



Evaluation of Conferencing Technologies For Learning

**Ranjana Shukla
Donald Joyce**

UNITEC Institute of Technology
Auckland, New Zealand

rshukla@unitec.ac.nz

ABSTRACT

Conferencing can be a cost-effective way of bringing education to learners who would not otherwise have access to a course because of distance, cost or other inconveniences. It can also be used to augment learning by including guest lectures, interviews with experts, and panel discussions. This paper evaluates four conferencing technologies from the perspective of enhancing the delivery of online courses, in particular by incorporating real time discussions, presentations or seminars. The analysis shows that each of the technologies has at least one advantage over the other three in particular educational scenarios. Guidelines are provided for choosing the most appropriate technology for a specific context.

1. INTRODUCTION

"Web-based instruction is coming whether we think it is good or not. ..web teaching is here to stay- at least for a while" (Brooks, 2000, p32).

The aim of this paper is to describe and analyse conferencing technologies to enhance delivery of online courses.

The technologies discussed are Audio Conferencing (AC), Videoconferencing (VC), Desktop Video Conferencing (DTVC), and Conferencing with Text-To-Speech (TTS) engines (CTTS). These conferencing tools have been examined for their suitability in different educational scenarios to incorporate real time presentations/seminars in online courses. Discussion boards have not been described in this paper as they are used for asynchronous text based group discussions, which may not be as effective as synchronous discussions (Brooks 2000, p43).

2. TRADITIONAL TEACHING

In traditional classrooms, a teacher generally delivers lectures. On other occasions a student or group of students might present a seminar. For student presentations a time frame for their research will be worked out between teacher and students depending on the course requirements. At the conclusion of this specified time period, students are expected to give a seminar or presentation on a given date and time in the presence of the selected audience. The choice of audience will vary from course to course. The teacher and students use a variety of media for presentations such as PowerPoint slides, or similar multimedia presentations tools, overheads, or whiteboard, as deemed necessary. At the end of a presentation or



lecture, a question and answer session is very important to ensure correct exchange of knowledge. All this happens in real time, in the physical presence of the audience.

3. RESEARCH QUESTION

How could such a live presentation be implemented in an online course, to enhance the course delivery? In a course that is delivered totally online, it can be assumed that the students will not participate in face-to-face classroom sessions. Students can be working professionals and/or residing in different parts of the country (or even different part of the worlds). In designing such a course, it is important to take the conferencing technology used into account as it is the main form of communication between teacher and students. In case of student presentations, choosing a topic, time frame and other details can be worked out in consultation with the teacher using any of the several electronics communication means available, such as electronic mail. For delivering the presentation online, a suitable conferencing technology should be selected based on the requirements of the course, including number of students, geographical situation and access to technology. Available funding might also influence the selection of the conferencing technology.

4. OBJECTIVE

The authors have critically analyzed Audio-Conferencing (AC), Videoconferencing (VC), Desk Top Video Conferencing (DTV) and conferencing using TTS engines (CTTS) for implementing presentations in web-based courses. The features considered for qualitative analysis are based on advantages and disadvantages in relation to

- ◆ Equipment
- ◆ Media
- ◆ Cost
- ◆ Training

The later part of the paper examines the suitability of these conferencing technologies for delivering presentations in different situations. According to Klobas (2000, p57) “no single technology can meet all the goals that may be set for web-based teaching and learning activities.” On the basis of the above analysis, the authors identify which technology is

relatively better suited in a specific situation to deliver virtual presentations for online courses.

5. LITERATURE REVIEW

Educational awareness has engulfed the world. The number of students seeking tertiary education is growing every year. Many aspiring students have jobs and may prefer evening or flexible classes. Such tutoring can be conducted between a teacher and student via web-conferencing. It is a very practical way of “conducting many student/teacher conferences” (Brookes 2000, p81). Porter explains that the students who require a set schedule for motivation and others who like direct interaction may benefit if some part of the course can be offered using videoconferencing. Because videoconferencing mimics some elements of classroom teaching, traditional students may feel more comfortable. The occasional videoconference could “enhance potential of many courses” (Porter, 1997, p157).

In a videoconference the teacher presents information that is uplinked and downlinked, via satellite, ISDN lines, microwave link etc., among remote locations. It is a live presentation; although physically apart, students and teacher can see each other and “can respond in real time” (Porter, 1997, p162). Videoconferencing is limited to the number of sites that can be linked in a videoconference. The limitation may be due to the number of sites with “available technology or number of participants” (Porter, 1997, p167). It is important to decide the protocol or netiquette between teacher and students. This may help in effective and consistent communication that will lead to “reliability of the study” (Miles and Huberman, 1994, cited in Hock, *et al.* 2000, p335).

Desktop videoconferencing is similar to videoconferencing. In desktop videoconferencing, transmission and reception of the presentation is through personal computers connected by modems to telephone lines. “The ‘conference’ is created through a LAN consisting of the videoconference’s participants” (Porter, 1997, p167). Videoconferencing or desktop videoconferencing might not be the best forms of distance learning. In spite of that “they are becoming increasingly common” (Porter, 1997, p157). According to Porter an increased variety of conferencing software is becoming available for face-to-face conferencing via computers and telephone technology.

6. TECHNICAL DETAILS

In the following paragraphs some technical issues pertaining to conferencing technologies have been described to indicate some technical difficulties in using these technologies.

Audio signal transmission takes up a consistent amount of transmission space on a channel, that is, it always uses a constant bandwidth. The audio signal is never compromised. If the data carrying capacity of a channel is increased, it only 'improves the video-carrying capability, not audio-carrying capability' (Porter, 1997, p159). The channel bandwidth available determines how much information can be sent at one time. Video communication requires a great deal of bandwidth since a large amount of data is to be transmitted.

Communication lines can transmit both audio and video signals. Integrated service digital network (ISDN) offers higher bandwidth than traditional telephone lines. The type of connection used in ISDN lines is circuit-switch communication channel. It can maintain the connection as long as desired. Ethernet is yet another type of faster network, used within a company or educational institution. Packet-switched communication channels have to share bandwidth with all other users in a system. When many users are accessing a packet-switched channel, it takes longer to send and receive information as compared to when the channel has only a few users. Packet-switched technology is used in Internet communication.

7. VIDEOCONFERENCING

Videoconferencing allows two or more individuals at different sites to see and talk to each other at the same time. To conduct videoconferencing, an organization may set up a special studio room equipped with videoconferencing equipment, TV, projection systems, cameras sound system, and other accessories as deemed necessary. The number of participants would depend on the conferencing system. During videoconferencing the presented information can be up-linked or downlinked via satellite, microwave link, or ISDN telephone lines, etc. Sometimes cable television or intranet is also used for videoconferencing. Videoconferencing caters for live presentations, where teacher and students can communicate synchronously. In a typical videoconferencing scenario two-way audio and one-

way video may be used to save the cost. A teacher can lecture in the videoconferencing studio and students at remote location can see the teacher and talk to him/her using microphones. Two way video would be possible at a higher cost.

7.1 EQUIPMENT

A videoconferencing system must have audiovisual equipment (monitors, cameras, microphones, speakers and control system) as well as means of transmitting and receiving information between two remote locations. A broadband satellite connection with a studio quality system gives excellent quality of video but at an exorbitant cost. One would require uplink and downlink equipment for satellite communication. Advances in videoconferencing technology have provided compressed video. Compressed video can greatly reduce the transmission cost and make videoconferencing available to broader section of users, who would like to use it but were constrained due to high cost. To incorporate this technology in videoconferencing systems, a special CODEC system is used. It COMPresses the outgoing video signal and DECompresses the incoming video signals. The CODEC allows information to be transmitted using Internet or ISDN telephone lines. Many videoconferencing systems provide features like remote control of cameras in the studio and also at remote location for better viewing angles. Depending on the requirement one could include a projection system and graphic tablet to enhance the quality of information exchanged.

The classroom used for videoconferencing is usually dedicated to this type of instruction; it should be equipped with special consoles, in-table microphones or moveable microphones to allow the room setup to be organized according to the type of course. Teachers typically work from a console, from which they can manipulate visual displays and control the camera's emphasis on their presentation. Documents, transparencies, computer displays, photographs, slides, and other graphics could be displayed for the viewing audience in classroom and remote site(s). It is possible to switch the video to show the person who is speaking and communicate directly with student.

7.2 MEDIA

Videoconferencing may be limited to an intranet (LAN) or may use public networks (regular phone lines). Often Integrated Service Digital Network (ISDN) lines are used. It is an economical solution. ISDN uses regular copper wire telephone lines and transmits and receives digitally. One can upgrade the ISDN capacity (64kbps to 128kbps or 256kbps or higher) to improve video quality. It is possible to use satellite to uplink and downlink the information to remote site(s) at a higher initial cost. Some organizations use microwave links for videoconferencing.

7.3 COST

In general, the cost of videoconferencing ranges from \$30,000 for a simple videoconferencing setup to \$100,000 for a superior one. Besides the basic components there are other hidden costs such as satellite uplink and downlink equipment, ISDN lines, microwave link. Therefore unless one has a clear picture of the requirements it is difficult to work out the total investment. The cost of videoconferencing might be prohibitive for some programmes, because each receiving location must be equipped with downlink equipment, and the transmitting location must have a studio or an interactive classroom from which to broadcast, complete with uplink and downlink equipment. Satellite transmission provides a "better quality visual, but the cost is higher than compressed video" (Porter, 1997, p167).

7.4 TRAINING

Teachers may require "continuous access to support from technicians" (Reynold and Fraeters, 1999, p13) for proper usage of videoconferencing and to help the teachers/presenter(s). The teachers/presenter(s) would require some training to use videoconferencing equipment. Training might range from few days to a couple of weeks, depending on the sophistication of the equipment. The teachers have to learn how to coordinate various systems properly and effectively. They have to develop a new methodology to deliver lecture in a studio. It is quite different from traditional classroom teaching. The teacher needs to develop "broadcast personality" (Porter, 1997, p172) too.

Unless the videoconferencing is properly integrated in a "graded curriculum" (Inglis, *et al.* 1999, p39), most of the students will never use

videoconferencing. New direction might be required in implementing the teaching strategies such as interaction and facilitation. Although the students seem to be there, in reality they are in remote locations.

7.5 ADVANTAGES

Videoconferencing may not be as good as classroom teaching, yet it provides "enough of personal interaction such that the teacher can provide adequate motivation and direction for the student" (Brookes, 2000, p81). It may also help in providing quality education to remote learners, not just correspondence, or a passive video or CD. Good real time communication should be able to enhance motivation, bring depth to understanding, and provide for multiple learning styles. It may give a community feeling and students will feel connected, not isolated. Videoconferencing can be helpful in bringing remote experts or guest lecturers to the classroom and enhancing contacts across the world.

7.6 DISADVANTAGES

Videoconferencing cost can be exorbitant and may be beyond the reach of many educational institutions. Connection is limited to the number of sites linked and limited number of participants. Videoconferencing is not cost effective for one-to-one or "for small groups" (Porter, 1997, pp157).

8. AUDIO Conferencing

Audio conferencing is a discussion forum between two or more individuals through a sound-transmitting device. This device can be a most expensive video conferencing microphone or a simple rotary phone. Regardless of what technology is used, audio conferencing is probably the oldest and most important form communication today. It gives personality to the individual behind the equipment and is effective in conveying emotion.

8.1 EQUIPMENT

At the technical level, audio conferencing consists of telephones (handsets and/or speaker-phones) that can be used by teachers and students; a telephone network that links the telephones (typically a standard dial up telephone); and a mechanism, which links these various telephones (a conferencing call service).

Audio conferencing in the 'multipoint' mode is becoming more readily available as a standard feature on modern PABX systems. It enables audio conferencing to be set up from a desktop terminal and allow number of sites to take part. In some cases the organizer maintains the control since he/she calls other participants, otherwise it could be set up in advance.

The Polycom Sound Station is quite commonly used in audio conferencing. It has a tabletop console with full duplex, integrated keypad with mute, flash, hold, transfer, and conference option buttons. It has a 360-degree room coverage and could be expanded to support additional persons for wider coverage. At the authors' institute, Polycom Sound Station is used for audio conferencing. For multi-location audio conferencing capability one would require audio bridge/bridges.

8.2 MEDIA

Choice of communication medium will depend on money allocated for audio conferencing, number of participants, terrain and usage. Internet is the cheapest medium available for this purpose; it requires telephone lines and an Internet connection. On the other hand if one is looking for quality and reliability in an audio connection it would require higher end technologies. ISDN telephone connections are generally good but are expensive when we consider international audio conferencing. It is possible to combine two technologies such as satellite and computer communication or satellite and ISDN telephone lines to achieve optimum performance. It is possible to lease satellite time. There are a number of companies who provide support for audio conferencing.

8.3 COST

The Polycom Sound Station, with its 24 ports and bridges, costs around \$78,000. It has API10 telephone interface, integrated with DTMF touch-tone.

One can choose audio conferencing equipment depending on available funds and requirements such as number of participants, locations to be connected, and acceptable audio quality. A crude low-end audio conferencing system may cost \$3000, a sophisticated one about \$100,000 (videoconferencing equipment can be used for audio conferencing).

8.4 TRAINING

Some training sessions will be essential to develop confidence in using an audio conferencing facility. The number of hours of training required would depend on where audio conferencing is going to be used, how many participants will be connected, and what type of audio conferencing system is used. A simple system may require just a few hands-on sessions and a more sophisticated system may require a few days before one feels comfortable in using audio conference for educational purpose. A technician may be required for maintenance and support. A course will require proper design consideration for integrating audio conferencing. Each audio conferencing session will be subdivided into segments of short duration. The teacher will have to be time aware.

8.5 ADVANTAGES

Teachers do not require too much training since it is a simple technology to use. Audio conferencing will reduce travel costs, increase productive staff time, and provide real time audio communication.

8.6 DISADVANTAGES

AC is less user-friendly compared to face-to-face meeting. It could be a tiring experience, especially using traditional handsets. In AC, sound quality is dependent on the quality of the worst line in the conference. If there is no proper facilitation, a student could drop out in the middle of a session.

9. DESKTOP VIDEO CONFERENCING

Desktop videoconferencing is done using personal computers that can be connected by modems through telephone lines. Desktop videoconferencing involves creating a conference through a LAN consisting of the students and teacher. Students and teacher could discuss, ask and respond to questions, and share documents and other resources. For conducting desktop videoconferencing all the participants' computers require to have compatible hardware and software to support desktop videoconferencing. Internet technology is used for communication and dissemination of information. It could be used for one-to-one interaction.

9.1 EQUIPMENT

If it is planned to include desktop videoconferencing for delivering a part or whole of a course, details about the course should be explained to all participants “including hardware and software specifications” (Porter, 1997, p157) they would need in order to join a desktop videoconferencing. This will help in achieving uniformity and compatibility to create the standard desktop videoconferencing environment.

The hardware specifications should include type of computer, CPU speed, memory size, sound card, video capture card, microphone, speaker(s), CCD camera, modem, and the type of Internet connection desirable. The common Internet speed (56kbps) provides good desktop videoconferencing performance. The students will also require information about conferencing software. It may be appropriate to specify the name and version of the conferencing software or browser. The institute can purchase the conferencing software package for a desired number of connections and give a copy to each student. Students should be clearly instructed on how to set up the environment for compatibility and clarity in communication.

9.2 MEDIA

Desktop videoconferencing generally uses telephone lines connected to an ISP (Internet Service provider) for communication. For better results one could use advanced networking technologies such as ISDN and ADSL. At present these technologies are quite expensive and might not be within the reach of every student.

9.3 COST

The cost of desktop videoconferencing is basically the cost of a good computer system. With desktop videoconferencing hardware and software, this ranges from \$3000 for a low end system to \$5,000 for a high end system with ADSL technology. It is important that the intranet service providers support a compatible ADSL connection.

9.4 TRAINING

For delivering a course online using desktop videoconferencing, the teacher will have to structure the course properly from the beginning. One should not view desktop videoconferencing technology in isolation. “Conferencing technologies may

complement” (Hock, *et al.* p343) or supplement an online course.

Teacher and students both will require guideline to communicate effectively. Once the students have familiarized with the desktop videoconferencing software, it might be useful to develop some protocols for desktop videoconferencing. It is important to make sure everyone follows the “appropriate netiquette” (Porter, 1997, p169). The students should be made aware of the possibility of communication gaps during desktop videoconferencing. There is a significant time lapse from the moment a person finishes speaking to the time it arrives at the other end. It may be appropriate to establish teaching strategies to indicate when the student or teacher has finished talking and the other person can begin. Generally it would be possible to have ‘overlapped conversations in videoconference, they often can be difficult to follow’ (Porter, 1997, p169).

If online presentations are not well planned and coordinated, the group can go on the “wrong track” (Hock, *et al.* 2000, p343) and some students might want to drop back. The teacher and students will have to learn to play multiple roles of a “commentator, presenter, moderator and director” (Reynold and Fraeters, 1999, p143) besides being the presenter/ teacher.

9.5 ADVANTAGES

“The convenience of desktop videoconferencing from home or office computer usually makes up for the lack of perfection in video quality” (Porter, 1997, p171). Students don’t have to meet at a prearranged time at one place. Desktop videoconferencing is more flexible since students can join in from the home, office or workplace. It can be organized in less time. Personal interaction and attention is possible. Convenience of use makes up for the lack of perfection in audio and video quality.

9.6 DISADVANTAGES

Participant using desktop videoconferencing work together in real time. It does not create the same classroom feeling as videoconferencing. In fact “Learners... Work alone at a personal computer” (Porter, 1997, p170). Conferencing may “represent a threat” (Nipper, 1989, p67) for some participants. Self-conscious students do not feel comfortable in communicating over the Internet. If the students are not guided properly, nuances of language and

distracting mannerism can be harmful. For the ordinary user, with no “prior experience” (Nipper, 1989, p68), the teacher would have to make special efforts to get good results.

10. TTS CONFERENCING

A team including one of the authors (Shukla, *et al.* 2001) developed this Test and Speech (TTS) software. This software program has been designed for synthesized voice conferences/presentation. Each student is given a copy of the client software to be installed on an individual computer. Students start the session by running the client software. This will activate a connection to the main software on the centralized server at the institute. Students will require a password to join the conferencing session. This feature is important for the “privacy and confidentiality” (Aggrawal, 2000, p7) of the students. There is no live video; only the facilitator’s picture is displayed to emphasize the facilitator’s role. A facilitator is there for “connecting ideas and experiences, integrating material over time” (Adesso, 1999, p120).

The conference starts by announcing the presentation schedule. It gives the details of the presentations - titles, dates and times. The presentation starts with an announcement about who is going to present the day’s topic. The teacher and the students are expected to prepare the presentation using PowerPoint displaying only the bullet points. The narration for each slide is saved as notes. The student audience can see the bullet points and hear (TTS) the previously stored narrations. This gives the illusion of the presenter speaking.

After the presentation, a question and answer session commences and participants can ask questions by typing the text. Other members will be able to hear the question and answer in addition to seeing the textual question and answer.

10.1 EQUIPMENT

The equipment required is a basic PC with modem and ISP connection. It is envisaged that the educational institute would provide the client software for TTS conferencing. The main conferencing software resides on the institute server. Only the students enrolled for the course that uses TTS conferencing component, can access the TTS conferencing server.

10.2 MEDIA

Internet connection of 56kbps is good for CTTS since only textual information and the presenter’s image is communicated.

10.3 COST

The cost for this technology is the cost of a PC. An individual may buy a low end PC from NZ \$2000 to \$3000.

10.4 TRAINING

It is assumed that presenter knows how to use a computer. Secondly the presenter should be familiar with PowerPoint software. The presenter will be required to prepare PowerPoint slides and narration for each slide. Later, PowerPoint slides and textual narration could be up-loaded to the TTS conference server using client software. The participants will be required to follow a certain netiquette during the question and answer sessions. The guideline for this would be provided. Participants might require some practice sessions to familiarize them with the software.

10.5 ADVANTAGES

It does not require expensive equipment. A basic PC is good enough. It does not need a constant bandwidth and other quality of service features since there is no live audio or video.

10.6 DISADVANTAGES

Although one can hear the presenter, it is only via a voice synthesiser and does not have same impact as a real voice. There is only a fixed picture of the facilitator, no live video to simulate a face-to-face situation.

11. CONFERENCING TECHNOLOGIES IN ONLINE COURSES

Based on these descriptions, the authors have analysed the suitability of different conferencing technologies in different education situations.

11.1 VIDEO CONFERENCING

Videoconferencing appears to be the closest technology to face-to-face, traditional teaching. It provides for two way video. Special equipment and set-ups are required. As described earlier, videoconferencing is an expensive proposition and is not suitable for one-to-one or small group teaching. Many universities use videoconferencing technology to deliver courses to their different campuses nation wide or around the world. This would save on experts and probably cut down investment on other resources required for the course. In New Zealand, Waikato University at Hamilton and Massey University at Palmerston North offer courses to Thames and Albany campuses respectively on regular basis. The Ministry of Education has set up a videoconferencing network and more than 20 schools throughout New Zealand are currently benefiting from this technology. "One teacher takes a class involving six schools he teaches computing with school having pods of four recycled PCs and a server" (Watson, 2001).

There are many companies who offer videoconferencing facilities for hire. Initially, if the videoconferencing component in a course is not very significant, an educational institute could lease or hire VC facilities. It may be a good idea to experiment with using videoconferencing for the online delivery of a course first. If it proves successful, the technology can be extended to other courses and the institute could consider establishing a VC facility at their premises.

11.2 AUDIO CONFERENCING

Audio conferencing is a cost effective alternative to video conferencing. It will add some personality to online learning, with little overheads. It could be useful for imparting special or specific information where teacher would like to ensure that a student has understood the course material before proceeding any further. The teacher may structure an audio conferencing lecture in small segments and multicast it to all students. Each segment can be augmented by a question-answer session that is either one-to-many or many-to-many. Audio conferencing could be affordable by all students and may boost morale of web-based students, working independently in isolation. It may give them some sense of belonging to a group and identification with other fellow students.

11.3 DESKTOP VIDEO CONFERENCING

Desktop videoconferencing technology may be quite appropriate for delivering courses where the majority of the students have a PC or have access to a PC. A desktop videoconferencing schedule could be worked out between students and teacher, choosing specific dates and times for conferencing sessions. No one has to travel. The teacher and students can join the conference from where they are as long as they have access to a computer having desktop videoconferencing capabilities. Students should be made aware of the Internet limitation, bandwidth and speed. The video may be jerky or the voice quality may fluctuate during the sessions. The good points of desktop videoconferencing usually outweigh its shortcoming. It is expected that high speed Internet and good compressed video CODEC will be available in future. This could improve the quality of desktop videoconferencing.

11.4 TTS CONFERENCING

TTS conferencing technology is still in its early stages and trials are still being conducted. It is text based with text narration in a synthesized voice. It does not have the same limitations of Internet speed and bandwidth as desktop videoconferencing. This technology can be useful where Internet connections are slow. It is a low cost solution and might help in improving interaction and online delivery of course to certain extent.

12. CONCLUSION

Conferencing technologies are able to bridge the gaps in remote learning, which "still resembles many aspects of traditional classroom" (Porter, 1997, pp172) teaching. Each of the technologies discussed in this paper have specific advantages over the others depending on educational scenarios. Many universities and schools use videoconferencing for sharing the teaching in different sites. It helps in pooling resources and sharing expertise.

An educational institute can use one of the three models for incorporating videoconferencing in their courses. The models are "rented, partnership or dedicated models" (Tait, 1999, p6). In the rented model, an institute leases the conferencing facility as and when required. In the partnership model, an

institute shares the setup with other institutes. In the dedicated model, in cases where videoconferencing is used extensively to deliver courses, an institute has its own setup.

Audio conferencing is an inexpensive way to enhance interaction between teacher and students and may help to boost the morale of online students by giving them a sense of belonging to a group.

Desktop videoconferencing is gaining popularity as Internet performance is improving (improvement in video quality). In the authors' perspective it may be used extensively for future online delivery of courses. In cases where Internet cost (usage charges) is high and video quality is poor (unclear, broken video), CTTS may be used, since it does not demand such high Internet modem speed and channel bandwidth as required with transmitting video.

Conferencing technologies have opened new possibilities for delivering teaching in schools, colleges, and universities. This may include having experts or guest lecturers, collaborating in projects, developing professionally, and holding meetings and interviews. If a teacher would like to incorporate conferencing in his/her course, then it has to be integrated in the design of the course. Interactivity and access should be made part of the course curriculum.

Conferencing is one of the ways to bring education to a traditional learner who would otherwise not have access to a course due to inconveniences such as distance or cost.

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