

## Multimedia and ICTs Scenarios in Higher Education Engineering Programs

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E-Learning is based on the use of Information and Communication Technologies (ICTs). These provide students with the means to accomplish their previously established knowledge acquisition goals. ICT tools must include the most adequate technical and expressive resources available in order to match, or even improve upon, the “in-situ” training model, which has, to date, proved to be the most effective.

Information and Communication Technologies have the potential of playing a really valuable role in Higher Education Development. However, it is not sufficient to simply have the appropriate technology and use it, without further consideration, as a mere vehicle to transmit the knowledge contents to be learnt by the students. On the contrary, it is crucial to design and develop the suitable scenarios which facilitate the use of the technology by combining the diverse resources that go to make up a pedagogical model and ensuring that user access is both fully integrated and transparent: information access and control, content transmission, student assessment, monitoring and guidance.

E-learning scenarios have been implemented as a way of improving the quality of the higher education learning process at the Universidad Politécnica de Madrid in a number of both technical and transversal subjects that form part of several engineering programs, using the Internet as the Communication System together with all the various services offered to users (Internet access, IP videoconferencing, E-mail, forums, group study, electronic messaging management, etc.).

The design and development of some of these experiments will be discussed and assessed in this paper.

### 1. - Introduction. -

E-Learning has been developed by bringing together a series of information and communication-related services and technologies that enables us to establish educational scenarios that can be accessed by students from anywhere in the world served by communication networks.

The component parts of this scenario are the Information and Communication Technologies (ICTs) themselves, which not only carry the signals to the users and thereby enable them to interact with the system, but also support the *Internet* and all of the other communication services that form the core of this technical process.

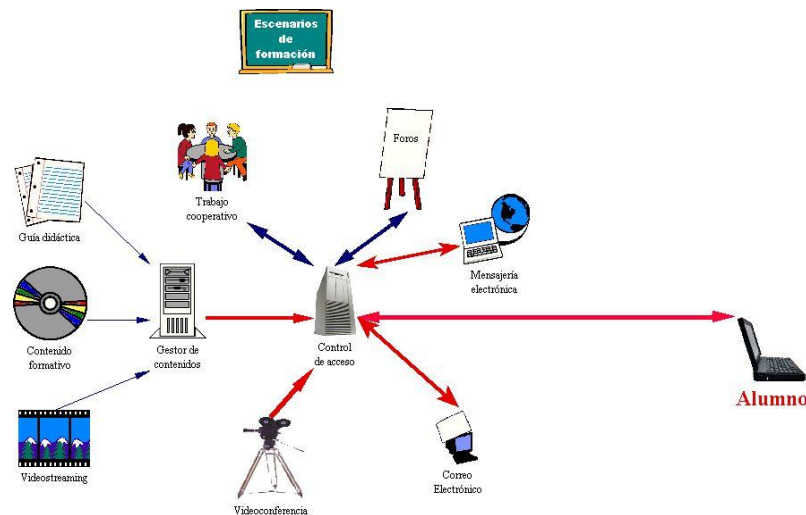


Fig-1 e-Learning scenarios

However, once the technology is installed and operational, it is necessary to use:

- Documental communication technologies**, which enable the messages to be organised in accordance with a series of communication codes that actually transmit the contents. These work by using the different sub-languages that go to make up the multimedia systems: texts, sound, images, graphics, videos, animations, etc. These must all comply with the characteristics of the E-Learning materials.

- b. A **methodological strategy** that enables the materials compiled in accordance with the specific characteristics of the E-Learning-dedicated texts to reach the students, allowing them to take full advantage of their educational potential. In short, the aim is that of establishing a teaching methodology that ensures that the objectives of the program are met.

The platform upon which the **E-Learning Program** is based is a technical device whose primary function is that of controlling student access to the main system and either allowing or denying them access to the different services, designed in accordance with the pre-established strategic methodology, that this provides:

- a. **Communications services** that ensure students feel themselves to be part of a community and allow them to both send and receive information related with the materials provided to them by the content manager. These systems are the same as those offered by the Internet, with the only difference being that instead of presenting them in a dispersed format, here they are integrated into a common friendly user environment:
- Group study.
  - *Fori*.
  - Electronic messaging and chat applications.
  - E-mail.
  - Videoconferencing.
- b. **Content services:** this forms the fundamental part of the platform and its purpose is that of transmitting the program contents to the end users. This management application is responsible for:
- Providing a **didactic guide** that supplies the student with clear and detailed information about the study program with respect to the subject he or she is going to study: objectives, content, methodology, teaching staff, activities and exercises schedule, synchronised sessions, programs and timetables, if applicable, etc.
  - **Enabling students to access the content** that they must learn, but also informing them of assessment tests, any tutorials organised, complementary teaching materials, bibliographies, etc.
  - Offering a systematic navigation, wind and rewind buttons, index bar, visited access identification, windows management and a navigation topology: lineal, destructured, hierarchical and structured (Gall and Hannafin, 1994)
- c. **Follow-** up of users actions, visited domains, dedicated time, answered questionnaires, etc.,

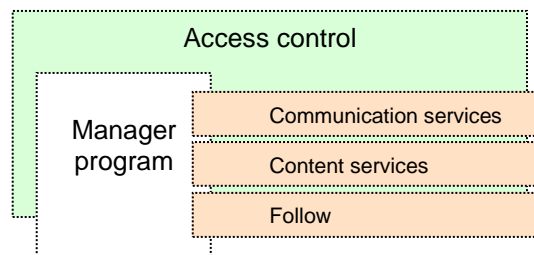


Fig 2,- System services

The **videoconferencing option** enables two or more E-Learners to establish a remote communication network. This is achieved by the simultaneous use of voice and image synchronised applications. This communications system improves the conventional telephone system by adding the visual option, but at the same time this complicates, in some ways, the technological process by requiring the use of several telephone circuits channelled through special networks (ISDN or RDSI in Spain) and the use of equipment to capture and process the audiovisual signal as well as to reproduce it.

This system has become increasingly less complex and cheaper for users to operate due to the fact that it can now be integrated into the E-Learning platforms themselves and use IP protocols. This has enabled videoconferencing to be increasingly seen as merely another Internet service.

## 2. - Criteria with respect to the development of E-Learning activities

Whenever we speak about E-Learning we are referring to a *flexibility*-based educational model that is, according to *Tirado, R.* (2002, 2003), defined by the following characteristics:

- A customised learning program that requires students having to concentrate exclusively on those aspects that interest them or that they find useful for their overall work.

- A flexible learning program that can be accessed by students via a wide and varied range of resources, activities and learning environments.
- A resources-based learning program, the quality of which will dictate the resulting learning effectiveness.
- An interactive learning program that allows students to choose their learning process at all times.
- A learning program that can be accessed if and when required. Given that the learning program is permanent, access to the learning resources has to be so too.

Within these characteristics that define the distance-learning program, we find ourselves having to create a number of scenarios that are, in turn, developed in conformance with a number of quality standards that are at least similar to the in-situ learning process that has proved itself to be so efficient down through the years. These educational scenarios include all of the services that go to make up a complete E-Learning system.

- When doing our experiment with have worked with these three learning scenarios:
- One that uses the web and all of the previously described communication services, but does not include the videoconferencing option.
- Other fundamentally based on the use of the videoconference, and the web, if used, complements it.
- The third one integrates all the communication systems with the learners.

### 2.1. – The Website-based E-Learning Scenario

This model is often presented without the videoconferencing service option. The missing resources have to be provided by the rest of the services for the Virtual Classroom. Bearing in mind that communication with the student must be constant, and as close as possible to the real situations in which communication is both fluid and spontaneous.

A methodological development process aimed at transmitting a full set of teaching materials via a website must ensure that:

- a. The student can access a range of continuous communication systems via the communications services provided by the website. To achieve this, it will be necessary to count on somebody to be specifically dedicated to carrying out the following tasks:
  - Reply immediately to all e-mails received.
  - Promote the efficient use of the *fori*.
  - Encourage the use of chats.
  - Provide student attention via the messaging service.
- b. A didactic structure with respect to the teaching materials. Such structure should ensure that these are something more than mere information placed on the website for students to download and print. An educational website must take the following characteristics into consideration:
  - **With respect to the user interface:**
    - **Objects spatial distribution** that organize the screen in different areas: the **working area** or section where the contents are displayed, the **navigation and control area**, which contains the buttons and hyperlinks that enable students to interact with the entire content of the website, and the **contextual area**, which informs users about the content of the chapter and the sections that they have already visited.
    - **Navigation guides** that help steer users as they advance through the content by way of: colours, symbols, headings to identify the different blocks, route tabs (hyperlinks visited), complete site navigation maps and uniformity with respect to styles, subjects, navigation system, etc.
  - **With respect to the characteristics of the expressive resources**
    - The user must be able to pick up and understand the information at a glance.
    - The user must be able to easily determine the function of each of the expressive resources, namely whether it: represents an idea, organises the ideas displayed, is a comment or observation, is a navigation control aid, etc.
    - Readability, or the ease with which the texts that form part of the content can be read, bearing in mind:
      - The type and size of the lettering used.
    - The typographies and frames included in the message. Care must be taken with those that are not commonly used.
    - Spatial distribution (column size).
    - Colour, and how this relates with the background.
    - Upper- and lowercase characters.
    - The use of different typefaces (no more than three).

- Highlighted words for emphasis.
- Line spacing.
- Alignment.
- Calculating time and reading spans so as not to overload the web page.
- Adequate evaluation of the expressive audio elements: reading, dialogues, narration, motivation, error, support, music, sound effects, etc.

## 2.2. – Videoconferencing-based E-Learning Scenario.

The **videoconference** is the perfect **distance-learning** medium as it enables the teacher to communicate with the students using a technology that is capable of simulating the in-situ learning format, albeit only partially.

Videoconferencing is also an E-Learning scenario whose efficiency as a teaching method is augmented by the way in which the teacher presents the material that he or she wishes to introduce or use in front of the camera and by the manner in which the methodology to be used is designed.

As is the case with any in-situ classroom situation, using a videoconferencing system requires the teacher to **set the scene**. This process has to be rethought in order to ensure that the message being transmitted reaches the user without being hindered by the communication barriers inherent to this type of system, which is prone to a great deal of communication interferences. In order to ensure that the videoconferencing sessions run smoothly, the teacher or those responsible for designing the scenario must take the following aspects into account:

- **The background** against which the teacher moves. The best option here is to opt for a neutral, evenly lit backdrop that contrasts with the speaker and that, under no circumstances, distracts the viewer.
- **Teacher's body language.** The teacher must be allowed to express him or herself freely whilst at the same time avoiding sudden rapid movements. We would recommend that the teacher be seated, behind a desk, in medium shot, and that he or she avoids making any sudden or continuous movements.
- **A framing or composition** that focuses the viewer's attention on the speaker. General panning shots should be avoided, as they do not transmit well due to the low resolution of the system. Instead, the camera should concentrate on the most basic and significant elements of each given set-up. We would advise against moving the camera to change or correct the composition. However, we would recommend using the options included in the videoconferencing systems for memorising certain positions. In order to introduce an element of visual variety into the videoconference, we advise the use of other options such as presentation video systems, video presenter, etc.
- The speaker's **wardrobe** must not clash with the other elements of the set-up. He or she shall have to wear clothes that do not clash with the background or cause camera interference. Speakers would be advised not to wear chequered suits (e.g. Prince of Wales check); white, which tends to darken facial features, or dark tones, which tend to excessively lighten them. The ideal solution is to wear pastel-coloured clothes and to avoid bright colours, especially reds, blues and greens.
- **Lighting** is a vital factor with respect to achieving a quality image. The set designers can always resort to lighting systems based on professional specification scattered light sources that create areas of uniform, shadow-free light. It is extremely important that this lighting is both directed and controlled so that it does not encroach onto the video projection screens and allows the return trace of the remote image to be seen.
- **Sound** is another fundamental component of the teaching session. It must be clear enough at source to be able to reach the listener in optimum conditions and overcome the degradation in technical quality suffered during transmission. Although many videoconferencing systems function using omnidirectional microphones located on the control desk of the studio in which the session is held, the most suitable solution is to use microphones that can be moved closer to the speakers.
- It is advisable to establish contact with a **remote coordinator** whose job is to organise the session. He or she will be our voice-off and would be responsible for running the tests required to coordinate all the technical characteristics of the various pieces of equipment involved in implementing the conference.

In order to ensure that the performance of these **videoconferencing**-centred activities is optimum at all times, the **methodological design** that we propose should have the following characteristics:

- The **discourse blocks and the duration** of each of these. Unlike an in-situ lecture, this video lecture is *mediate*, in other words, broadcasted using a medium that imposes *noises* upon the communication system that make it more difficult to follow. It is therefore advisable not to create large blocks of content. The logical solution is to divide each of the contributions up into thematic blocks in which the subject matter in question, without listener input, does not exceed 30 minutes and the overall duration of the session is no longer than 90 minutes.

- **Visual teaching support materials** that enrich the message, support and complement the oral expression process and display elements that provide the communication session with visual variety.
- **Complementary activities** enable the length of the videoconference to be extended and ensure that the message is more effective. These are essential in order to avoid the monotony and tedium that so often blight the videoconferencing format. The activities that can be planned are:
  - Practical exercises using pieces of IT equipment located in the room in which the videoconference is received.
  - Written exercises along the lines of work documents.
  - Consulting and use of documents to which the listeners also have access.
  - Video. Using the corresponding usage strategy and sending this through the videoconferencing system, the following can be planned and provided: a presentation of the content, the way in which the visual content is presented, activities that complement the visual content and materials that complement the video.
  - A videoconference debate, with the presence of a coordinator among the audience to liven up and organise the proceedings.
- **Other support materials** that can be broadcast using different media and that complement and round off the learning program. In some cases, these materials can be sent to those interested in *advance*, so that the audience can familiarise itself with them prior to the session, and in others *subsequently*, to be used as reinforcement material and/or a reminder of the subjects dealt with.

The **coordinator** working at the remote sites has an extraordinarily important role to play in the videoconferencing program that we are going to run. His or her mission will be to guarantee the operability of the distance-learning system. He or she will have to be the audience's spokesperson, ensure that the debates run smoothly and, in short, be the voice of the remote *video-lecturer*.

### 2.3. The Complete E-Learning Scenario

A definition of the scenario we are proposing, which is web-based and includes the incorporation of a videoconferencing service, can be found in *Bravo, J.L. y Caravantes, A. (2004)*, and its operational characteristics are based on a didactic strategy developed around the following options:

1. **Student information** via a **Learning Guide** that contains a general explanation of the subject. The student must be familiar with and always be able to see the learning program, which in turn must feature: Objectives, Contents, Methodology, Teaching Staff, Timetable and Assessment.
2. **Content Transmission**
  - a. Via the **Contents Manager**, in which all of the information related with the learning activity is published. Students will be able to access this option on a temporary basis in accordance with the deadlines stated in the timetable. This selfsame management application will track the route taken by the student through the contents and base its supervision and follow-up functions on this. On the other hand, the application will provide students with the information they need to enable them to follow the course in full and be assessed.
  - b. **Videoconferencing**, to enable teaching staff to be in direct contact with the students, provide them with the opportunity of visually presenting the course material and, once students have used the contents manager to familiarise themselves with this, to inform them of the general aspects of the learning activity and hold group tutorials.
  - c. **Fori**, to enable the teaching staff to know the students' opinions with respect to the subjects they propose and to provide a debating platform.
3. **Tutorials**

Distance-learning demands that students are in continuous contact with the teaching staff via the communications services built into the environment. This is, in our opinion, one of the great benefits of the distance-learning process using these systems, due to the fact that they establish an interdependency between the teaching staff and the students and provide the means for holding real tutorials. In the context of the post-graduate program referred to in this document, the tutorial systems are established via:

  - E-mail, which enables communication that is both written and asynchronous and, therefore, thought out and documented.
  - Electronic messaging as a synchronous contact system, which enables immediate and continuous customised supervision and attention.
  - Videoconferencing, for debating and clarifying doubts of a general nature and resolving shared questions.
4. **Assessment**

Assessment is an accumulative process within which all of the details related with the development of the activity have been taken into account. It goes without saying that the key elements of the proc-

ess are the exercises that have been explicitly proposed to the students, with these being complemented by the completion of questionnaires, the realisation of exercises related with theoretical approaches and a final assignment that provides an overall answer to the entire learning activity.

All students were personally informed of their assessment results together with all corresponding comments and observations via e-mail.

### 3. - Conclusions

Our experience as regards using these E-Learning scenarios has shown us that the three aforementioned formats are capable of transmitting a comprehensive content to an audience with a certain guarantee of success, especially when we bear in mind the aspects, both of a technical nature and those with respect to the methodological design, that we are dealing with in this document.

The first scenario is used whenever it is impossible to connect up with the remote centres for reasons of timetable incompatibility, lack of equipment or the incompatibility of the equipment used by the main distance-learning centre and that of the remote centre or even if the methodological design is not considered as being important and priority is given to the documents published on the web, which can be worked on and added to in-situ.

The second scenario is the one that shows itself to be the most fragile as a learning program model, especially if it is not accompanied by a strategy that includes the use of other media and resources. It comes into its own in situations where direct communication and debate are more important factors than the retention of a number of specific contents that meet certain learning objectives.

Nevertheless, we have developed a number of learning projects in the field of Languages of Speciality, which are included as an interdisciplinary subject in the engineering programs using videoconference. The results are proven that:

- Videoconference allows “real communication” in the language, which is the study subject.
- Short seminars in language topics can be really successful, using both in a one-point or a multi-point videoconferencing platform.
- Bilingual and multilingual conversations via videoconference can help the oral skills improvement and assessment.
- Virtual mobility can be enhanced via the videoconference programs.

Several of these experiences coordinated and implemented at Universidad Politécnica de Madrid may illustrate the videoconference benefits.

It is obvious that the third model that we dealt with, namely that which includes the other two, is the one that has proved to be the most efficient, more so, in some cases, than in-situ teaching situations. Specifically speaking, with regard to postgraduate activities where the control demands are much stricter due to the fact that it is a distance-learning program. Whereas during in-situ teaching situations students limit themselves to *paying attention* to the lecturer’s explanations, with this system they have no choice but to participate in and develop all the activities and exercises laid down by the methodological design.

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