Chapter 9
Technological options: guides inside the NICTs' labyrinth

Let us make a "small" preliminary list of formats, means and technologies:

- Whiteboards, easels, transparencies, slides, projects for computers…
- Different texts: printed, photocopied, sent by e-mail, published on the Internet, hypertext...
- Audio and video, cassettes, CDs, DVDs, the Internet, compression, streaming.[1]
- Video and computer animations.
- Simulation devices, graphic simulations for computer.
- Written press, radio, television, Internet press, radio and television.
- Basic phone service, cell phone service, Internet phone service.
- Multimedia CD (texts, video, audio, animations, exercises), hypermedia.
- Tele and videoconference, uni- and bi-directional, bi- or multipoint, by telephone line, satellite or the Internet.
- Computer-mediated communications (CMC): e-mail, distribution lists, chats, video-conferencing, news groups, collaboration software.
- Computer-based learning, self-learning software, tools for network cooperative learning.
- Copyright software to produce courses and contents, to manage courses, to manage courses and contents (LMS and LCMS).[2]

Which of them do you know and are you familiar with? Which others do you know?

1 Technology that allows to play (though not to burn) audio or video without the need to download the whole file in advance; it downloads in batches.

2 *Learning Management System* and *Learning and Content Management System*.

Maybe by the time I write this and it reaches you, new technologies will have appeared or variations to them. In many cases the "new" stuff has mainly to do with the technological support that is used and not with the language or the format. Images in motion, whether in a celluloid, television, magnetic video or digital film, have many aspects in common, but they change the possibilities of production, distribution and use. A good part of IT and the Internet development has been based on text. And the hypertext retakes and largely multiplies the notes and reference systems of the traditional text.

In view of all that variety, I do not intend to talk about each technology and its characteristics. What I will try to do is to offer criteria to guide oneself in this technological labyrinth and take some rather sensible decisions. I trust that you will include a specialist on these technologies in your team.

Assessing technologies

When should we decide what technologies to use? As I see it, the general rule is the following: the decision about technologies should be based on pedagogical design and not the other way around. I already tried to show in Chapter 5 this prevalence of the pedagogical core within the design of a course.

It could be said so that the technological decision comes after the pedagogical concerns, and to some extent it works like that. However, as I also mentioned in Chapter 5, the available technological possibilities in each case open and close doors which, even if they do not change central pedagogical options, they can affect or bolster working methods and expressive and communication possibilities.

For example: having a good system of forums and tools of collaborative work will facilitate an already taken decision for a course which intends to promote interactions and group work. The unavailability of these tools does not prevent us from doing it anyway, by looking for "homemade" alternatives. For example, making "forums" with mailing lists. It will not be so easy, however, to include videos if we do not have enough resources. We may be able to include short and very simple videos made with a home camcorder and even with a Web cam. But something more complex requires other technological resources and experts to handle them.

What should not occur is that technological "solutions" turn into pedagogical problems. For example: many development programmes and course administrations plan a main assessment methodology –and sometimes the only one–: multiple choice questionnaires. As I have already said in Chapter 6, they have some important limitations as assessment tools. And the way in which we assess also affects the rest of the pedagogical options. It seems that many of these programmes have been originally thought from a behaviourist pedagogical perspective. Although it is possible to use them from a critical-constructivist perspective, for example, we should not be "taken by" its pedagogical "suggestions" without much thinking.

But what do we mean by "available" technology? It implies at least evaluating the following aspects:

- *Is it within our reach to obtain it and pay for it?* I mean the initial decision but also maintenance, updating and renewal, which may result in significant expenses.
- *Is it within our reach to use it?* For example: it is not enough to have equipment for video recording and editing if there will be no one that knows how to handle them well or money to pay for the work hours implied in producing good videos. This is one of the reasons why many educational institutions tend to be technological cemeteries of equipment that was once bought and almost never used.
- *Is it within the reach of our potential students?* Do they have, for example, an appropriate computer and DVD player to view and use the materials we are going to send? And the minimum training to use the computer? And the money to afford connection time? Or the time and money to travel to the videoconference room? And if thousands of students enrol, do we have servers that can bear thousands of simultaneous logins? Or will the "available" technology stop being really available the day courses begin because everything "breaks down" or "freezes"? Or will everything work properly but no one will be able to afford it?

If our answer to these three issues is 'yes', then we can say that the technology is available. This does not, however, guarantee that it is appropriate –or the most appropriate one– for the course or courses we have planned to run. Therefore, it will be useful to check a larger list, like the one suggested by Bates (1995, 2001) with the acronym *ACTIONS*, which introduces the following criteria to bear in mind:

- *Access*. It refers to what I have said before, though Bates places the emphasis on the student and on flexibility. How well does technology adapt to the different target groups?
- *Costs*. In part, I also mentioned this before and I will go back to it in the following chapter. Maintenance costs and particularly the cost of using them –whose main component is human work– tend to be higher than the initial cost of purchase. The main thing would be to compare the cost per student.
- *Teaching and learning*. Pedagogical problems are crucial. If some technology does not actually help in a concrete educational situation or if its contribution is similar to that of another kind of technology, we shall consider that other alternative.
- *Interactivity and user-friendliness.* How easy is this technology for students and teaches to use? What interaction possibilities between them does it offer?
- *Organisational issues.* What changes in the organisation of the institution and work are implied in adopting this technology to be able to use it successfully? What barriers do we need to remove? For example: who will be benefited from and who will not by its adoption? What extra efforts will it imply for everyone?
- *Novelty*. To what extent is this technology new? Is it reliable and stable? Has it been tested enough before having it massively spread? What previous student and teacher training does it require?
- *Speed*. How fast can courses be produced and run? How fast can materials be changed?

Faced with this group of criteria, all technologies will show both advantages and disadvantages, strong and weak points. A list should be made for each case and situation. That is, for each course and each type of student.

For example, we suggest you to try it with some specific case, giving a score according to the extent to which a certain technology that you wish to assess complies with each criteria.

	0	1	2	3
A				
C				
T				
I				
O				
N				
S				

0. Inaccurate, insufficient… 1. Satisfactory, fair...
2. Appropriate, good... 3. Very appropriate, very good...

Primarily, the technology that obtains the highest score for that case will be the best one. But a 0 in some of these criteria should worry us. How worthy is an almost excellent technology that is inaccessible? Or what is the use of having a technology that scores well in all categories but that is inappropriate from the pedagogical point of view?

As we will hardly ever find a technology that solves everything in the best way, in general we should *combine* more than one technology in order to solve the educational needs established.

Of course there are advantages in adopting *a certain* technology which more or less complies with all criteria. If the team or the institutions manage to master that technology they will be able to achieve satisfactory results for very different situations. It can be better then to make some efforts to guarantee that everyone –institution, students and teachers– can adapt to it.

Many think that IT-based and Internet-based technologies have enough flexibility to work well in any situation. As it is shown by our initial list, means and formats increasingly tend to be directed to telematics and they are able to bear and transfer sound, image, texts, animations and simulations. Others –I include myself here– think that this is true only to some extent, since the statement is too general.[3] Among other reasons because there is no *single* telematic technology but many other options. The fact that they all use computers and the Internet does not mean they are the same thing.

In the technological *mix*, we should not forget some "technology": the traditional face-to-face educational work. Interpersonal dialogue is still some "tech-

3 Cfr. Aparici, 2004; Fernández Díez, 2001; Huergo, 2000; Kaplún, 2000, 2001a and b; Lacerda, 2005.

nology" that is not easy to surpass in many senses. It can even fill a larger portion of the total duration of courses compared to other technologies.[4] Face-to-face sessions and group work, with or without a teacher, are very powerful teaching tools. Sometimes students are the ones who remind us of that:

> "(During a) a distance learning (experience) which was strongly based on the use of the Internet, teachers noticed the highly positive impact caused by two facts that had not been originally planned in methodological design. The first one: that students preferred to go to the computer room at the same time, thus several exchanges took place among them, instead of having them coming at the time of their choice, as it was first thought. In fact, they were trying to recover the sense of group which the course design had left out. The second fact that caught our attention was that they asked for a new "technological" support inside the room: a table. From then on, around a table, the group ended up being a group as such. This may explain, in the same way or even more, the "new" technologies used, the academic success of this group, which obtained better academic results than classroom courses, where group interactions tend to be poorer... (Kaplún, 2001b)

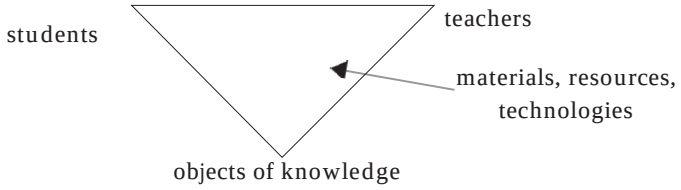
Texts, images and vocational training

I will not be able to assess each and every technology I mentioned according to this list of criteria. I would like to insist, though, on one aspect which I consider important for vocational training.

During educational processes, educators, learners and objects of knowledge meet. The educator aims at helping the learner to approach, discover, know and construct such object. In DL teaching materials, resources and technologies play a major role in this process of approach and construction.

In so-called e-learning, much of the material development is based on texts. The texts are published and digitally distributed, but they are texts anyway. Text is, no doubt, a very powerful language. It allows to deal with the most diverse topics by combining abstract concepts with a big deal of information. Their pro-

4 As it happens, for example, in SENAI-SC's postgraduate courses. Brazil has, in addition, legal regulations and quality indicators for DL which give significant important to this face-to-face component. (Cfr. SENAC, 2002; Tori, 2002).



duction may require great intellectual effort but not necessarily big production equipment or complex technology. A single person can produce an excellent text with paper and a pen. If they have a computer with a word processor, then much better. Training to write has been widely spread: there are many people who are capable of writing relatively well. This works like that according to the teacher angle of the triangle.

But if we have a look at the other two angles of the triangle, in the case of vocational training, there appear other aspects to bear in mind. On the one hand, there are several objects of knowledge that are linked to hand work processes and whose learning is difficult and sometimes impossible to achieve by reading a text. It is necessary to see them and experience them. A text can be very useful if it includes good illustrations. And if it is necessary to view some piece in movement and a delicate operation, then it is better to watch it on a video. And to experiment there is nothing better than a simulation…or a workshop.

To make a video or a simulation it is usually necessary to have pretty complex technological and human teams and more working hours than a text. Downloading a video from the Internet is very difficult to do without a broadband (even if you have it, it can take some time). It is possible that CDs or video cassettes have to be sent… or work should be done at a workshop.

On the other hand, vocational training students, particularly at basic levels, tend to find it hard to understand texts. They usually need to build a permanent bridge between abstract concepts and experience (cfr. De Moura Castro, 1984). For a text to achieve this –even for a video to achieve it– a careful pedagogical and communication work must be done (See Chapter 5). This turns material production into a more complex and expensive task.

On the other hand, it is not so certain that text production will be easy for teachers. Many excellent teachers, experts in their subject and in how to transmit it, find it difficult to share their knowledge through a text (cfr. Barato, 2004). Other experts are more willing to write, but the type of texts they produce are not so useful for students because they are too abstracts and theoretical.

All this adds specific pedagogical and production concerns to the difficulties in the access and in e-learning –at least text-based e-learning– in vocational training. This does not leave it aside in the least. But it forces to limit its relevance to certain objects of knowledge and certain kind of students. And, above all, combine it with other working methodologies and technologies.

How many and how good are the printed texts your institution uses in face-to-face teaching?
How are they assessed by students?

They can be good indicators to think about what is going to happen with your e-texts…

Technological models and educational delivery methods

Although the ideal technological mix should adapt to each particular case, it is advisable to visualise some of the typical models that have been developed historically and some of the most popular ones at present. In general, each model links some technologies with certain educational methodologies.

1. Self-study materials and tutorials.. They began as "correspondence courses" with printed materials. They may include other support materials, for example, to do manual work and exercises. Language courses include audio materials recorded on cassette or discs. Higher courses mainly have a selection of texts and study handbooks. Tutorials used to be done by mail or phone, and recently by e-mail. In many cases, there are also face-to-face tutorials, which may become something very similar to traditional classes, in a group with all the students of a course.[5] Assessment usually requires attendance.

Many current experiences still follow this model though materials may include videos, audio or multimedia CDs, apart from printed ones. The student receives them or picks them up from the educational centre –in a single package or several– and works with them. Sometimes work can be done in small groups.

5 It is the case, for example, of the Universidad Nacional de Educación a Distancia (UNED) of Spain, where students usually have tutorials every night which have a high attendance rate.

Tutors may be asked in person or else group work sessions are organised. In this case, sessions can be more than just "consultancy" and optional instances; they can be spaces for compulsory work that cannot be substituted by the materials. Some other times, exchange among participants is mainly done through the Internet.[6]

It could even be said that computer-programmed instruction is not that different. Material is already packed and the student works with it. The difference is that it offers the possibility of interacting with the material, according to various itineraries planned with more or less sophistication. From a tutorial to handle some IT software, to an "intelligent" course about a scientific topic, the essential model is the student who works alone with the material; then other interactions with peer students and teachers are added.

This type of model may be summarised in the following way:

1. Self-study materials plus tutorials.

Self-study materials (printed, audio, audiovisual, multimedia)
Individual work (and eventually group work)
Individual or group tutorials and / or
Face-to-face sessions and / or
Exchanges through the Internet (e-mails, forums, chats)
Assessment (usually face-to-face)

2-3. Radio schools and Television schools, educational radio and TV. First the radio and then television created great expectations regarding the potentialities of these means to educate large portions of populations who had difficulties to access educational centres. It was soon seen that they were not enough by themselves, it was necessary to add some readers and tutorials. Some experiences formed study groups. Many felt the need to go beyond the scheme of traditional "lessons" taught by radio or television in order to adapt better to the formats of both means, with documentary, journalistic and fiction resources. All of this rised costs and implied using mass media for very specific audiences. If programmes were not shown during prime time then they could not, in turn, adapt to the learners.

6 For example, the course on Distance Learning by SENAC (2002) or the one on Customer Service by INA (2004).

Many of these experiences were reconverted and became radio stations or educational programmes in a broad sense, but leaving behind radio or television courses. All or part of programming can have an educational sense, reaching a wide scope of social, scientific, cultural, environmental topics, among others, in very creative ways. This is something they have to do if they do not want to be doomed to the destination of educational programming, which is regarded as didactic but boring. They do not intend to make a methodical follow-up of curricula, assessments or accreditations. But there could be group work triggered by such programmes, phone dialogues with the audience, etc.[7]

Cable TV –and probably digital radio and TV in the future–,[8] which allows to divide audience even more, opens new experiences in terms of distance telecourses that are more similar to the original ones. In some cases tutorials and other support materials are reincorporated, by making use of the Internet, for example.

Another option which has been used by several educational institutions is to distribute some of their materials through the written press. They are usually self-study readers, that are relatively similar to the ones mentioned in the previous model.[9] Those who wish to have a course certification must pass a face-to-face assessment. Sometimes readers are compiled in books that may still be used after a mass dissemination period. Assessments here usually require attendance. Sometimes this is the only physical contact of the student with the educational institution.

7 The radio programme Sintonía SESC-SENAC, which is broadcast in all Brazil, has adopted some of these characteristics. It is complemented with readers to take better advantage of them (SENAC, 2004). And STV, the SESC-SENAC television network –"the channel of education and citizenship"– has a cultural and educational programming in a broad sense; it does not include distance learning courses, as such (see www.redestv.com.br). There are, however, private companies, such as Futura channel in Brazil and Formar in Argentina (which is exported to several Latin American countries) which include tele-resources that are supplemented with materials such as CDs or materials published on paper or on the Internet. We did not find this kind of experiences nowadays in the institutions we visited.

8 Depending on the technological model adopted or developed in each country, digital TV can also promote interactivity and Internet access, in a similar way to computers, with significant advantages in terms of costs and utility. Brazil is making an important bet on creating their own technological model, which will probably be shared with other Latin American countries, and thus be an interesting one (cfr. Barbosa and Castro, 2005).

9 This is how it was done, for example, by SENA in Colombia and SENAI-SC, with topics such as marketing, sales, etc.

We have then two main models:

2. Radio and telecourses, written press courses
Radio and telecourses (+ readers)
(or only readers distributed by the written press)
Individual work (and / or group work)
(Sometimes: tutorials by phone, in person or through the Internet)
Face-to-face assessments

3. Educational TV and radio
Educational programming in a broad sense.
Educational radio and telemagazines, educational soap operas, etc.
(There can be group work and dialogue with the audience)
(There are no assessments or certifications)

4-5. Tele and videoconference. At first they used to be conferences that were broadcast in a TV close circuit from the original place to one or several locations. Then there appeared various interaction possibilities between the audience and the place of origin, whether by phone, fax or television. In this last case, the scheme of "conference" can be broken and, although there is an operational centre that coordinates logins and logouts, an active interchange can be generated between several groups.

We can talk about two types of main models.[10] On the one hand, *teleconference*: usually massive events that reach a large number of conference rooms simultaneously and where the audience can ask some questions or express their opinions by phone, fax or the Internet, but interventions are centred on the conference lecturer or the central panel (cfr. SENAC, 2004d).

On the other hand, *videoconferences*, which often limit exchanges to only a few points (often not more than five or six) in order to guarantee an appropriate interaction among all of them. In this case, everybody can be seen and heard, several groups can be seen on screen or attention could be placed on one. There is a general view of all the groups or of one participant who intervenes, thanks to cameras placed in each connected location, with a voice tracking device. At least

10 Actually, the literature on this subject mentions these two methods in different ways and often interchangeably. I use here one of the terminology used to distinguish them.

up to now, the image is not entirely clear and there is some delay between issuance and reception which makes dialogue not entirely comfortable.

Similar systems are beginning to be spread through the Internet. They require a broadband connection and they have a limited amount of spots connected in order to assure good interaction.

In any case, when it comes to videoconferences, the degree of interaction depends a lot on the pedagogical design. It can be reduced to questions made by the students to the teacher or a more active exchange can be created. An element that promotes such exchanges is the presence of coordinators or tutors in each location and some group work done prior or after the connection.

Teleconferences seem to be used by vocational training institutions, whether for some big public events or internal training cycles (cfr. SENAC, 2004d). It is possible, though, to think of a complete course where *videoconferences* are the main technology used and they are combined with printed or Internet support materials, sending of work and comments via Internet and group work developed in each connected location, either in a large or in a small group.[11]

Tele or videoconferences may also be part of any of the other methods. For example, for a round table with some special guests or a regular exchange among groups. Internet videoconferences can also be an interaction method among the members of a single group. It can be very useful in corporate training programmes of enterprises or institutions whose offices are far away from each other.

At first, an advantage these technologies have is that they do not require extensive material preparation in advance: a lesson for a course can be prepared in a relatively similar way to a traditional lesson. But we should be careful about certain aspects in order for it to work properly and encourage genuine exchanges.

Assessment can be face-to-face, it can be done through work sent to the central team or handed in to local tutorials.

Leaving aside the possible use of other models, we could summarise these last two as follows:

4. Teleconference
Conferences broadcast to multiple rooms.
Questions and comments sent via fax, phone or the Internet.

11 We did not find this kind of experiences in the institutions we visited. Personally, I had to work with one at the University of the Republic (Uruguay). See www.relabor.fder.edu.uy .

5. Course with videoconference
Videoconference lessons, where students in different rooms interact through the same channel.
Printed or Internet support materials.
Local tutorial or coordination.
(Group work done before and / or after the connection)
Individual and group work.
(Student and teacher exchanges through e-mails or forums)

6-7. Internet at the centre: e-learning at last

Because of its flexibility, Internet adapts easily to several work methods, but we can also distinguish some predominant models so far. On the one hand, what we can call "pure" e-learning; on the other, there are multiple combinations that receive the name of blended learning since they are mixed or they combine several technologies and particularly distance work with face-to-face meetings.

In the first case, both materials and interactions among participants exclusively take place through the Internet. Individual or group work also require to be connected.

Work and interactions can be synchronous, asynchronous or more frequently, a combination of the two. Therefore, e-mail and forum systems are used (asynchronous) as well as chats and videoconferences (synchronous), mail, especially for posing queries to the teacher or exchanging information with another student or group of students, forums for general interaction, in the same way as chats and videoconferences, though these two can be used also for individual tutorials. There are several studies and opinions about the cases in which it is convenient to use synchronous or asynchronous tools. The general criterion is that asynchronous tools require more work but encourage more reflection and do not force us to combine timetables and vice versa.

Among the materials we can find are readings and activities. These can be exercises, self-assessment or external assessment questions, text composition, problem-solving activities, etc., depending on the content and the pedagogical approach of the course. They may include tasks to be done individually by students away from the computer: some research, manual practical work, etc.

We could include here self-taught courses without tutorials and only through computer interactions: tutorial programmes, texts with automated self-assess-

ment, etc. It could be said that the fact that a course is on the Internet does not make it different from the ones that are delivered on a CD and are installed in the PC, which we mentioned in model 1.

Together with "all online" methods, the use of the Internet is increasingly being combined with other means of material distribution, other student work methods and other forms of group interaction.

The first aspect, materials distribution, can make use of CDs, video cassettes, printed material, etc. as substitute or additional materials. This can avoid the problems of "downloading" heavy files and the transfer of printing costs to the user. Several contents can be dealt with during face-to-face sessions or through videoconferences.

Student work can also be focused on or supplemented by computer activities without Internet connection, that are then sent. There can be group work with students getting together physically or virtually. This is a particularly enriching delivery method that should not be excluded when working on projects. Although some exchanges among the members of a team can be made at a distance, it seems necessary that some contact takes place face-to-face. In several areas of vocational training, doing workshops is an essential component.

For exchanges with tutors, the telephone can be used together with personal consultations. For general group exchanges, face-to-face sessions are advisable. When a group works online but in the same place –a computer room– it is possible and desirable to have exchange spaces and collective work there (like in the example of the table above).

In general, distance learning systems have increasingly recovered face-to-face spaces. The advent of the Internet had made them look unnecessary after having a means with dialogue possibilities at a distance and among many speakers. However, everything shows that personal contact is very useful whenever possible.

Therefore, we can visualise two types of models:

6. Pure e-learning
Materials available on the Internet
Online individual work
Consultation to tutors by e-mail or chat
Group exchanges in forums, chats or Internet videoconference
Self-assessments and online assessments

7. Mixed Internet systems + other technologies
(Blended learning or e-learning+)[12]
Materials on the Internet and / or physical means (CDs, videos, print)
Distance individual or group work and face-to-face sessions (classroom, workshop, group projects)
Consultation to tutors by e-mail, chat, telephone or in person
Online or face-to-face group exchanges
Online and / or face-to-face assessments

This last model goes along the lines of what some call "no distance education" (Giusta and Franco, 2003).

It is highly possible to find delivery methods that can be combined with some of these (7). The presentation of these broad types helps to the effects of a combined evaluation of an *ACTIONS* sort, not only for one technology but for a technological model, a certain combination of technologies already tested on DL.

Models 3 and 4 are not applicable to vocational training in a strict sense, at least if we think about courses that can be assessed and certified. Model 6 does not seem very popular, at least in terms of basic vocational training: a minimum of work done in a classroom or workshop seem to be necessary. It is not yet clear either the more powerful return of radio and telecourses (model 2) which will probably depend on the development of digital radio and TV. In my opinion, the main technological options for distance vocational training in the short term are:

- Self-study materials with tutorials (and classroom, workshop and group work, etc.)
- Courses with videoconference (plus group work in each location).
- E-learning + classroom and workshop work, group projects, etc. (no distance education).

12 According to some authors, blended learning refers exclusively to the combination of e-learning and face-to-face lessons; others refer to blends between the use of the Internet and other technologies. I use 'e-learning +' here provisionally to refer to both things at the same time. Coming back to what I stated in Chapter 1, it could be said that a more accurate name, though too wordy, would be "distance and blended learning courses with the use of telematic and other ICT tools".

The second option does not appear to be reaching great development, may be due to the relatively high costs of the initial investment, the need to gather groups in particular places or times or greater promotion –cultural and commercial– of other technologies. However, I think it is a model worth taking into account, either alone or combined with some of the others. Several countries have public videoconference rooms that can be rented –at a reasonable cost for time spent and having a location connected–, so they may allow to start testing this model without making a private investment.

The first model is much more up-to-date than one would think, despite the advance of the so-called e-learning. Many institutions continue and will go on using it because it provides good solutions to concrete educational needs and situations. But everything shows that it will be increasingly combined with what we could call "e-learning +". Or, better said, the technological blend will include NICTs and other old ones which have proved their efficiency throughout time.

And what will certainly go on happening is the incorporation of NICTs to traditional face-to-face teaching, thus extending the access to materials and communication possibilities among actors in the educational system.

Finally, I would like to stress, once more, that one technology can be used with very different pedagogical approaches (See Chapter 3).

What are the most widely used models in your country nowadays? And in vocational training?
Have any previous models been left aside? Why?
What results have these changes brought?

NICTs for DL: assembling the puzzle[13]

A problem faced by institutions which embark on DL with NICTs –the so-called e-learning– is that they tend to add one tool after the other. They regard them as necessary but were not planned from the beginning. And later on they discover that it is hard to articulate them, that they are doing a work that is too artisan and annoying that could have been done better with a platform that integrates all of them. Or they chose a platform without being too familiar with its requirements and then they were faced with limitations or problems they had not expected.

Offering DL through NICTs implies carrying out a series of activities that are sometimes developed in a sequential way and sometimes in parallel. This set of activities can be grouped in three big areas:

- material development (design and production);
- course running (access to materials, activities for teachers and students);
- management (of courses, enrolments, certifications, materials, teachers).

Materials development and administrative management seem to be more frequent inside VTIs; whereas offering a DL course through electronic means appears to be a novelty and can create doubts and fears.

All these activities have technological requirements that institutions in general have never taken into account or are discovering at the time of beginning their DL experiences. To visualise them we are going to deal with three great areas of activities and identify and discuss the technological requirements and strategic decisions that will be faced by the institutions. On the other hand, each decision influences the others: choosing a technology for an activity affects the technological choices for the other activities.

Materials development

- IT tools

Authorware They are tools to develop teaching materials. The components of this group range from a word processor to animations development software.

13 The elaboration of this point was made by Eng. Rodrigo Filgueira, from Cinterfor / ILO, whose precious contributions I truly appreciate. I have just made some adjustments to his original text.

Teaching resources database.[14] In order not to "reinvent the wheel" it is worth having a system that describes and allows to reuse already existing educational materials. From animations about the water cycle to tutorials already validated for the use of simulators or "good" games of questions or exercises already used in the past.

Collaboration tools. Some development achieved by a multidisciplinary team, where it is also possible that some part is outsourced and it is advisable to use pre-existing resources, produces many files and versions of the same files. If we also think about teams that are not always integrated by the same kind of people and processes that can take many months, the situation is even worse. The solution is to incorporate new tools that allow a centralised management of the material produced and the software to manage versions. There are several options, whether owned, such as the open code, bought or free.

- Strategic decisions

The *tools used to develop materials* can be produced by different companies. There are two possible strategies to follow here. The first one, selecting the best tool each company offers for each function. For example, the software used for graphics can be bought from company A, the one to handle text from company B and the one for animations from company C. In this case we sacrifice the interoperability ability among applications: materials produced by one of them may not work well or be combined with those produced by another one. The second option is to "marry" a supplier, intending to achieve interoperability and sacrificing quality in some software or area.

Teaching resources databases can be made by adapting already existing applications with open source, acquiring knowledge management systems or making some development –our own or an outsourced one– that is adjusted to the institution's specific needs. This last option is highly recommended. The institution should at least carry out the exercise of analysis in order to understand what

14 See the already mentioned example of SENAI-SC (2004a). They are useful resources, both for DL and face-to-face classroom work. We do not refer here to "Learning Objects" databases, which are the basis of a methodology for the quick development of materials. It implies a significant institutional investment in people and technology that is not justified at the beginning of these processes. LCMS are very useful and also expensive tools to solve this problem. They are more than a database since they allow to develop materials and structure courses. Their use requires great planning and anticipating ability, as well as understanding and applying learning objects technology.

are or could be its requirements in this area. Descriptive elements that allow to correlate the material with the curriculum or the structure of courses can be very practical to avoid having a big database of resources that no one uses.

Regarding *collaboration tools*, teams should have to be trained in their use and overcome some of the cultural resistance since they demand more discipline and a little more "administrative" work.

To outsource or not to outsource. Variables that influence this decision are many and some of them have already been presented in other chapters. But it is worth insisting on the fact that any institution that aims at becoming more involved in this subject in the long term should have to learn on the way. Although outsourcing does not incorporate the "know how" in detail, it can be defined in such a way that this learning takes place effectively and dependence is not created with regards to the company hired.

Another interesting point is defining the copyright of the product developed in the most convenient way for the VTI. With respect to this issue, it is advisable to specify:

- Copyright of the material developed or –in the case of having software– the ownership of the code and the minimum accepted documentation levels.
- Selection of technology or technological line, not allowing companies to use tools only as a means to guarantee that they are essential. It is worth specifying aspects such as the following: use of tools that the VTI knows, tools with many years in the market (so that it is not difficult to find human resources), tools with a large community of users, if possible.
- High levels of interaction between the company and the managers and technicians of the VTI. This allows to make regular assessments of the development, to suggest changes and new paths, to follow the process closely and to learn about the difficulties that can be encountered.
- Specify guarantee period. Technological solutions tend to have mistakes that need to be corrected. It is worth establishing both the VTI's support and tolerance when faced with frequent errors and failures.

Type of material to be developed, from printed material to simulations or virtual reality. If the technological decision is dependent on the pedagogical objective, we cannot establish a close relationship between a material's complexity

and the type of course. Primarily, materials for DL course that seek to develop mainstream competencies require less effort and investment than distance courses on automobile mechanics or CNC turning. It is clear though that if we decide to develop a role simulator for a course on ethics or sales, the cost and effort can be too much.

Standard-based development: SCORM? If a course is developed according to a SCORM standard,[15] it can be transferred to any LMS platform that is compatible with SCORM. This offers independence from the LMS and LCMS supplier (a topic we will soon deal with). But to embark on SCORM-based courses, it is necessary to make efforts and investments that can be excessive if we are taking the first steps in this activity.

Running a course

- IT and telecommunication tools

  Software

  - *E-mail* for person-to-person communication or mailing list discussion.
  - *Chat systems*: online synchronous communication. General content is not kept.
  - *Forum systems:* online asynchronous communication. It offers more meditated interaction than the chat. The content usually remains available to the rest of the participants.
  - Videoconference systems through telephone lines or the Internet: real time face-to-face communication.
  - *Teaching resources database.* The selected materials for the course and some similar ones must be available to adjust the course to the tutor's or the student's needs.
  - *Collaboration tools* to carry out work with groups of students.
  - *Tools to follow-up* students (access to materials, academic performance, etc.) and the monitoring of tutors by coordinators.

15 Sharable Content Object Reference Model.

Hardware

- *Telecommunication servers and equipment.* This equipment is usually available inside the organisation for pilot experiences or those having a small number of students; no investment is usually needed. But if the intention is to cater for large populations, then it will be necessary to establish services to fulfill these functions: servers with software to balance load and broadband reserve for course-related traffic. This will also be necessary if the idea is to have a lot of videoconferences through the Internet.
- *ISDN videoconference equipment.*[16] If the videoconference is not done through the Internet, the ISDN lines need to be installed at local and regional units as well as ISDN videoconferencing equipment.

• Strategic decisions

Computing and telecommunications centre. Computing and telecommunication departments should be involved from the start. In this way, they will be able to assess which amount of work is expected and if it will be possible to handle it with the available resources. It does not seem advisable to have a parallel computing centre since the 'know how to accumulate', by launching this activity, should be taken advantage of also from the computing centre.

LMS or the sum of services. It is often the case that the technological tools required to offer DL with NICTs are already available in the VTI, as a sum of independent tools that are disconnected at the IT level. This situation will have to change in the medium-term, by incorporating a LMS or a LCMS since maintaining a sum of isolated services demands too much "manual" work and confusion to participants and makes the process more prone to mistakes. We will come back to this issue later on.

Outsourcing. The option of hiring connection services, software and servers is tempting since it takes pressure away from already existing computing centres and it allows to place responsibility on a supplier who can be required to comply. This is even harder when the means is internal, and if the service is new and had never been considered within the plans of the computing centre itself

16 "Integrated Services Digital Network" that allow to transmit data, audio and static and moving images through a single means.

(we can be faced with answers such as "we are doing our best"). But hiring external services increases in price as the enrolment of participants grows. So if it gets too expensive, the VTI will have to consider offering these services with their own staff.

Buying LMS systems or developing our own. Buying large-scale LMS can be expensive and only seems to be justified once a DL programme with NICTs has been consolidated as an institutional decision and/or when the intention is to achieve a high number of enrolments. Having our own development or outsourced one according to our needs seems to be interesting but it requires having a permanent staff of people making improvements and maintenance or keeping a strong dependence relationship with the developing company. A third alternative, which is less expensive and provides strong back-up, is adapting already *tested open source tools*. We will come back to this topic later on.

Educational management

- IT tools

  Management systems that are similar to the ones available at VTIs but which have extra functions:

  - Allowing online enrolment and, perhaps online payment.
  - Managing marks and assessment of students online.
  - Online supervision of geographically distributed tutors.
  - Materials and group management. Cases where the material is distributed in batches –which do not always have the same size– to different centres or students' addresses should be planned.
  - This system must be interoperative with the usual administrative system and the LMS that is currently being used. It will be necessarily developed by the VTI since the administrative needs of each of them are not interchangeable.

A telecommunication network that integrates local and regional units with central units. Local management systems must be able to interoperate in some way with central management systems.

- Strategic decisions

Integrating these new characteristics to pre-existing systems. There are two options: developing a system that is independent from "passed on" systems or opening up the possibilities of existing systems. The first option is easier to develop since it does not require considering any existing technological restriction, but it should simultaneously develop some communication mechanism between the passed on system and the new one. As a result, this connection will not take place in real time and data will be strongly marked by "manual" activity, which makes it more prone to the appearance of mistakes. The second option provides a system that is more integrated but which tends to be more complicated since passed on administration systems were in general developed time ago and with no Web-oriented technology. They are solid systems that are not frequently modified and it is possible that the people who developed them are no longer available. In addition, in the same way as in football, "if the team is winning, then we do not change the players". Another justified resistance can come from the fact that some of the characteristics that wish to be added do not correspond to the original function of the existing management systems. In general, we will find the way to apply the first option and develop clear interfaces and accurate processes to connect both systems.

Interoperability between the educational administration and the LMS. In the case of buying an LMS it is advisable that the data required by our management system can be extracted from the LMS. If we develop our own LMS or an outsourced one, we will not have major problems to integrate data sources as we are the ones to establish requirements. In the case of being adapting an open source LMS, it will be simple to incorporate a module to communicate the LMS with our management application.

Which were the strategic decisions your institution made in terms of technology to develop materials, run courses and manage education? How do you evaluate them? Could better decisions have been taken?

Educational platforms

It is worth considering more in detail this tool or group of integrated tools called LMS and LCMS. If an institution has taken the firm decision to embark on e-learning, it is likely that sooner or later it will end up choosing or creating a platform of an LMS or LCMS sort.

Creating our own can be extremely expensive and is only justified if we have available human resources to handle it and if it is taken as a research and development area.[17] The time taken for testing and correcting failures or problems until the platform is mature enough can make this path even more dangerous. Ordering one can be a good alternative to ensure it meets exactly our requirements, but it can also be an immature product and can leave us tied up to the supplier if the necessary provisions are not made, like assuring training and the subsequent ownership of the software's source.

It may be interesting in the future to think about some collective work in this area among VTIs in order to obtain a product that adapts better to their needs. The potential customers and the community of users that the platform will have may be the justification.

But, in the meantime, in order to choose a platform, it will be necessary to compare some of the available ones, according to the specific requirements of the institution, the type of course and the pedagogical approach and characteristics offered by each of them.[18]

In general, different platforms offer:

- Content management, edition and file management.
- Students register. Users database.
- Different access levels for managers, teachers and students.
- E-mail, forums and chats management. Some offer videoconference management.
- Notices, organiser for pending tasks.

17 It is the case of the Centro de Tecnologia em Automação e Informática of SENAI-SC in Florianopolis, which we visited for the purpose of this work. The experience can be followed by other VTIs.

18 I use here some of the ideas suggested by Eduardo Fernández and other members of the Computing Institute of the Engineering School of the University of the Republic (Uruguay), who have been working on this subject for a long time and have shared it with the University's IT and Educational Network. Cfr also Fontela (2003).

- Management of assessments and self-assessments (closed, open, of automated and manual correction, compulsory or optional, repeatable or not, etc.).
- Access statistics (logins and connection times).

Some also offer:

- Tools for group work (collaboration software, group portfolios, etc.). This is particularly important if group work is part of the pedagogical approach.
- Content downloading to work offline. This is helpful when connection costs are too high for students. In general, in this case the access time statistics are lost.
- Possibility to customise each course according to the needs of each user. This allows, at least in part, to avoid the rigidity teachers and students usually complain about.
- Use of international standards (such as *SCORM*), which allow to transfer everything or part of a course to other platforms. This can be useful to share experiences and work with others and when there are already existing platforms.

Other three aspects to bear in mind:

- Owned or free software. The first option may offer more back-up and maintenance guarantees, the second one, saves money and gives access to the source to modify and adapt characteristics of the software.
- Community of users. The larger this community and the more active it is, the more chances there will be of solving problems and improving the product.
- Scalability. It is the possibility of expanding the number of users without the risk of "breakdown". This is particularly important if we are going to have thousands of students. It can be rather annoying to find out late that hundreds of thousands US dollars will have to be spent on additional servers that can bear such number of users.

If you already have a platform, which criteria did you follow to choose it? Which are its strong points and the problems you encountered?