Modernizing and Globalizing the Learning Environment: Video-Conferencing in Education

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Abstract

In 1999, with the new millennium just around the corner, I was asked to participate in an educational project which involved determining, analysing and implementing new educational methods for the modernization and globalization of the learning environment at the level of higher or university education. The project, which came to be called "The World as a Classroom", and which still goes on today, constitutes an attempt to evaluate video or tele-conferencing as one of the many means available to introduce necessary innovation into teaching. The basic concept behind it is to create a network of global connections and to bring students in direct contact with other students, researchers and lecturers around the world. Students get to practice their foreign language skills and obtain first-hand information about new and important studies being done abroad. A simple exchange of opinion with fellow-students from different countries internationalizes and globalizes their worldview. The aim of this paper is to share my experiences with the implementation of video conferencing in my language teaching programme and to relate the considerable potential of this new medium in the educational field without overshadowing the difficulties and the problems with which I was confronted throughout the project.

Although this paper is not directly concerned with distance education in small states, I am convinced that video conferencing could eventually provide a relevant educational medium in this context. It could constitute a possible solution to staff/Faculty shortage; it could be used in creating a unifying educational network among different regions of small island states, and it could be a useful element in linking relatively isolated areas with the rest of the world.

Introduction

In 1999, with the new millennium just around the corner, I was asked to participate in an educational project which involved determining, analysing and implementing new educational methods towards the modernization and globalization of the learning environment at the level of university education. The project, which came to be called "The World as a Classroom" and which still goes on today,

constitutes an attempt to evaluate video-conferencing as one of the many means available to introduce innovation into teaching. The basic concept behind it is to create a network of global connections and to bring students in direct contact with other students, researchers and lecturers around the world via the medium of video-conferencing.

My aim in this paper is to provide a brief introduction to video-conferencing technology and the types of systems available, and to put forth some suggestions on how to implement video-conferencing in educational contexts. These suggestions are based on the research I conducted and the practical experience I acquired during the project mentioned above. Although this paper is not directly concerned with distance education in small states, I am convinced that video-conferencing could eventually provide a relevant educational medium in this context. It could constitute a possible solution to staff and faculty shortage; it could be used in creating a unifying educational network between different regions of small island states, and it could be a useful element in linking up relatively isolated areas with the rest of the world. My study represents a basic introduction to video-conferencing, which has to be necessarily followed by specific research on the applicability of the medium at a local/regional level and by a study of local/regional human, financial and facility resources.

1. What is Video-Conferencing? A Brief Introduction to the Technology

Video-conferencing is a relatively new technology (only about fifteen years old) which allows for interactive meeting between individuals or groups of people located in two – or more – different sites. By "interactive" it is meant that participants in a video-conferencing session are able to see and hear each other and to share information by means of different types of visual aids.

In most modern video-conferencing systems, video signals are transmitted over switched digital lines like International Services Digital Network (ISDN) lines provided by telephone companies. There are two types of ISDN connections available: Basic Rate Interface (BRI) and Primary Rate Interface (PRI). One ISDN line is a collection of telephone lines known as b channels, each of which provides a bandwidth of 64 kbit/s. BRI ISDN lines provide two b channels, while PRI is the fastest connection available as it runs with 30 b channels; that is, more than 2 Mbit/s. PRI constitutes, however, a very expensive option. Most video-conferencing connections are made over BRI (Ho Tak, 1998).

In order to minimize costs, the video signal has to be compressed so that it requires less bandwidth. This compression is done by a codec (coder-decoder) which also allows for interface between all the equipment being used in the conferencing room and the telephone network. Video, audio and data signals are all connected into the codec, which transmits a single digital signal. The codec controls, as well, the quality of the video: the more compression, the lower the quality. Most codecs can be set to produce varying compression levels and data transfer rates depending on the quality desired and the network service available (Schwartz and Norton, 2000). Today, most video-conferencing systems can be connected to one, two or three ISDN lines at data transfer rates ranging from 128 to 384 kbit/s. One ISDN (128 kbits/s) requires a higher degree of compression, which normally results in slight, intermittent delays in the transmission of image and sound and, occasionally, in a blurred picture whenever there is a certain amount of movement at a

conferencing site. Three ISDN lines (384 kbits/s) offer a very good, almost television-like quality, as sound and image delays and blurredness are minimized by the higher, though more expensive, transfer rate.

Video-conferencing intercommunication is not limited to two sites. By means of a Multipoint Control Unit (MCU), multiple locations can be bridged together in an interactive connection. The audio signals are heard in all sites during the whole period of the session, while the video image can be controlled in one of two ways: it can be voice-activated, which means that when participants talk at one of the locations, their site becomes the broadcasting site which is seen by every one else. The video image can also be controlled manually: a chairperson or teacher is in control of the exchanges between the different sites and can manually select the desired broadcaster. Multipoint Control Units are expensive devices. However, most telephone companies provide multipoint services which allow users to rent the equipment and avoid a costly initial investment (Schwartz and Norton, 2000).

As most systems operate over a telephone network, establishing a video-conferencing connection is, indeed, as easy as using a phone: one just has to input a regular telephone number preceded, if necessary, by a country and/or area code into a video-conferencing unit and wait for the call to be answered at the far end of the connection. In the last decade, there has been a movement toward regulating video-conferencing. This has resulted in a higher degree of compatibility, which allows different vendor's systems to interface. An important step in this direction was taken in 1990 with the creation of an internationally accepted standard for codecs called H.320, also known as the Px643 or H.261. This standard allows for seamless translation between NTSC – the video format used in the United States – and the format most commonly found in Europe – PAL. While H.320 regulates transmission over high-speed telephone lines like ISDN, today a newer standard has been implemented to enable video-conferencing over local area networks (LANs). Known as H.323, it will allow institutions to use existing infrastructures for video-conferencing. Worldwide video-conferencing interface has, thus, become a reality: most systems adhere to one of these two standards and can be easily upgraded to incorporate the latest developments in telecomunications technology.

1.1 Types of Video-Conferencing Systems

Video-conferencing systems can be divided into two major types: desktop and rollabout/built-in systems. Desktop systems are usually PC-based: a computer is furnished with a camera, an audio-card and the required software to make conferencing possible. Connection to a digital switched line is usually necessary in order to transmit the video signal, but there are alternatives to ISDN transmission, like using an existing LAN or even the Internet. Desktop video-conferencing (DVC) is fully interactive as one can see and hear the person at the other end of the line and exchange PC files and applications. In comparison to other systems, desktop solutions are a cheaper alternative: it is calculated that it costs between US$ 2000 and $6000 to convert an IBM PC into a fully operational, ISDN-based video-conferencing terminal (Schwartz and Norton, 2000).

Rollabout systems are very common today. They constitute a complete video-conferencing package contained in a cabinet on wheels. The unit is made up of one or two monitors, a camera on a pan/tilt head, an audio-system and the codec. The audio system, which is partly built into the camera device, consists of an echo

canceller, microphones, speakers and amplifiers. A desktop microphone especially designed to be flatly placed upon a conferencing table may be included to improve sound quality. A remote control panel allows the participants to control the video images, the camera orientation, the sound levels and other peripherals. Most panels even allow users to operate the camera, sound levels and peripherals at the far-end site. The camera in the rollabout unit captures the assembled participants and can be manually controlled by a chairperson or teacher who selects varying views of the room. Most video-conferencing cameras can be set on automatic mode, which means that they are voice-activated and automatically focus on the person or group of persons doing the talking. A useful addition to a rollabout system is one, preferably two, video-recorders to tape both the outgoing and incoming signals, providing a permanent record of the sessions.

A variety of visual aids can be used with rollabout systems. Documents, charts, maps, other graphics and even very small objects can be shown by means of a so-called document camera. This is a small camera mounted on a stand, which vertically focuses upon a flat platform. If funds for a document camera are not available, a "low-tech" solution is to have the video-conferencing camera itself show visual aids placed upon a pin-board. Most video-conferencing cameras have a wide focus-range and can clearly transmit images of A4 or even smaller sizes. If a video-recorder is plugged into the rollabout unit, videos can also be shown. This should only be done, however, at higher rates of transmission – 348 kbits/s – because at lower rates the remote site will experience difficulties at the level of image and sound reception. A computer connected to the video-conferencing system will also allow participants to share PC files and applications and even to show PowerPoint presentations. The newest in video-conferencing visual-aid peripherals are the interactive whiteboards. This is a relatively large electronic surface of approximately the size of a classroom blackboard upon which information is hand-written and automatically transmitted to another interactive surface at a remote site. The advantages of this kind of device for educational purposes are clear; however, interactive whiteboards are expensive, especially if one takes into consideration the fact that all conferencing sites have to acquire one. Furthermore, they are a very new technological development that has not yet been thoroughly tested in practice.

Built-in video-conferencing systems are a less mobile variation of rollabout systems. They include the same equipment found in a rollabout, which instead of being stored in a cabinet resides on shelves behind a facade wall. Both systems are similar in their capabilities, although built-in alternatives – because they are thought to be more permanent solutions – usually offer a wider range of peripherals customized to particular applications.

Although prices of systems differ widely and are subject to constant change, it is calculated that low to medium end rollabouts cost between US$ 20,000 and $60,000. Higher end rollabouts and built-in customized systems may cost between US$ 50,000 and $100,000 (Schwartz and Norton, 2000).

2. Video-Conferencing: The Educational Technology of the Future?

Having discussed the basics of video-conferencing technology, it is appropriate to turn now to its practical applications and

especially to its usage as a tool in distance education programs. The advantages of this technology have been extensively practically proven in a variety of fields. In telemedicine, for instance, video-conferencing has played a vital role in training doctors and in transmitting urgent expert diagnostics and other medical information to remote areas which otherwise would lack proper medical assistance. In business, many companies rely on this technology to speed up communication and to more efficiently use time and save travelling costs. In engineering, research projects have become more efficient and less costly by sending an engineer to a remote site with a camera set on a helmet. By means of video-conferencing, the engineer can be guided through a project by a group of experts located at a distant site (Napir, 1998).

In education, video-conferencing is an important aspect of the overwhelming technological developments that have rather suddenly transformed classrooms in the last decade. Together with the Internet, video-conferencing systems are contributing to what seems to be the inevitable trend towards the globalization of learning environments: an increasing number of schools, colleges and universities are becoming part of educational grids or networks linked via the Internet or video-conferencing channels. Recent developments are making video-conferencing a very attractive solution for distance education programmes. It is rapidly gaining more acceptance over the traditional teleteaching methods like audio-conferencing, audio-graphics, interactive satellite television (ISTV), and computer conferencing.

In attempting to explain the growing popularity of video-conferencing in educational contexts and specifically in distance education programmes, I can only put forth one advantage this technology has over other teleteaching methods – an advantage which seems to make, as far as my experience in the project "The World as a Classroom" proves, all the difference for both teachers and students. The point at which video-conferencing surpasses other forms of teaching at a distance is in its allowing for full interactive communication in which participants are able to simultaneously see and hear each other and to exchange a variety of data. In other words, video-conferencing is the closest distance education has got to face-to-face teaching. And it is one method that minimizes in distance students feelings of frustration regarding being taught by means of a method that is a rather inferior, makeshift alternative to face-to-face teaching.

However, the fact is that despite its unquestionable advantages, video-conferencing facilities are not available in every school or university and neither are they deployed in every distance education programme. This is partly due to the fact that innovative technological developments need time to make their way into educational structures. But the main reason for this, which brings me to the only disadvantage of video-conferencing I can think of, is that this technology is still a financial burden on academic budgets. It involves the expensive initial investment of acquiring the equipment, the costs of installing switched digital lines where they are needed, and the monthly charge that these lines require. In addition, there are the connection costs: a rough estimate which can be applied domestically and internationally is that one ISDN call (one line of 128 kbits/s) costs twice as much as a regular telephone call.

Thus, video-conferencing is for many schools and universities the educational technology not

of the present, but of the future. Ironically, this is especially true of smaller and also poorer states, which most depend on distance education grids and would most benefit from video-conferencing: these are the states that are less likely to be able to afford it. However, in the near future and once the aura of novelty which presently surrounds the technology dissipates, prices of systems are bound to decrease to affordable levels. The recent developments and the growing competitive strain felt in the area of telecommunications will very likely have a positive effect on consumers in terms of lower installation, service rate and connection costs.

With a view on near future developments which should make video-conferencing a more realistic option towards a widespread globalization of learning environments and optimization of distance education networks, I propose now to take a closer look at the practical aspects of implementing video-conferencing in educational contexts.

3. Suggestions on Implementing a Video-Conferencing System in an Educational Context

My participation in the project "The World as a Classroom" resulted in an extensive, daily activity involving the introduction of video-conferencing technology in our university and, specifically, in our language programme of English for Special Purposes. I partook in the process of acquisition and installation of the equipment and in the design of the conferencing facilities. Our project team was asked to compare systems and to research network options for optimal connection conditions. Later, we were lucky to able to test in practice the theoretical results of our research by taking part in numerous video-conferencing sessions with partner universities and institutions around the world. These sessions were structured so as to constitute an intrinsic part of our course programmes and, as such, they were conducted with the participation of classes of students and were subject to the specific thematic orientation of our curricula.

The experience gathered in this project has taught me that there are some important aspects that should be thoroughly considered when implementing and using a video-conferencing system in an educational institution. Such aspects, which I will discuss separately, involve:

- A needs assessment study prior to the acquisition of equipment
- The type of video-conferencing system and network connection
- The design of the video-conferencing facilities
- The group sizes of the video-conferencing sessions
- The length of the video-conferencing sessions

3.1. Needs Assessment

The first step in the process of acquiring a video-conferencing system for an educational institution should involve a needs assessment study. This study is conducted to provide detailed and statistical information to justify the investment. It should specify the use – or uses – to which the system is to be put and, accordingly, take into consideration the advantages or disadvantages of video-conferencing as opposed to other and, perhaps, already existing teleteaching options. A target group should also be identified; that is, the approximate number of people (students, lecturers, researchers) who would use and

benefit from the acquisition. The facilities available for conversion into video-conferencing spaces should be assessed, as well as the availability in terms of network service. Such a study should realistically take into account the funds available for the implementation of the system, while at the same time aiming at influencing budgetary decisions on the basis of the needs determined. A thorough needs assessment guarantees that once a system is installed, it will be used effectively because it was designed to meet the specific requirements of the educational institution. A comprehensive study also provides input into long-term plans for eventual system expansion.

3.2. Choice of Video-Conferencing System and Network Connection

The first and most important decision to be made when implementing video-conferencing technology in any institution regards the type of system to be acquired. This decision should take into consideration a needs assessment study and, of course, the financial means available to buy, install and maintain the system.

As discussed previously, there are two major options in video-conferencing systems: a desktop, PC-based solution or a rollabout/built-in solution. For educational purposes and at the present state of technological advancement, rollabout units prove to be, pedagogically speaking, the most successful and efficient alternative. One advantage these units have over PC-based systems is the size of the image. Rollabouts provide full television-size images of relatively good quality regarding resolution, colour and sound transmission (this depends, of course, on the transfer rate of the connection). The technology employed in desktop video-conferencing usually allows for smaller, window-size images which only take up part of a whole computer screen. The rule of thumb in PC-based video-conferencing is that the smaller the image, the better the quality.

While desktop solutions are appropriate for one-to-one conferencing, they prove uncomfortable and unsuitable for sessions involving groups of people. One alternative would be to conduct PC-based video-conferencing classes in which each student is assigned a computer terminal to individually interface with the teacher at the far-end site. This, however, would have pedagogical implications: it would certainly stifle group discussion and teamwork.

Adding to the significant disadvantage in image-size and intrinsically related to it, most desktop video-conferencing cameras do not yet exhibit the technical flexibility of rollabout cameras in terms of focus range and the mobility provided by a pan/tilt head. PC cameras are usually designed to provide a static focus on one person at a terminal. This necessarily means less freedom of movement for both teachers and students who have to sit at computers for the duration of a session. In comparison to this, rollabout systems allow selective focus and participants to move around in a conferencing area. Excessive movement should be avoided, however, because it results in a blurred image.

In choosing a system, it is also important to consider the type of network connection desired. Most rollabout/built-in packages are designed to connect over a telephone network; PC-based systems may connect over ISDN, LAN or the Internet. The two last options are the most affordable solutions, but also the least reliable. The quality of a LAN or Internet connection varies considerably according to the capacity of the network and the number of users accessing it. In a connection made over LAN, technical difficulties in the local network will reflect upon the quality of the transmission

and may even make conferencing altogether impossible. During high access and traffic hours, Internet connections may experience serious difficulties in image and sound reception.

In implementing a video-conferencing system at the Environment Campus, our main concern was reliability and independence from the technical fluctuations of our local computer network. The choice of connecting over ISDN proved a good one: we have not yet experienced serious difficulties with our telecommunications provider at either a domestic or international level.

3.3. The Design of Video-Conferencing Facilities

The design of video-conferencing facilities will always constitute a compromise between optimal conditions and the limitations of the real space available for conversion into conferencing areas. Here, a needs assessment study is especially relevant because the design of a room is intrinsically related to the use(s) the which the room will be put and the group size(s) of each session.

Even though there are no established guidelines concerning the design of video-conferencing facilities, there are some details related to the technical characteristics of the equipment which should be observed. I am referring to the design of rooms in which rollabout conferencing is to be conducted. This is the kind of conferencing I have experience with and which I find, as opposed to PC-based options, most appropriate for educational purposes.

The selection and treatment of the space available will have a noticeable effect on the image and sound quality of video-conferences. Most audio systems in rollabout units are very sensitive. A video-conferencing room should be located in a quiet part of a school or university building, and carpeting should be used to absorb the noise inside the room. As video-conferencing cameras record and react immediately to any light changes, a room with no windows would be the best option. If windows cannot be avoided, shades or heavy curtains must be installed to give participants full control of the daylight entering the room. These cameras provide best colour saturation and hues when diffused fluorescent light sources are used. If the layout of the room includes a conferencing table, it should be white or of a light colour to reflect the light onto the participants' faces. It is appropriate to have additional fluorescent light sources around the perimeter of the room to give walls an even wash of light and to avoid darker areas and corners.

As for furnishing the room, the group size, purpose of the sessions and the imaginative input of the person in charge play an important role. Although, traditionally, most meetings are conducted around a video-conferencing table, this is a procedure imported from the business world, which need not necessarily be followed in educational contexts. Students can also sit in rows of chairs; this proves an especially productive and space-saving alternative for larger groups and for lectures in which one person – a professor, for instance – will be doing most of the talking.

At our campus in Birkenfeld, we thought it convenient to maintain video-conferencing facilities as adaptable as possible: they should accommodate different group sizes and different lecturing purposes, from the more theoretical to practice oriented ones. Adaptability may be the appropriate solution for other educational institutions as well. We were fortunate to have a room large enough to

make possible a variety of conferencing layouts. We conducted conferencing sessions in small groups around a conferencing table. These included a maximum of ten persons, which made camera control relatively uncomplicated and allowed for a room overview in which all participants were included.

When groups were larger (up to twenty participants), the table was removed and chairs were placed in rows of six to seven students each. It was not possible for participants at the remote site to have a room view which included all our students because our facilities were too narrow to allow for an appropriate camera distance. Instead, selective focus was used to transmit close-up images of groups of students at a time.

We also made sure an audience area was available for attendees who did not participate directly in the conferencing, but who were interested in listening to the topics being discussed. The attendees sat in rows of chairs placed at the side of the room. The audience area was, in most sessions, maintained out of the focus range of the camera so as not to interfere with the active video-conferencing meeting.

3.4. Group Sizes of Video-Conferencing Sessions

In business contexts, it is commonly established that video-conferencing of the rollabout/built-in type should not take place between large groups: this usually means that the number of participants in a meeting should not exceed fifteen persons. I basically agree with this rule-of-thumb, but I think it has to be reformulated to adjust to the employment of video-conferencing technology for educational purposes.

If the aim of implementing a video-conferencing system in a school or university is to bring together groups or students and researchers from different institutions and parts of the world, this formula should be respected. It becomes quite complicated to trigger and conduct a productive discussion via video-conferencing between groups of more than fifteen people. However, the group layout will be somewhat different in the case of a distance education programme: normally, there will be one teacher/lecturer at one end of the connection and a group of students at the other end. In such a case, the optical and audio flexibility of a rollabout system should be optimized to permit lecturing to larger groups of up to thirty students.

Larger conferencing facilities will need to be carefully inspected and tested for acoustic traits, and they will have to be equipped with sufficient fluorescent fixtures to assure all students are properly lit. A larger group will necessarily require more microphones, which can be distributed around the room or hung from the ceiling. Rollabout systems also allow for the incorporation of several video-cameras which can give complementary views of areas out of the focus range of the video-conferencing camera.

3.5. Length of Video-Conferencing Sessions

During the project "The World as a Classroom", I was able to ascertain that communication conducted via video-conferencing exerts some demands upon the participants. First and foremost, being in front of a camera made our students especially self-conscious and created a certain degree of uneasiness and tension. Students needed time to overcome camera shyness when actively participating in discussions, and were especially self-critical

when they made language mistakes or provided the wrong answers. In addition to this, the project coordinators instructed students to avoid excessive movement during video-conferencing meetings; to keep noise levels down, and to speak clearly, loudly and slowly so that participants at the other end of the connection could understand all that was being said.

These demands cause communication via video-conferencing to be more tiring for the participants than face-to-face interchanges. In sessions that lasted more than an hour, I noticed that students tended to show signs of tiredness, which usually resulted in a loss of interest and in retreating into a passive listener attitude. Given this experience, I tend to believe that video-conferencing classes of more than 60 minutes can prove pedagogically counterproductive. If a session has to last more than this period of time, it should include breaks of at least ten minutes after each hour of conferencing.

In Conclusion

My evaluation of video-conferencing as a new technological medium in education is based upon the experience gathered in the project "The World as a Classroom" and draws the following conclusions:

- Video-conferencing of the rollabout type conducted over an ISDN connection proved a technically reliable medium for educational purposes. It allowed us to maintain a conferencing schedule and conduct interactive sessions of adequate image and sound quality without major or impairing technical difficulties.
- The rollabout system was technically flexible, permitting adaptable solutions in the choice of facility layout and group sizes. Furthermore, it allowed for a variety of data transfer/visual-aid options.
- The immediate, direct contact with partners around the world enriched our course programmes and constituted a necessary step away from the traditional, enclosed classroom environment and textbook-based transmission of knowledge.
- The one major drawback of the present state of the technology is the cost of acquiring, implementing and using such a video-conferencing system.

Bibliography

Daunt, C. (2000). "Is Teleteaching Different?" *Interactive Multimedia and Collaborative Communications Alliance*. Online.

Earon, A. (2000). "Seven Steps to Successful Videoconferencing." *Interactive Multimedia and Collaborative Communications Alliance*. Online.

Hendricks, C. and Steer, J. (2000). "Videoconferencing FAQ." *BitScout Software*. Online.

Ho Tak, U. K. (1998). "How to Use ISDN Video-Conferencing to Develop Efficient Remote Education and Corporate Training," *Educational Media International* 4: 264–265.

Kies, J., Willeges, C. and Rosson, M. (1997). "Evaluating Desktop Video Conferencing for Distance Learning," *Computers and Education* 2: 79–82.

Napir, P. (1998). "Video Conferencing Face to Face," *Premises and Facilities Management* (August): 18–20.

Schwartz, O. and Norton, J. (2000). "Introduction to Videoconferencing." *Interactive Multimedia Collaborative Communications Alliance*. Online.

Suhre, N. (2000). Videoconferencing 101. "The Basis of Planning, Producing and Managing an Event." *Interactive Multimedia and Collaborative Communications Alliance*. Online.

Thorpe, R. (1998). "The Use of Personal Video Conferencing with Special Needs Pupils from Three Schools Serving Rural Areas: A Case of Successful Adoption of New Technology," *Journal of Information Technology for Teacher Education* 3: 395–412.

Warrilow, R. (1999). "I See What You Mean," *New Electronics* 10: 23–24.