping the user in concentrating on the material used in the learning process instead of on the way of using the application itself. All the actions that a user can do in each moment have been represented with intuitive icons.

We believe that, given the peculiar features of UNED, the Study Centre is the more rational "unit" for validation and demonstration of any new learning programme, at least during the first stage. This is because, even if the students do not attend tutorials regularly or do not benefit from the services of the Centre, they still "belong" to it in an administrative sense and have to go there for examinations and, if necessary, for practical seminars. The first prototype of DEMOS is ready at this moment. Then the validation phase will start with students in four Study Centres, mainly belonging to the UNED's European EuroStudy Centers Network, next academic year.

From a pedagogical point of view, this represents a big challenge. DEMOS pays special attention to the preparation of materials. There is a facility that lets the authors create materials (in an easy and friendly way) which will be used in the application, especially in the virtual classroom. A collaborative hypermedia editor has been used which allows creating those courseware multimedia materials including also files and objects made with many different standard-authoring tools.

5. REFERENCES

- Carpio, J and Ramos, E. (1994). UNED-EVCN: UNED Educational Videoconferencing Network. *DELTA Conference for Education and Training*. Düsseldorf, 1994.
- Carpio, J. and Pérez, C. (1996) Enseñanza a Distancia utilizando las Nuevas Tecnologías Telemáticas. *Jornadas Las Tecnologías de la Información como instrumento para la Formación Permanente: Nuevas perspectivas para la Formación Abierta y a Distancia*. Universitat de Valencia, 1996.
- García-Aretio, L. (1994). *La Educación a Distancia Hoy* (in Spanish). Ed. UNED.
- Moreno, J.M. (1993). UNED: The first twenty years. *EADTU Newsletters*. No 13, April.
- Sánchez-Dueñas, G. (1994). EDUBA: Applications for Education on Wide Band Communication Networks. *DELTA Conference for Education and Training*. Düsseldorf, 1994.

6. BIOGRAPHIES

Clara M. Pérez-Molina received a degree in Physics from the Complutense University, Madrid, in 1995. She has been working as researcher last two years at the Department of Electronic Engineering and Computer Science in the Spanish distance learning University (UNED). She is one of the members of the DEMOS project team of UNED. Her research interests include object-oriented programing, information and databases management systems, and neural networks.

Carlos de Mora is an Industrial Engineer. He holds an Associate Professor at Department of Electrical, Electronic and Control Engineering. His research interest is focused on Control Theory, Artificial Intelligence and Telematics.

José Carpio received the MS Electrical Engineering in 1985 and the Ph. D. in 1988, both from Technical University of Madrid. He joined the “Ingeniería Eléctrica, Electrónica y de Control” department at UNED in 1989 as Associate Professor. In 1993, he was visiting researcher in the “Department of Operation Research” at Stanford University. From 1994 to 1996, he was director of the Telematic Services Center in UNED. His research interest focuses in Optimization Power Systems and Technology for Distance Learning.

Manuel Castro, Electrical and Computer engineering educator in the Spanish University for Distance Education (UNED), has an industrial engineering degree from the ETSII / Madrid Polytechnic University and a doctoral engineering degree too. He worked during 5 years in Digital Equipment Corporation as senior system engineer. He works as researcher in different projects, ranging from solar system and advanced microprocessor system simulation to telematics and distance learning systems, acting now as and senior technical coordinator. He is now

serving as UNED's Information Services Center Director. He has published different technical books and articles for journals and conferences. He is senior member of IEEE and board member of the Spanish ISES committee.

Juan Peire received the MS Industrial Engineering in 1976 and the Ph. D. in 1979, both from University Politecnic of Madrid. He worked as R&D Director in GAMESA for five years. He is author or coauthor of books and more than eighty international papers. Currently, he is the Director of the “Ingeniería Eléctrica, Electrónica y de Control” Department at UNED. His research interest focuses in Distance Learning applications.