Video Conferencing in Higher Education

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sima
Support Initiative
for Multimedia Applications

Part of the JISC New Technologies Initiative

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About This Report

Video Conferencing as a term has become a misnomer. It no longer embraces the full range of technology, or the communication styles, it is supposed to describe. In education, the situation is further complicated by the range of teaching and learning methods applied. The technology ranges from microwave, satellites, optical fibre to ISDN. The communications from person to person informal discussions, formal group meetings to large lectures.

It is only recently that technology has reached a level of stability, usability and affordability which permits its use in real teaching scenarios rather than research projects. Exploring the technology in a real setting highlights any problems of use, however it fails to provide enlightment as to the underlying reasons for the success or failure of any project. On the other hand, carefully controlled psychological experiments which manipulate individual variables create an artificial environment and the results may not be generalisable to real settings. It is therefore extremely difficult to evaluate the effectiveness of technology-mediated communications for learning. This report is intended to make the readers aware of the relevant problems by separating technological, psychological, pedagogical and sociological issues.

The experiences which have led to this report are mainly the use of compressed video conferencing delivered via ISDN, using both Rollabout Systems and Desk-Top Systems. Rollabout Systems are designed to be used by sma groups of people located at remote sites and Desk-Top Systems are designed to be used on a person-to-person basis, with individuals located at remote sites. Links can be made to any site, regardless of geographical location, provided it has access to ISDN and the same equipment and software at both ends.

The aim of this report is to put Video Conferencing into a Learning Framework and to take a learner-centred rather than technology-centred view of the problem. This requires understanding the problem from a number of perspectives:

- Understand the learning framework;
- Understand the technology;
- Understand the role of technology within that framework;
- Understand how to make best use of the technology in fulfilling that role.

SIMA Video Conferencing Outline

The report is divided into two parts. The first describes the technology. It is necessary to understand the limitations and the potential of the technology to be able to evaluate its potential within education. The second part describes a framework for learning and investigates the role of technology within that framework. The report will not provide operating instructions for specific technological systems but will provide generalisable information about how to make best use of Video Conferencing technology.

Video conferencing has great potential for learning in Higher Education. The potential lies in creating greater opportunity for dialogue which facilitates more effective learning than working in isolation. Dialogue may be between tutors and learners or amongst learners. However, the success of video conferencing may well be dependent on factors other than the technology. These factors range from Institutional issues, to cost, to student and tutors attitude to the technology. It is also highly dependent on the teaching methods adopted. There are many unanswered questions from an educational and psychological perspective. The technology is in a transitional state and many may feel it is currently unsuitable for education. This makes video conferencing highly challenging and exciting to some and a nightmare to others. Like the telephone in the past, we as users must learn how to make best use of video conferencing. It may well be the next mode of communication to be universally accepted.

Part One: Video Conferencing

1. A Definition

The term videoconferencing is a confusing one. Some commercial companies (AT & T in the States) are now advertising "videoconferencing: as a new technology. The fact is that videoconferencing is a function which can be hosted on a variety of technologies and has been for some years. It is not a technology in itself. In America, the term is fast becoming defined as any use of television to join people in some live interaction. However, the term is actually applied to a wide range of situations from live video lecturing to large audiences, to a point-to-point, individual-to-individual desktop PC chats. One possible categorisation is into large scale and small scale. The majority of large scale set-ups are currently satellite-based in the form of "*interactive television"* i.e., one-way video, two-way audio. This allows for broadcast from a central point to many different locations regardless of distance. Small scale refers to compressed video for meetings between relatively few points for small meetings. A technology used for this function is ISDN. ISDN promises to make two-way video equally as cost effective, with potential for greater interactivity.

Traditional video conferencing requires expensive, fixed delivery and reception installations and high transmission costs over full band width analogue video channels or high capacity digital channels. Such high grade services allow full two-way audio and video communication between several locations at a price; a more common configuration is that of Interactive TV (Full service out, audio only in). High costs and lack of flexibility has limited the past educational uses in the past to research projects . Recent developments in video compression and codec technology is increasing the use of relatively low bandwidth ISDN using a variety of display formats.

2. Technological Issues

The technologies used to deliver video conferences currently have a dramatic effect on the quality of the communication achievable. This report concentrates on the use of ISDN with compressed video where as earlier examples, often referred to as Interactive Television use transportation media such as microwave links or satellite links and provide high cost, full motion video links. In order to understand the issues in video conferencing, a basic understanding of transmission technology is required. The issues are those of:

- bandwidth
- video compression
- delivery method
- standards

2.1. Bandwidth

Bandwidth (or baud rate) refers to the amount of information (bits) which can be transmitted along a carrier every second. The bandwidth required depends on the application. Thus textual data can be transmitted slowly, or using a narrow bandwidth because it is not required in real time and the printed information contains little information relative to sound and video. Sounds such as speech, contain more information than the printed word and have to be carried at the same speed as normal speech for conversation to be possible; thus a wider bandwidth is required. If moving pictures have also to be sent and real time transmission is required then we have a lot of information to send very quickly, thus a high bandwidth is required.

Consider the amount of information that must be transmitted if a video image is to be sent in real time.

A screen has 625 lines and there are 625 points on each line.

A point is stored in 24 bits.

To transmit in real time, 25 pictures must be sent every second.

This adds up to 234,375,000 bits of information to be transmitted every second.

Telephone lines are required to carry voice information at roughly 2400 bps which they manage. A single ISDN telephone line can carry information at 64 Kbps. So consider how many telephone lines would be required to carry the amount of information for a video image! It would not be possible. Thus alternative to telephone lines, such as satellite or fibre optics which have extremely high bandwidth would have to be used. This would reduce accessibility of the technology and increase costs. An alternative is to compress the video image thus less information is transmitted along a lower bandwidth medium. We will look at both solutions.

2.2. Video compression

An analogue, full motion, signal takes up a great deal of bandwidth. It can be converted to digital signals (and vice versa) and compressed using codecs. One way to reduce the bandwidth required is to compress the video image; that is digitise the signal and then remove as much extraneous data as possible. A video signal changes 25 times per second, not all the picture changes in each frame and so with a compressed image only the changes are sent. Thus the more changes, the less compression can occur. Compressed video can be squeezed into as few as two telephone lines, or up to 24. The greater the compression, the greater the loss of clarity, continuity of motion and colour information.

There are already several levels of compression being adopted:

Video on desktop computers

64 kbps. Allows video integrated into the screen. However this rate is not good enough for full video conferences, it would suffice for one to one video phone situations. Many people in education do not feel it is adequate.

Group video conferencing

Between 128 kbps and 2 Mbps. 384 kbps is providing a good quality reception for conferencing and is used in many educational environments.

Digital Broadcasting

Uses 2- 6 Mbps rates. The quality is greatly increased over the previous compression levels but costs are also higher

HDTV

25-45 Mbps is adopted by High Definition Television. This is a relatively new technology and it is not universally accepted.

Some vendors provide equipment that can operate at a variety of compression levels. Remember the more visuals and movements to be transmitted the greater the transmission requirements and hence the higher the cost of both transmission and site equipment. There are recommended ways of coping with video compression (see Appendix One).

2.3. Delivering Video Conferences

By standard telephone lines

- The advantage of this method is one of accessibility. However, this only allows 64 kbps transmission rates. This is relatively untested for education. The picture and sound quality will be poor and the picture jerky.

By ISDN

- ISDN can in theory be carried through any telecommunications delivery medium: fibre optics, or telephone. This method is rapidly being taken up by educational establishments. There are several advantages for the education sector:

    - Two way voice, data and graphics can be carried simultaneously over the telephone network.

- May become the standard telephone system and therefore reach all homes, offices and educational establishments.

- It is relatively inexpensive.

By satellite broadcast

- A common use of satellites is for one way television transmission with audio only feedback.
- The advantage is that its cost is independent of distance, where as cable transmission costs increase with distance. This method is used where very large distances and many sites are involved or there are natural barriers to the laying of any cable technology, such as mountain ranges or oceans.
- The disadvantages include lack of visuals from receive site, unavailability of transmission time, or particular time may be expensive and the cost of the equipment installation.

By VSAT (very small aperture terminal)

- This method uses narrow band transmission (256-384 kbps). They can be used as receive only, or for data transmission to a central point, with a more powerful "hub".
- For education, it is possible to use VSAT in a "mesh" system with each site capable of both transmit and receive, to any other site on the system, thus allowing any site to originate teaching materials. Full two way motion video with sound is possible.
- Transmission costs are likely to be low but ground stations are in the range of 50,000 dollars.

By co-axial cable

- Cable is a useful medium if delivering from a single point (TV Station) to many different sites. It is a common form of television broadcasting in North America and becoming more common in the UK.
- Co-axial cable can allow up to 40 TV channels to be carried without compression. In Canada, at least one of these must be dedicated to educational programming (The Knowledge Network).
- It can also be used for two way video communication provided there is a suitable equipment at both ends.
- The cost of laying cable is high so would only be of benefit for educational video conferencing if the cable was already laid. This is the case in the USA, Canada and some parts of the UK.

By fibre-optic cable

- This has a far greater capacity than co-axial cable.
- It is currently being installed by major telecommunication companies. It will form a backbone for services that will often transfer to copper wire for local delivery.

There is therefore a growing range of ways to deliver video conferencing. The most appropriate choice of system will depend partly on the physical configuration of sites to be connected, the applications which are required, the amount of traffic to be carried, and the distances between sites.

2.4. Standards

- There are two video conferencing standards: H261 and H320.
- H261 standard refers to the visual and audio part of the conference. This standard has been in existence for a number of years and any system complying with it will at least be able to see and hear people using another compliant system.
- Only H320 affects Desktop Video Conferencing. H320 is supposed to link together different software standards by setting factors such as voice and picture syncing. This is not well implemented. The different interpretation of the standard means that if using a desktop system, to guarantee success, the equipment and software at both the send and receive site must be identical. This rule holds even if both systems say they comply to H320.
- Every country does not have International ISDN, different countries have their own form. This is particularly apparent between the USA (56 kbps) and Europe (64 kbps) although most equipment can now deal with this difference.

3. Range of equipment

One site to one site connections are typically called point to point connections. This reflects the number of sites connected rather than the number of people present at a site. Multipoint connections are also possible. However this is achieved by using a multipoint bridge and switching between sites can be carried out manually or can be voice activated (if you make a noise, you are seen). Multipoint bridges can be rented from British Telecom for the duration of a conference. They are prone to technical problems.

3.1. Full screen TV image

The Rollabout systems are used by corporate meetings when full screen, life-like intimacy is required. The codec, TV monitor, camera and microphone are all integrated into a single unit. Other audio-visual equipment can be used in conjunction with this equipment:

- Slide to video devices for displaying slides
- Micro-video systems for displaying microscopic images
- 3-D imaging devices for displaying real images
- PhotoCD presenters
- Video players
- Video Lecterns (visualiser) for documents and prepared presentations.

The choice of devices is dependent on the nature of the content of communication between the participants.

This form of equipment is more reliable than its DeskTop version. It is also more expensive. A recent setup at Heriot Watt University required investment of £25,000 at both ends of the connection. This type of equipment can be linked with stations supplied by other vendors. We have used this system with Norway, Holland, Australia and California on a regular basis. Although some functionality such as remote control of cameras is lost, the audio and visual connection is manageable. This equipment can be used if the focus of the conference is on the speakers and the materials being discussed are not in a computerized format. The range of audio-visual equipment means that little reworking of material is necessary.

3.2. Desk Top Video Conferencing (DTVC)

DTVC is the technology which is bringing video conferencing back into focus. However, the frame rate and the tiny picture window makes standalone DTVC an uncompelling application. But when it is used in conjunction with other collaborative work software, such as whiteboards, shared screen and shared control, there is adequate functionality to entice users. This type of video conference is most useful when the documents and information to be exchanged are stored on the computer and of importance rather than the presenter. Information can be shared and discussed quickly over the network. Cutting out the time and cost of a courier.

There are a number of problems associated with this equipment:

- The best DTVC offers 15 fps (frames per second) or 16 fps. This is like watching a pixelated home video. Typical rates are even lower. This may never prove adequate if full screen live interaction is required.
- Crashes and bandwidth problems are common.
- Many systems do not support sound. This is handled via the telephone! This means that the sound and video image are not kept synchronised.

The odd thing about DTVC is that it is not the video aspect that sells the system. This is simply incidental to file transfer and other co-operative working activities.

This equipment is not currently 100% reliable. The H261 standard is not well implemented. The equipment is cheaper than others, requiring an investment of around £5,000 per station. But both stations must be identical in terms of hardware and software, including versions.

4. The Physical Environment

Often people think they can set up a video conferencing system anywhere. This would be analogous to holding a seminar in the coffee lounge or your office while the person you are working with is trying to get on with their work! To maximise the chance of successful interaction the quality of the input must be maximised. The content of the conference should be the central issue, but if the student is uncomfortable, sound is poor or inadequate lighting is reducing the quality of images, then the learning process will be interfered with. The conference equipment should be based in a special room if possible. It can then be available for use when ever it is required rather than setting it up everytime it is requested. There is justification for support personnel to

maintain and run the equipment and leave the lecturers free to concentrate on the learning process. There are some guidelines for room set up (see Appendix 2) and organising a video conference (See Appendix 4).

Summary

Anyone considering video conferencing as a solution to an educational need should understand the nature of the technology. The technology is still evolving. ISDN and desktop systems are still problematic and fall-back scenarios should always be in place in case of system failure. This supports the need for specialised technicians who understand the technology and keep it up and running. This would be an added burden on lecturers if they were to maintain the equipment and get the best out of it. The quality of the signal is going to be reduced due to compression and therefore someone who knows how to maximise input in terms of sound and vision would be an indespensible member of staff. To reduce the potential for problems, the equipment at both ends of the connection should be identical.

Part Two: Learning

1. Learning

Learning is a social process involving the active construction of new knowledge and understanding through individual learning and group and peer interaction. This means that a key learning skill is that of communication. Clear communication, effective communication tools and channels are necessary pre-requisites for effective collaborative learning. One form of communication is *dialogue*. Dialogue, refers not only to the interactions between the learner and teacher(s) but also interactions between learners. The extent to which this occurs depends on the content of the subject matter, the overall educational philosophy in which the interaction occurs, the personalities of both teachers and learners, and the nature and variety of the communication media.

Technology is blurring the boundaries between distance, open and tradition education. It is important to consider which of these contexts learning is occurring and the video conference is being applied to.

1.1. Traditional learning

Students turn up to lectures and take notes. If they have a good lecturer they might take part in an active way. They attend tutorials, seminars or laboratories. Their learning is timetabled for them by the Institution. The course is time and location dependent. All students progress through the individual courses and the whole degree at the same pace unless there are exceptional circumstances. Many students do not take responsibility for their own learning. They may not be motivated to be more active participants in the learning process. They have the opportunity to interact with tutors and peers on a face to face basis at any time. As student numbers increase the possibility of face to face time with tutors is reduced. More students find they must work to pay for their studies and so the opportunity for dialogue with fellow students is reduced. Incorporating communication technology into this situation could well be seen as a direct replacement of face to face meetings unless the role of technology was clearly defined.

1.2. Distance Learning

"The learner is compelled by distance to assume a degree of autonomy that might be uncomfortable in other circumstances. In the same way the instructor in distance education is compelled to assume a more...supporting, helping role. When the teacher prepares instruction for a print-based, television or computer course, it is with the intention that the material will meet the goals established by learners and will be used as they go forward to achieve their goals, but whether the material is used remains outside the teacher's control, and the decision depends almost entirely on the worth of the material in the programme." (Moore 1990)

In this scenario, the course and degree is location independent. Students may undertake the course from any location. However it is not time independent. There is a minimum number of courses to be taken each term and a

course is run at set times of the year and must be completed within a set time. Distant learners have less opportunity for interaction with peers or tutors. They are keen to achieve a sense of belonging with a peer community. Thus the introduction of communication technology increases the opportunity for interaction.

Three generations of distance learning associated with the historical development of production, distribution and communication technologies, can be identified (Bates 1991). The first generation had no communication possibilities and a high drop-out rate would be expected. The main focus of second-generation distance teaching has been on the production and distribution of teaching materials. Communication with learners has always been a secondary consideration, with communication *amongst* the learners being almost non-existent. The third generation is based on the new technologies of interactive communication (telematics, tele-education: the facilities afforded by the application of new telecommunication and computer technology). This technology now opens up possibilities for dialogue between teachers and learners, or between learners themselves, or even between teachers

1.3. Open Learning

Students undertaking an Open Learning Program have neither time or location dependencies. Thus the opportunity of interacting with peers is extremely limited: who else is taking the course at the same time and progressing at the same pace. This would mean only asynchronous, non-compulsory communication technologies would be applicable.

1.4. Why use Video Conferencing

New communication technologies are blurring the distinction between traditional and distant teaching. It has potential uses in both situations. The main pedagogical issue is to understand where the new technology will have real impact on learning *effectiveness*. Some of the technology will support a second generation approach, bringing new impact and *efficiency* to the second generation model. Other aspects of the technology, however, allow the constraints of time and distance to be greatly lessened in bringing the power of small-group face-to-face teaching to the individual desktop, in home or office. The opportunities within open learning is less clear.

The reasons for using video conferencing in traditional and distance teaching are very different. There is also a role for video conference on an international basis.

SIMA Video Conferencing Outline

Traditional Education	Distance Education
Increased access to students	Social contact
Broaden the learning experience	Telepresence
Distributed, virtual classes	Group coherence
Increased access to experts	Increased access to teachers and experts

International

Access to International expertise

Cultural understanding

Language learning

Table 1: Why use video conferencing

- Video conferencing should be used to facilitate the best of distance and conventional teaching. Distance learning is normally associated with more class materials and better preparation of teaching materials. Conventional with lectures and face to face meetings.
- Video conferencing provides a means to get both students and tutors to a central location, all be it virtually. In Australia the introduction of video conferencing has helped rural Institutes expand by 500%!
- Video conferencing does not support open leaning, students must still register and attend classes at pre-set times and progress at the pace established by the course.
- Video conferencing could lead the way for a dual approach, giving students more responsibility for their learning, working in groups, doing tasks, all of which would benefit conventional teaching, but video conferencing provides an opportunity to implement them.
- There is no firm evidence as to whether full two way or one way with audio or simply video tapes are most effective. Depends on the situation of the learner and whether true open (time and location)learning rather than distance (location) learning is required.

2. A Learning Framework

The purpose of this section is to describe a framework for learning in which the developing role of telematics in education can be understood. The components of the framework are:

- A model of learning, described at both cognitive and social levels of analysis.
- A mapping of current technology onto this model.
- A description of institutional and organisational factors which lie outside the model.

The learning model, at its most basic level, can be described as an iterative process of seeking understanding. This process involves a re-conceptualisation cycle. Effective learning lies in experience with

- the active construction of knowledge,
- peer interaction and the development of oral explanation skills,
- exposure to different learning styles and
- the motivating feedback received from others.

This process consists of three fundamental components:

- *conceptualisation (structuring)*. This refers to the contact the learner has with other peoples' views/thoughts on a subject. This involves an interaction between the learner's pre-existing framework of understanding and a new 'exposition'.
- *construction (learning by doing)*. This refers to the application and testing of developing conceptualisations in the performance of meaningful tasks.
- *dialogue (learning through discussion and reflection)*. This refers to the creation and testing of developing conceptualisations during conversation with both tutors and fellow learners, and the reflection on these. Much significant learning arises from conversation, argument, debate and discussion amongst and between learners, peers, colleagues, experts and teachers (Bruner 1984). There is also a motivational value of being part of a healthy group (Rogers 1970).

The process becomes cyclic through reificiation (creating re-conceptualisations). This process is illustrated in Figure 1.

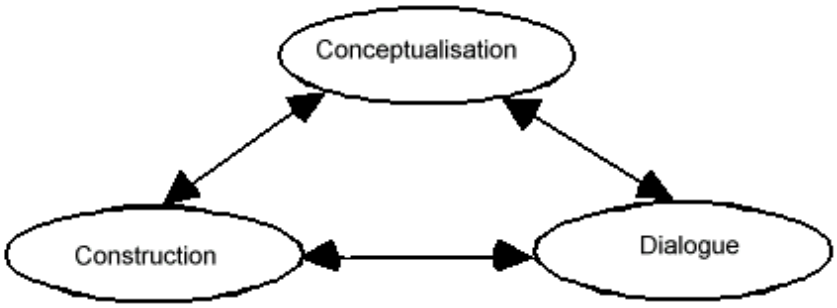

Figure 1: The (Re)conceptualisation Cycle

Each component can be further expanded into its own cycle. This is illustrated in Figure 2. In general, this analysis of learning places greater stress on the need for learners to perform meaningful tasks, and for the resultant understanding to be reflected on, and discussed with others, than on the 'primary exposition' - the material from which the learner forms initial conceptualisation. This contrasts with the prevailing view, both in the choice of methods of the higher educational system, and in the assumptions of the multimedia industry, that the main contribution of technology is to present the primary exposition in an enticing form.

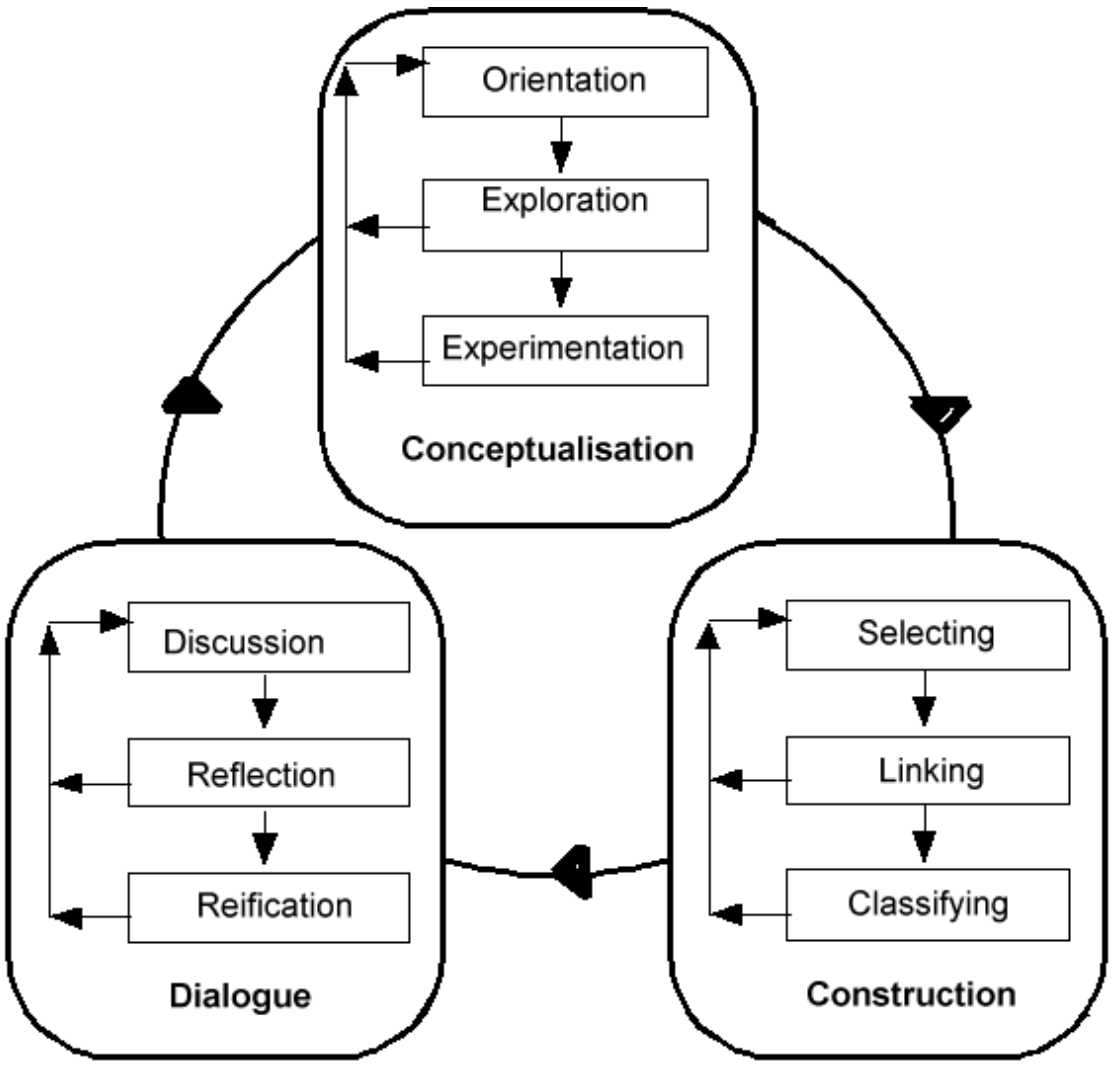

Figure 2: The (Re)conceptualisation cycle in detail

2.1. Conceptualisation

2.1.1. Orientation

Orientation is probably the most important function of the primary exposition. It gives the learner a map of what is to be learned and understood. It denotes the boundaries of the topic to be studied, and it should also make clear its relevance, both to a course of study and to the wider body of knowledge to which it relates. Orientation should also influence affective variables; the excitement associated with learning is largely set at this early stage. Since this is the main function of the orientation stage, interactive technology is of little importance.

2.1.2. Exploration

Exploration allows the learners to be more active in their interpretation of public domain material. After basic orientation learners are free to explore other books, reports, multimedia, hypermedia etc. written about the subject. Discovery learning is based on the notion that a learner will explore and search for meaning.

2.1.3. Experimentation

Experimentation involves genuine interaction with the learning environment. An environment where "what if" questions can be answered, must be provided. In traditional situations, this would mean laboratory work or role playing sessions, depending on the subject matter. The tutor is still guiding the learner, outlining the experiment and the evaluation criteria for the students. In multimedia it could mean the use of simulations.

2.2. Construction

This decomposition is supported by the work of Sternberg (1984). In completing a learning task, the learner must sort and apply the knowledge gathered during conceptualisation. In conceptualisation the tutor/expert uses tools to produce learning materials. The same productivity tools are now put in the hands of the learners to support the construction tasks. Apprenticeship learning theories are based on this idea.

2.2.1 Selecting

The learner is required to pick out relevant information for encoding.

2.2.2 Linking

The learner is required to combine information, old and new gained from a variety of experiences, in a way which has meaning for the learner.

2.2.3 Classifying

The learner is required to compare information, noting relationships between new and old information. That is create a structure which is meaningful to them.

2.3. Dialogue

2.3.1. Discussion

Discussion is fundamental to education. It is, of course, possible to learn without discussion, but the need to support deep learning through tutorial and peer-group discussion is paramount. It is the small group discussions which are being squeezed out of the education process.

2.3.2. Reflection

Reflective thinking has also been regarded as fundamental for learning for as long as the topic of learning has been discussed. We may not actually talk with other people but simply review the information in our own mind. W need to take time to think about the issues. A striking example of the processes of discussion and reflection was illustrated in a television programme about crime. At the beginning of the program participants completed a questionnaire designed to evoke their opinions on crime and punishment. After a weekend of discussing the issues, and having time dedicated to reflecting on what was being said, they completed the questionnaire again. The results revealed a dramatic shift in opinions.

2.3.3. Reification

The process of re-conceptualisation - of coming to know through discussion and reflection - can be consolidated through the process of reification. Literally, this means “making an object of”; the formation of a new schema, a more advanced exposition. This new object can be used as part of the primary conceptualisation for new learners or to advance the learner’s own ideas and move on to deeper learning.

2.4. Summary

The framework identifies that learning is both a cognitive (individual) and a social activity. As a cognitive activity, the learner is required to understand. This means that information must be processed at a level that integrates with existing knowledge structures. The creation of knowledge structures involves considerable cognitive effort. Whereas most learning experiences involve only natural accretion of new information, filling in the slots. This accretion is effortless in comparison to structuring. This cognitive activity is always situated in a social context. The nature of that context will determine which approach to learning is adopted by an individual. In many circumstance individuals will learn more effectively through co-operative or collaborative group activity. This involves interaction with other learners who have a shared perception of the task. Peer tutoring can be very effective.

The model emphasises the importance of construction and dialogue. Too much effort in the field of Advanced Learning Technologies (ALT) has been direction towards conceptualisation, teaching-by-telling. The significant challenge is to devise ways of using technology to support dialogue beyond simply providing direct channel of communication between tutors and learners, but to look at the potential of communication between learners, supporting each other.

3. The Role of Advanced Learning Technologies

The three stages identified in the learning framework, provide a framework for the evaluation of courseware developed using advanced learning technology (ALT) for education. Three kinds of courseware can be identified:

- Primary courseware (*conceptualisation*) will support the presentation of content.
- Secondary courseware (*construction*) will provide resources for the doing of learning tasks.
- Tertiary courseware (*dialogue*) will support dialogue through communication.

3.1. Primary courseware

Primary courseware is courseware produced professionally, authored by subject matter experts but usually designed and programmed by specialists. It involves the presentation of what is termed the 'primary exposition.

Traditional linear media, especially film and television, and the new multimedia environments, are highly effective for orientation; to give interesting overviews and entice people into a new subject area.

Much recent literature has discussed the suitability of hypermedia for exploration, whether a rich set of interconnections will allow opportunity for learning by browsing. Initial enthusiasm for this paradigm has given way to a realisation that free exploration is inefficient and needs to be supplemented by guidance.

For experimentation technology, particularly in the form of interactive simulations or expert systems, can begin to achieve real added-value for learning. The learner can interactive with the software. The answers to the learners' questions are provided through the (re)action of the simulation software. Here we begin to encounter the idea of the computer as a virtual laboratory.

3.2. Secondary courseware

Secondary courseware is constructed by teachers for their own courses. or is tailored from primary sources. The same tools can also be used by the learners to create their own courseware.

Secondary courseware supports the tasks students actually do when learning. This covers formal activities such as the completion of assignments, essays, projects, laboratory work as well as informal activities such as organising notes, searching for material, practising for exams. Here productivity tools can be used far more effectively if put in the hands of the learners to create their own material rather than for teachers to deliver material. It is the process of collecting, organising and explaining the material for other people which facilitates learning rather than reading the results of other people's learning activities. These tools range from word processors, graphics packages, authoring packages, expert system shells and even video conferencing.

3.3. Tertiary courseware

Tertiary courseware is a new kind of courseware, which hardly exists at present, but represents an idea which is currently attracting attention. Learning is facilitated through communication. The communication may take the form of questions, answers and discussion. This provides material for re-conceptualisation.

Tertiary courseware provides the best current opportunity for adding effective support to learning. It is centred around communications and uses technology to provide opportunities for discussion and reflection. This is particularly relevant to the needs of distant learners to provide a sense of belonging to a group, but

is also relevant to campus based institutions, especially multi-campus or those wishing to share resources and those wishing to broaden the learning experience for their students by introducing guest lecturers and broadening their peer community.

What technology now offers in support of dialogue is an environment in which discussions can occur without the participants being physically close and/or simultaneously present. Video conferencing makes distance unimportant but time is still crucial. Therefore this is not suitable for open learning. With the use of asynchronous communication tools such as computer conferencing and email neither time or location are important. Moreover, technologies such as the Internet allows the appropriate participants to locate one another in the first place.

3.4 Assessing the role of technology

When the role of a technology within learning is assessed, there are two separate criteria to consider, those or *effectiveness* and *efficiency*. Effectiveness refers to the opportunity the technology offers to improve on what is obtainable with traditional methods. Video conferencing is particularly promising for the support of dialogue.

When we turn to the question of efficiency, the case of technology delivering the primary exposition - the access to content - becomes stronger. The delivery may take the form of a video conference lecture or other forms of multimedia. The case revolves around the following issues:

- convenience and cost in allowing learner contact with primary courseware,
- the cost of original production of material,
- the frequency with which primary courseware needs to be updated,
- the importance of telepresence in distributing live teaching.

Video conferencing was not designed as a method for educating the masses. It is an intimate method of communication on an individual or small group basis. It does not replace the use of print or other methods used in the conceptualisation process. Its can be used to encourage construction, its true use lies in encouraging dialogue and increasing the scope for dialogue.

- It eliminates expensive travel
- It makes the best use of limited time
- It allow genuine dialogue between all participants.
- It allows immediate, full two way communication of content - verbal, pictorial objects etc.
- It provides a sense of social presence

3.5. Conclusions

Most ALT and multimedia development has been, and still is, aimed at the production of primary courseware. This represents a limited and mistaken view of the main opportunity for technology in learning. In many cases, existing media would fulfil learners' needs for access to subject matter perfectly adequate. The case for developing expensive primary courseware for delivery on a computer depends on the extent to which it makes the subject more understandable, perhaps through the use of simulations. Unfortunately such cases are quite rare. There is a cost efficiency argument for using technology for distribution but this should not be confused with the argument of using technology to provide more effective learning. To create a more effective learning environment, the scope for construction and dialogue must be increased. Figure 3 illustrates where video conferencing can be used to increase the potential for dialogue, both with in an individual learner environment and within a collaborative learner environment.

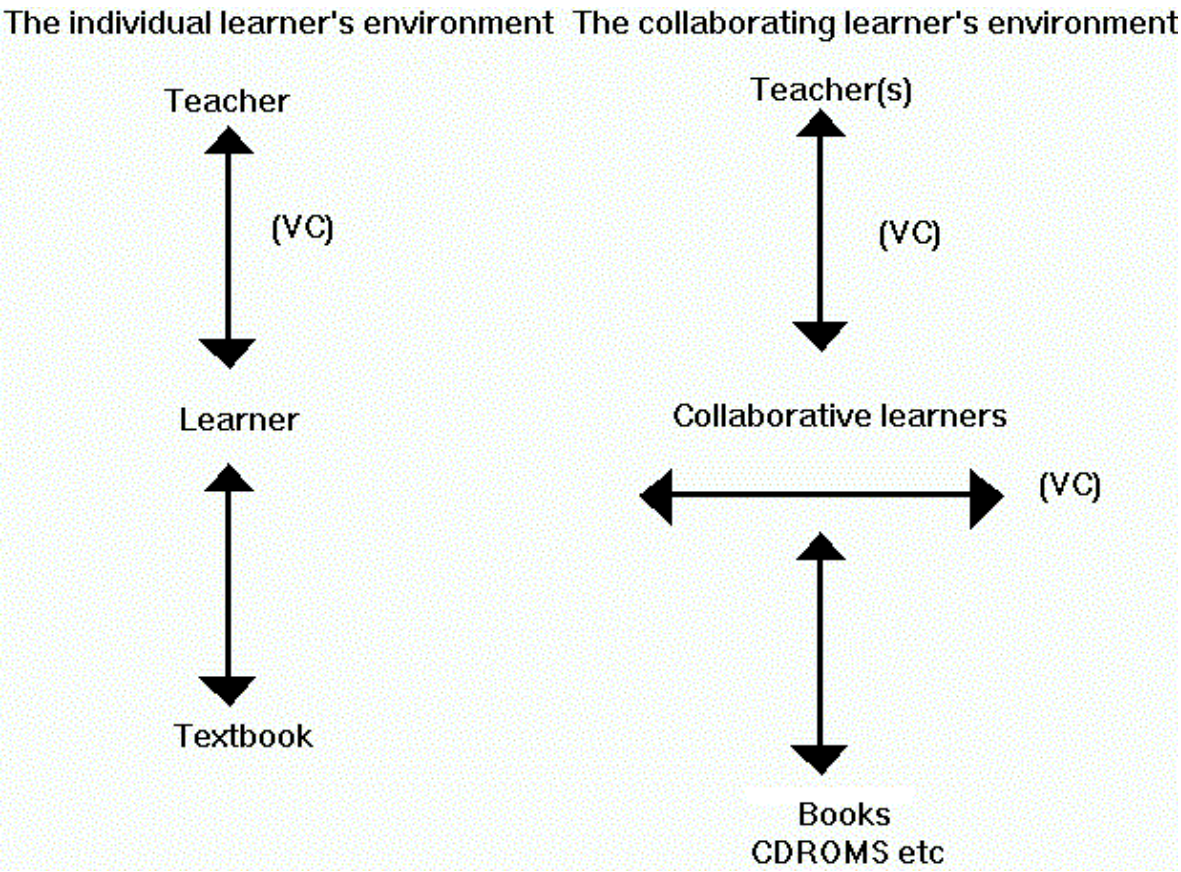

Figure 3: The learner's environment

Video conferencing has potential to deliver any of the three forms of courseware.

- *Conceptualisation.* The potential here is for delivering lectures at a distance, and following on traditional approach to learning in higher education.
- *Construction.* The video conferencing equipment can be used by the learners to work in groups on a task which they may not have been possible without the equipment.
- *Dialogue.* This is where the real potential of video conferencing lies. To support discussions and answering questions , otherwise unobtainable, either because of distance or of dwindling resources for small-group teaching. The visual presence of others may create a sense of social presence, although it does not add much in cognitive terms.

4. Learning and Technology

For the purpose of completeness, this report will quickly review the role of technologies, other than video conferencing, in learning.

The tables below illustrates the role of technologies for supporting learning. In one way applications, if the tools are put in the hands of subject experts to produce learning materials then they support the learner's conceptualisation. If, on the other hand, the learner is required to produce the handout, make a video about..., make a tape about..., give a lecture about..., then the same tools now support construction.

Media	Optimum no. of participants	One-way applications	Learning phase supported
Face to Face	10-200	Lecturing	Conceptualisation
print	20-1000+	course units; supplementary materials	Conceptualisation, Construction
audio	50-1000	cassette programmes; radio programmes	Conceptualisation
computer	100+	CAL, CAI, CBT, databases, multi-media, CD-ROM, productivity tools, structuring tools	Conceptualisation, Construction
television	5000+	broadcast programmes; taped programmes	Conceptualisation

Table 2: One-way technology applications in education and training.

Media	Optimum no. of participants	Two-way applications	Learning phase supported
Face to face	5-10	Seminars, discussions, tutorials	Construction and Dialogue
print	20-1000+	correspondence tutoring;	Reflection
audio	5-20	telephone tutoring; audio-conferencing,	Discussion, Reflection
computer	5-100	E-mail, desktop teaching computer-conferencing, audiographics, CSCW, Internet tools	Conceptualisation, construction, dialogue
television30+	5-30 (video conference)	interactive television (TV out, telephone in); video-conferencing	Conceptualisation, Discussion

Table 3: Two way technology applications in education and training

Tables 2 and 3 summarises the nature of support for learning offered by different technologies. It illustrates that it is more difficult to support learners in two-way communications than it is in one way. However the difficulties and costs of production and delivery of information in the one-way settings is much higher than in the two way. It is necessary to remember that two-way communication yields more effective learning, where as one-way may be more efficient for the organisation. This is particularly the case if the organisation is already set up to produce materials in this manner, with appropriate equipment and staff. Production costs are high and support costs are low. In traditional universities production costs are kept low and support costs are high. Distance Universities are set up to develop course material on a one-way basis. They have a production cycle of 2 years! A luxury not afforded more traditional universities. It would be more difficult for traditional universities to convert to producing books, multimedia, video tapes than it would be to convert to computer conferencing, using the Internet or video conferencing. For a more detailed discussion of the relationship of technology to the learning model see Mayes *et al* 1994.

5. Does the technology cause barriers for learning?

So far this report has discussed technology and learning and looked at how technology is being used to support learning. This section will look more closely at the psychological umplications for technologically-mediated learning. Figure 4 illustrates the potential for barriers as messages are coded, transported and decode by technology. This process is in addition to coding and decoding being carried out by the communicators.

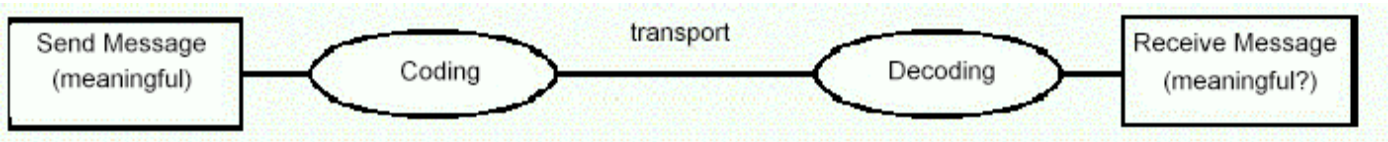

Figure 4 : Transporting Communication

An important question, still to be answered, is the extent to which video conferencing, with two-way video, can provide the psychological attributes of face-to-face encounters. If the richness of communication and a genuine sense of group that accompanies face-to-face encounters can be attained through telecommunication, then the consequences for education and training will be profound.

However, we can not simply assume that a 'virtual' situation will be the same as a face to face situation. If it is not the same we must find out how it differs and if these differences have a significant effect on the communication and learning process. The dynamics of educational and interpersonal interactions are dramatically changed when mediated by technology. To understand the nature of the changes we must investigate

- what are the effects of inter-communication delay?
- does the ability to see the person speaking improve interpersonal interaction?
- is all information transmitted in a real face to face received in a video conferencing situation, eye contact, gaze, body language etc.?
- what are the problems of managing video conferences?

5.1. Inter-communication delays

Timing of visual signals is known to be important for effective face to face communication and it is also known that ISDN technology with 128 kb/sec transmission rates carries signal delays, what effect does this delay have on performance? Inter-communication delays causes performance degradation on a collaborative task in both audio and video conditions (O'Malley et al 1994). This is particular obvious in the ability to interrupt, as the speaker has already continued with the next piece of information.

5.2. Interpersonal Interactions

Audio conferences have been used in distance education for a number of years. These are difficult to manage and learn with. Much attention must be paid to turn taking, involving everyone, identifying the speaker and speaking clearly. The natural advance, when the technology became available was to move to visual and audio communication, after all face to face interactions had been shown to be more effective than audio-only interactions (Boyle, Anderson & Newlands 1994). However, the adding visual images to distant conferencing does not appear to confer the same benefits of face to face. Another situation where people have been dragged behind advances in technology without understanding the implications. It was just assumed that seeing the speaker would be better. However research is now showing that the case is not as clear cut.

In audio-only interactions, the lack of visuals is compensated for by clearer enunciation, more thoughtful communication with less monologues. Adding visuals in the form of audio-graphics appears to maintain the need for clarity of interaction with explanation of the visuals being presented. Adding visuals in the form of "a view of the speaker" as mediated by video conferencing, does not lead to replication of the communication patterns and styles of interaction observed in face to face scenarios (Schiller & Miller 1992).

5.3. Information transmitted and received

It is naive to believe that the inclusion of a visual channel into a remote conferencing situation means an 'ideal' fact to face situation will be attained. The ability to see the remote teacher or peer groups does not automatically lead to increased levels of interaction, that is two-way communication. Many studies have shown that two way video conferencing cannot serve as a direct replacement for face to face (including Edigo 1988, O'Malley et al 1994). Other studies (Gensollen & Curien 1985, Bruce, 1994) in looking at video conferencing as compared to audio conferencing point out that technologically mediated communications filter out and distort many of the, often unconscious, signals which are used in face to face situations. These signals include lip

reading, body movement, gaze and eye contact. Such signals are used to regulate, maintain and progress verbal interactions. Paradoxically the existence of a visual channel may encourage lecturers to be far less attentive to distant groups and not take as much time to elicit questions and answers as might be expected in audio conference. This may mean that the visual channel is being used to verify the class is still there.

Video conferencing is difficult to investigate as it does not only add visual contact with the speaker but also the sharing of visual information in the form of overheads, slides, 3-d objects or even microscopic objects. It is still not clear which is more important. When we are in a lecture, we do not watch the lecturer all the time, we watch the materials being presented. The quality of this material has an effect on the communication process as is suggested by the number of guidelines on producing good visuals for presentations.

5.4. Management problems

The problems of communicating via video conferencing is also dependent of the geographical separation of the participants and the number of separate sites involved in the interaction. Obviously, the more sites the greater the problems of managing the communicational and educational process. Multipoint video conferencing is particularly problematic. Often the session is voice-activated, with the person speaking being visible to all participants. This means, as speaker, you see yourself not your audience! It can also lead to many problems as who ever makes the loudest noise grabs the camera, and thus people interrupt unintentionally.

5.5. Geographical set-ups

- remote teacher with all class at one distant location
- remote teacher with distant class separated over multiple locations
- teacher present at one class with one or more other locations taking part
- teacher to one individual at another location
- teacher to a number of individuals at a number of locations

If the teacher is actually present in one of the classrooms, it takes a lot more effort on their part to remember to involve the distant class and for both groups to feel equal. Ritchie & Newby's (1989) study showed that students in a distant classroom without an instructor felt less involved and did not enjoy the experience.

With different pedagogical scenarios, e.g. groupwork and peer tutoring it may be possible to eliminate the teacher from all these situations.

The more groups involved, the more complex the interaction and the technological and managerial problems grow. Such problems may distract from the learning process.

How many students can be managed, is the same as how long is a piece of string. Though it is dependent on the technology and the style of presentation adopted. Satellite with non-interactive lectures v's intimate one to one desktop. 100's v's up to 25

It is much harder to manage a virtual meeting than a real one. The educator must consider

- the management of communication flow between sites,
- the nature of activities at each site, individually or collaboratively,
- the number of people at each site.
- the management of social control (leaving the room, monitoring presence, not listening, interrupting the class, turn taking and disrupting a distant class).
- The educator must also consider how communications will occur during off-air time.

Considering the problems of technology, it may be that video conferencing is best suited for non-interactive lecturing to large groups, when students can not be physically present. This is especially so when detailed visual material is to be presented, for instance slides in microbiology. In small group discussions, the case is less clear. Some researchers suggest that the visual channel for eye contact, and sense of social presence will give more efficient performance (Taylor 1991), but newer research suggests the case is less clear (Bruce 1994). It is also not clear whether the barriers imposed by the technology can be overcome with appropriate training. It is clear that it is not possible to generalise the effectiveness of video conferencing out with the context in which it was carried out; the educational scenario, group size, role of tutor, number of sites and role of visual materials and motivation of the participants are all compounding variables.

6. Pedagogy

It is important to consider the methods of teaching adopted in video conferencing situations. It is necessary to consider whether the technology is more suited to a particular teaching strategy. In Australia has tried it with courses as diverse as a traditional lecture course, to Sign Language to a workshop for Chefs.

One study which looked closely at this issue is Kendall & Oaks (1992) They used two way interactive video delivered via microwave. Tutors (n=68) were asked to rate the effectiveness of this system over tradition face to face for each teaching strategy. There were a number of interesting findings.

1. Tutors were most likely to use the video conferencing system for lectures (100 % of tutors used the system where as only 49% of tutors used it for case studies. Over 90% of tutors used it for group discussions and question and answer sessions, 64 % for laboratories or demonstrations and about 50 % for seminars.

2. Over two thirds of the tutors thought it was less effective for group discussions and seminars and half for question and answers. For the other teaching situations, most tutors thought it was equally or more effective.

3. When asked to rate the amount of curricular adaptations that had to be made, changes were always required. With course syllabus, organization of the course, handouts, assignments and exams they were mainly minor changes. With interaction with students, audio-visual aids, and delivery of content major changes were required.

Asked whether the system affected their ability to perform selected activities in the classroom over half the tutors found it harder to actively involve students, to encourage participation, to give hands on experience. But over half found it equal or easier to respect student opinions, stimulate critical thinking, consciously plan for the event, prepare lessons based on needs of learners, encourage the expression of differing viewpoints and use active interesting audio-visual aids.

5. What teachers said they missed most about using the system was loss personal interaction with students at other campuses, 83% said their teaching over whets was more impersonal.

6. They also felt that off campus students were more motivated, independent, older higher achievement level but equal in academic confidence.

6.1. What the students think

Paul Rixon says that the students vastly prefer video conferencing to other forms of communication in distance education. They also become more self reliant, they run their own rooms, and this self reliance spills into other parts like negotiating with lecturers and libraries. Results are at least as good as for standard courses. because the students realise that video conferencing gives then access to a wider range of options, they generate considerable peer pressure to keep the group going - this creates a low drop out rate.

In another study which asked students rather than tutors, Students at the University of Ulster sessions felt that the VC system lent itself best to lectures and least to free flowing discussions and they would recommend this form of learning to other students(Abbot et al 1993)

Ritchie & Newby (1989) randomly assigned 26 college student to three classroom settings: traditional classroom with instructor,, TV studio with an instructor, studio classroom with no instructor. The students in the studio classroom rated instruction less enjoyable than those who had an instructor in the room with them; they also rated their involvement as significantly lower than the other two groups.

8.2 Summary

When looking at the pedagogical issues, the research is very contradictory, is the method suitable for all teaching methods, does it facilitate effective communications and learning. Do not confuse technology with pedagogy or students reactions to teaching methods as reactions to technology. Most importantly, do not underestimate the power of the Hawthorne effect when video conferencing is novel to students and staff. The successful projects appear to change their teaching methods as well as use video conferencing. Tutors lecture less and encourage active student participation in course content and presentation. They also encourage independent group work rather than all individual assessments. (Abbot et al 1993) There is a need for evaluation with the same independent group learning without the video conferencing system. Thus improvements or failures in students attitudes and learning cannot simply be attributed to the technology. Also when students are asked to do presentations followed by discussions many are not good at this, talking too much etc. but this is not because of the video conferencing technology. It illustrates a need for such a skill to be taught to students. Although exaggerated in a video conferencing setting as students have to manage the equipment as well as the group and the discussion. Many are petrified. There is still a lot to understand about technologically mediated communication, its interaction with teaching methods and student attitude to active learning.

7. Technological and Cost Issues

- Very little experience of two way video services is not simple ad hoc or special event. It is difficult to anticipate the costs of running a regular service **based** on this technology.
- Compressed video reduces dramatically the bandwidth required for high quality digital video. This will reduce transmission costs. (but still high)
- The educational **justification** for 2-way video conferencing comes from increasing teacher to student ratios by sharing teachers between sites, through reducing travel costs, and allowing greater access to quality teaching regardless of geographical location.
- Costs will also be incurred by curriculum development, preparing teaching materials, training teaching staff, facility costs (codecs and building conversions) - not just transmission.
- The cost of hardware, software and transmission is constantly changing.
- Careful consideration of all the costs involved is crucial. Network management and volume of traffic are also critical factors. Few educational users can generate sufficient traffic to justify a dedicated wide band system. On **demand** wide band services are not generally **available**. Maybe that we need a dedicated government funded, video conferencing network that is shared between all educational services. This has been done in Norway. Then economy of scale can be achieved.
- Who will pay the costs?
    - Initial set up
    - Staffing
    - Compensating staff for extra work

- Ongoing phone bills. There is currently no educational rate for phone calls.

- Training: Invest in People

  Technological training - for a small investment in people (one half to one full days training with the technology) a vast improvement in the use of the technology will be seen. It is critical to deliver such training in advance of course design and development so that the deliverers are aware of the strengths and weaknesses of the medium.

  Ongoing training - lecturers can not continue with no teaching in teaching methods, communication skills, organisational and time management skills etc. The success of video conferencing will lie in the people communicating not the technology.

8. The Institutional Context

It is clear that an understanding of the learning process and the way in which technology can best support it, are necessary for successful teaching. However they are not sufficient conditions for success. There are other factors which are also important determinant s of successful implementation, but which lie outside the model of learning. These factors relate to the current institutional culture in UK higher education. The main factors are as follows:

- The need for large scale collaboration in education technology development.
- The need to share resources, especially transferable courseware, on a national scale.
- The need to establish links with schools and training organisations.
- The need to mount a programme of research into the approaches which work best for different disciplines
- The need to recognise that proper evaluation of educational technology needs resources at least as substantial as those provided for the development of the technology itself
- The need for staff development
- The need for computer literacy programs for learners and teachers.
- The need for a ‘systems’ view of technology, in which the human factors, including training and staff development, are seen as equally as important as the hardware and software.

The greatest underlying institutional barrier to development is the value attached to teaching.

> *..”The greatest challenge is to persuade a majority of those involved in higher education to see teaching as their prime activity, and as one posing intellectual challenges and offering rewards comparable to those of standard research.”*
>
> The MacFarlane Report, 1993.

9. Critical Factors for success

Through carrying out the research for this work, and taking part in a number of video conferencing scenarios, a number of critical factors have been identified. These factors are listed and discussed next.

- critical preparation
- site logistics
- microphone issues
- leadership
- timing
- non-verbal and verbal communication
- enhancement of interpersonal skills
- the issue of control for the instructor
- information dissemination
- media to use
- site involvement
- variations in teaching skills and instructional strategies
- training requirements

Critical preparation

- Most projects have initial teething problems, sometimes with serious negative consequences for learning such as cancellation of courses. There must be a back up to established in case the technology fails!
- Consider whether a pre-course face to face meeting is necessary to establish good interaction during the course.
- Prepare students to understand that this is new technology and that we are all learning and that things may go wrong. Admit there are special challenges in video conferencing.
- Prepare students for the form of learning to be adopted during the course. Ask students to take some responsibility for their own learning,
- Trials have brought to light a number of technical limitations and unfulfilled requirements which were not initially anticipated (e.g. dealing with mathematical notation). Test whether you can use the system for what you want to. If you do not see it in action, do not believe it. Run a pilot course.

- Plan for a large amount of instructional preparation time (including running a pilot trial) if you have not used video conferencing before.
- Tutors must take more preparation time, pre-distributing notes etc**.** so that the most effective time can be made of the actual conference time.

Site logistics

Evaluations have identified a number of problems with both the configuration of the electronic network (too many students at some sites for meaningful interaction, too many sites involved) and the physical layout of the classrooms.

- consider the number of sites and the number of participants at each site. As numbers increase management issues are compounded.
- Most of the situations I have reviewed only use point to point for normal teaching.
- Students valued the exchange of ideas, debate of professional issues and the new collegial relationships made possible. Students remarked that liked fewer sites so as to get to know individuals better and have longer time to interact.

Equipment

The numbers of cameras, monitors, VCR's, microphones and other forms of technology can vary greatly between sites.

- It is useful to have at least two monitors, one for outgoing and one for incoming.
- Many different forms of microphones, push-button, omni-directional, bug in the ear, cordless and open.
- Speakers should not be tinny.
- Point to point is fine, multi point with auto-cycling or audio activated can cause problems.
- The instructor should cue for orderly conduct. With instructions of what to look at.
- Inter-communication delay should be minimised. If there is a delay, then the speaker should take breaks to allow interruptions and ask for questions.

Microphone issues

- Students did not like push-button microphones. the site with omni-directional microphones was more conducive to normal interaction within and between sites, others tended to discuss locally.
- Asking a question or making a comment bordered on a competition. Instructor should take specific action to include all sites in an orderly fashion

SIMA Video Conferencing Outline

Leadership

- Ask a student to be representative to report sound/ vision quality at the time, and to report on the course in general as soon as there is a problem.
- The more sites and participants the greater the need for instructor leadership.
- Sessions should be well structured and defined with clear time constraints
- Leader must acknowledge verbally all contributions.
- Check for understanding by giving time to capture thoughts, doing a summary session,
- Provide clear time out for reflection.
- A proactive instructor gives concise directives, speaks clearly, paces sessions, monitors the length of responses uses signs on the screen (e.g. 7 mins to go)
- Time management creates a professional respectful atmosphere.
- Allow each site to work by itself on various things and bring people back at a specified time and with a specified signal. Build site camaraderie as well as cross site
- Prepare a bag of trick to use under various situations such as later in a session that runs for several hours or if there is down time.

Timing

Video conferencing can cause extreme fatigue. More intense concentration is required. Video conferencing should not be used to cram all contact time into one session but should be spread through out the duration of a course.

- Keep the first session a short orientation session.
- Some people can not concentrate for more than 6 minutes at a time! Do not talk at students for more than 10 minutes at a time. After such time allow for an activity or time for interaction.
- Have a break every 30 minutes.
- A maximun of 60 minutes for each session is recommended.

Non-verbal and verbal communication

- Instructor must establish interpersonal rapport with students. Instructors should be sensitive to learners social and emotional needs, create a sense of belonging. Should still lean forward to listen, nod head, open mouth to participate.
- Voice quality (pitch tone volume pausing and pacing) is important. The visual component encourages participants to enunciate less clearly as they would in a face to face situation when in fact they should maintain the same level of clarity as communicating via the telephone.
- Voice animation energy, enthusiasm critical motivating factor in distance learning.

Enhancement of interpersonal skills

- Depersonalisation can occur due to lack of physical contact with sites. Learners view instructor as object on a screen. The tutor must overcome this and develop an environment of trust and co-operation.
- Should address affective issues openly, explain that it will be more difficult . Learn peoples names, address them directly
- Initial face to face, or going to other sites to broadcast, is the best way if possible.
- Building up student profiles - personalities and individual needs is more **difficult** at a distance. Tutors should **endeavour** to get to know students at the beginning, could **incorporate** some game, introduce each other, send photo at beginning/during induction.

Also for students

- encourage mutual assistance when students know in advance that they will miss a session

Issue of control

- The instructor can only see one site at a time. Students off camera, sometimes mute the microphone. Can be frustrating and disappointment if the camera auto-cycles and finds the class doing something else.
- Students do have a tendency to talk during class presentations.
- Must engage learners, balance involvement.

Written materials

- course readings etc. outlines worksheets capture attention and free learner from note taking must be established and distributed on time. Course schedule expectations assignments, procedures for communication, criteria for evaluation, should be part of course packet.
- Students often want overheads as handouts

Other media

- Hard copy, overheads, slides, video can all be used. They add visual interest to the presentation.
- Do not be frightened to show tapes as would in normal class where appropriate
- Some reports recommend Video taping sessions for those who have missed a session or wish to use it as revision reminding people that if they don’t come there is less to see. It is questionable, it may encourage lack of participation.

Site involvement

- Involve on-site and off-site equally. Think of camera as another student.
- Consider at least one session that brings everyone of all the sites together e.g. a tour or special presentation
- During each session ensure that there is a lot of opportunity to interact with others, either at the site or across sites. Individual reports, team reports, presentations and feedback etc.
- Students often report feeling isolated and that they don't get enough feedback, tutors should endeavour to supply regular feedback through out the course.

Moderator

- To welcome the session and insure smooth flow between topics. the role of moderator can be passed around sites and individuals to encourage involvement.

Student contact

Procedures for contact when not video conferencing should be set up. Some tutors miss the lack of personal contact with students and may prefer to have some face to face within a course.

- Arrange for times to chat individually with the tutor especially about projects in progress. This could be during class or at a specified time or via email or phone
- If possible set up a support network and means of communication (email) for off air time between learners.

Variations in teaching skills and styles

There is still a need to determine the best teaching method, material and media to meet learner needs effectively in each specific situation. It is not a straight forward face to face situations, so methods used in a face to face situation may not be appicable.

- Many guidelines include a bit about using humour and surprise judiciously, difficult to guide some one on this - just don't overdo it!
- Arrange for opportunities to interact with others with the same technology e.g. a guest visit or visitor
- Information should be provided in small components.
- Students didn't like being lectured at for long periods of time
- Practice participation and involvement.
- The most effective style of presentation is conversation. Not to lecture at the students but to encourage active participation. This does not come naturally to all.

- Class discussions, debates, role playing, presenting papers should be used instead of lecturing
- Individual and group projects with the students controlling the video conferencing can also be useful.

Training

Training of teachers and students on how to use technology is one side of the problem; the real trick is helping lecturers adapt teaching and learning methods to fully exploit the potential of the technology. Without training, the systems will be under used. Although it is not as expensive or different as full TV production there are still additional skills required to those possessed by a classroom teacher (or is it that existing weaknesses are just highlighted??). After a couple of sessions most lecturers and students just take video conferencing in their stride. However it would be better if these sessions occurred out with the learning experience.

- video conferencing can be challenging for the tutor. It may prove harder for them to get contribution from students, strategies should be developed to encourage student contributions
- Fear of the technology - this must be combated. Video taping self for private feedback
- continuous staff development
- Levels of interaction will only increase when both the students and the tutors are comfortable with the set up.

Students need training too

- students must not be frightened to interact
- many are anxious about using the technology
- feel they need more training especially in using the rostrum camera
- Some students did not like seeing themselves on the monitor to start with. They continually assess themselves. After a few weeks, students accepted and ignored the cameras

Videoconferencing: the future?

There is, as we have seen, an increasing variety of ways in which to deliver videoconferencing. The most appropriate choice of system will depend partly on the physical configuration of sites to be connected, the number of people to be included in the conference, the applications that are required, the amount of traffic to be carried, and the distances between sites.

A recent survey of educational applications of videoconferencing technology in North America (Bates 1992) identified a number of findings that are likely to have a wide relevance.

- Trials of medium- and wide-band applications have consistently shown that students prefer the 'electronic classroom' at a local site to having to travel to another learning centre or central campus.

- The amount of time needed for instructional preparation time was usually grossly under-estimated, and teaching (and learning) methods often had to be radically changed to exploit fully the teaching potential of the technology. Videoconferencing for teaching purposes required additional skills to those of a classroom teacher. Without training of the teaching staff and their students, systems were under-used.
- In many of the projects reviewed, it was difficult, given the extra cost and lack of exploitation of the visual medium, to see the justification for using videoconferencing rather than audio-conferencing.
- None of the projects reviewed provided firm evidence that two-way live videoconferencing was more effective than one-way video plus two-way audio, or even the distribution of video tapes for individual use. Indeed, there was some evidence that mature students who were working preferred flexibility to live video interaction, if the latter meant they had to be in a certain place at a certain time (Stone 1992). We do not fully understand the psychological limitations of video conferencing, more research in this area is essential.

Despite these views, there is current excitement over the development of low-cost PC-based videoconferencing, using public domain software and small cameras (the manufacturing cost of the Edinburgh university-developed 'camera-on-a-chip' is now negligible). Increasingly, we are seeing videoconferencing experiments conducted over the Internet. The Global School House project [7] is a good example. If video of the user becomes "just another datatype", so the argument goes, then video will be used naturally to support communication. Where high-bandwidth communication (high-bandwidth in the psychological sense) is found to be important, then video will be demanded.

Anything is possible with video conferencing if enough money is available. However, Institutes must have a clear plan about how they want to teach and where they want teaching to be delivered before committing to a particular delivery technology if cost effective systems are to be established.

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Appendix 1:
Coping with video compression

Because compressed video uses such a narrow bandwidth (typically 128 kbps - 384 kbps) the quality of the connection is not of broadcast quality. These tips are useful for presenters on how to cope with some of the difficulties this causes.

Video

Motion is not handled as well as at might be. This means that rapid movements produce a blurred effect at the far-end. Strategies to deal with this include:

- try to avoid rapid movements, like shaking your head;
- try to avoid pacing around or erratic hand gestures;
- make use of the visualiser (show what you are talking about);
- have your presentation aids ready to hand and organised.

Audio

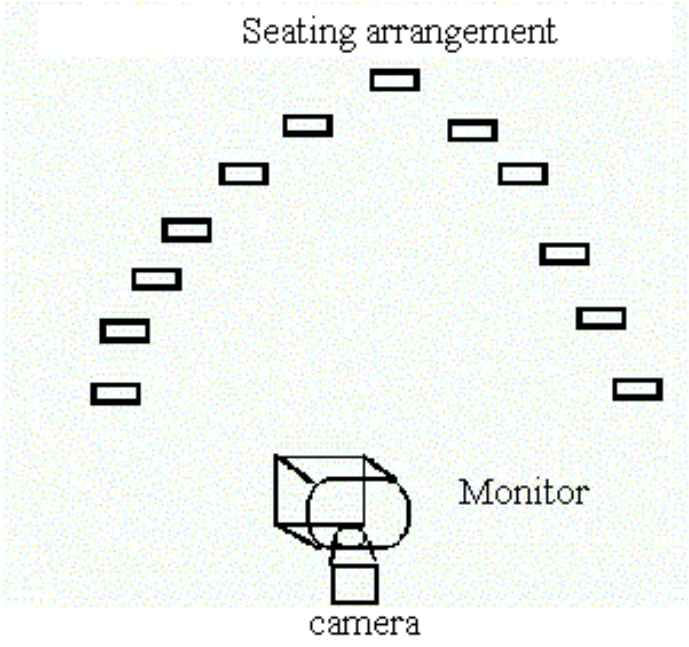
Users will note that there is a delay between talking at one site and when a response is noted at the remote site. This delay is just long enough for participants to talk over each other until they adjust to the delay:

- pause when you expect a response from the far-end site;
- wait until the speaker at the far-end has finished talk before you reply;
- speak at a comfortable pace but not too quickly
- enunciate clearly

Appendix 2:
Room set up

The best scenario is to have a specialised room with qualified staff to set up and maintain the room and the equipment.

- ensure that the room has a wall clock
- ensure that the room is well air conditioned
- if the session is to last more than one hour ensure that coffee facilities are near at hand to counteract “technostress” - concentrating on content whilst coping with equipment is stressful.
- ensure that water is available in the room
- seating arrangement may be best as a V shape allowing the remote group to be involved and discussion locally to be facilitated. The monitor can be thought of as another person in the group.
- Placing the camera above or below the monitor can help achieve eye contact as people tend to look at the monitor and the image of the person rather than the camera.



- Lighting and framing subjects should follow the same guidelines as for photography.
- Good, controlled lighting, which reduces shadows, have the background evenly lit.
- Do not put people next to the window, especially if the camera is to focus on them.
- Frame people properly. Close ups do not work well with compressed video.

Camera equipment

- There are a few problems with classroom design, especially camera placement. It is an iterative process, make sure there is enough time to try out different designs.
- Camera should be placed for eye contact
- Try to have a fixed camera position
- Mark the floor where the lecturer will be on camera

Sound equipment

- Check sound, have acoustics as good as possible cut out extraneous noise.
- Remember microphones are difficult to manage
- Have good speakers, not too tinny, not too strong.

Appendix 3:
Visual Presentation Issues

When looking at the visual information presented via the video conference there are three aspects to consider:

- The backdrop;
- The Presenter's appearance;
- The Information presented.

The backdrop
The backdrop is important. Some people feel that a video conference can take part in any environment, with anything going on in the background. This depends on the nature of the communication as a busy background can have a distracting effect. A plain, uncluttered backdrop, probably in pale blue or grey has the least interfering effect. The backdrop may also be used to display your logo/identifier so that the remote site has a visual reminder of the Institution you represent.

The Presenter
- wear white shirt
- Don't wear high contrasts such as herring bone or small black/white checks
- Don't wear highly saturated colours such as bright red or green

The Information presented
Effective visual presentation can improve retention by up to 50%. Thus investment in producing good and appropriate visual aids can produce practical and measurable returns. With other things lacking (face to face, body language), visual material even more important. The proper audio-visual hardware and materials are key to informing and communicating with every conference participant. We have heard about active learning, we also need active presentations!

Using real materials (rather than line drawings) can stimulate interest. If possible use the real object rather than a representation of it. This means using the appropriate hardware, for instance the Micro-video system for biology or chemistry

The following information is vital for the presentation of visual materials. Visual materials should be *attention getting, meaningful, memorable* and *activating*. They should be created in such a way that they

- fit the setting
- support the message
- awaken the audience

This will probably mean

- pictorial
- colourful and
- creative

An excellent book on preparing the visual side of a visual conference is “Effective Video Conferences”

Appendix 4:
Organising a Videoconference

- Ensure all sites have the appropriate digital service
- Overseas connections should be tested before assuming they will work
- Plan to have a technician at all sites if possible.
- Think about how different visual resources will be used
- Design visuals according to guidelines
- Experiment with the camera to get focused well composed views
- Pre-set the camera for graphics
- Pay attention to lighting and sound.

Bookings

- Do you have to book a videoconference room?
- Leave enough time to make all arrangements

The person organising the set up will need to know

- the number of the locations to be linked in
- name and contact number of the conference organiser
- name and contact details of other sites involved
- who will initiate the calls
- the date and time of the conference (be aware of time difference)
- the length of the conference. It is good practice to connect 10 minutes prior to start time to allow fine tuning
- the number of participants at each location
- the facilities required
- whether assistance is required during the presentation
- whether the conference is strictly private.

The participants will need to know

- is attendance compulsory
- who will be facilitator or chairperson
- contact details of conference convenor and studio manager
- any special items that have to be brought to the conference
- location

- date and duration

Confirmation

- It is a good idea to confirm all details with all concerned a few days before the conference. Confirm start and finish times, equipment requirements and any support staff
- Confirm the link has been tested
- Confirm the attendance of all participants.

Preparedness

- Video conferencing equipment should be set up at all times to enable any caller to walk in and use the system as they would a phone.
- Induction time: course induction should cover not only module information and organisational issues but also adequate and appropriate instruction on the use of the equipment itself. “hands on” “dry run”
- Packages of information should be sent to the students in advance so that they are prepared for each meeting.
- Plan ahead to allow for professional and complete visual aids. Unfortunately many speakers leave this to the last minute. Then you might not be able to get exactly what you want. Prepare your visuals professionally if you can afford it, but in any event before the day of the video conference.
- On the day of the video conference, check all visuals are in order, equipment in order etc.

Appendix 5:
Contacts

This project has involved interviews with many people actively involved in video conferencing in Higher Education. These people are always willing to assist those new to the field and discuss their set ups.

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SIMA Video Conferencing Outline

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