
CHALLENGING STREAMING VIDEO IN E-LEARNING

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Abstract.

The success of the large scale inter-university IT course in Flanders in 1998 – 2000, using live ISDN-videoconferencing, persuaded the Institute for Continuing Education (IVPV) at the Gent University to organize a second edition, taking into account the remarks of both students and supporting industrial partners.

Taking up current ‘best practices’, a renewed course framework based on streaming video on CDs has been set up. Considering the unsatisfactory performances of available commercial products, an in-house system for streaming video has been developed, with emphasis on animation and interaction. Following a successful trajectory, the new student evaluation showed aims were largely achieved. Currently the IVPV started a new project to integrate the learning materials with a global open management system based on an e-learning framework. At the same time, contacts are being made with countries where student’s mobility is restricted in order to make all produced learning material available to those countries.

Setting out the milestones.

In [1] a large scale continuing education programme in IT organised in Flanders (Belgium) from 1998 to 2000, using massive ISDN-videoconferencing at 384 kbps (6 ISDN channels) has been described. The target of this programme was to train a new generation of IT-professionals by the year 2000. It was jointly organised by the 4 main Flemish universities (Ghent, Leuven, Brussels and Antwerp). In twelve sites, spread around Flanders, for 417 hours, two times a week in the evening hours, 3 hours of interactive videoconferencing were set up, complemented by 87 hours of hands-on exercises. . As much as 1145 participants subscribed to this massive continuing education programme of 206 213 [participants*hours], 80 of which passed the necessary assessments to obtain a full academic certificate and 317 obtained a modular certificate. The course was largely self-supporting.

In the follow-up of this course, a scientifically based evaluation of the complete educational programme among the participants was carried out to gather information about the effects of the videoconferencing framework as such. More detailed data can be found in [1], but the mainstream results were as follows:

- the well known obstacles of videoconferencing remain in effect: too static, little interaction, no ‘classroom feeling’,..
- the limited quality of the image together with a good sound quality was not seen as a real problem;
- the real-live animation of the videoconferencing (animated powerpoint slides + mouse interaction) was considered as highly beneficial to enhance the learning behaviour;
- the possibility of bridging time and space was seen as a main advantage;
- the accompanying electronic discussion forum (Majordomo) was appreciated very much.

All this resulted into an overall satisfaction degree of 79%.

Following those assessment results, a fundamental discussion with main representatives from the industry in Flanders was engaged to set out the framework for the second issue of the programme (2000-2001). The output was that the main idea of the videoconferencing was all right, but that the necessity

for people, working in industry under high pressure, to be lively present at fixed times was impractical, and that a swing to more asynchronous learning was highly desirable.

Therefore a modified framework for the course was designed as follows:

- the videoconferences have to be digitally recorded on CD or DVD in a format which:
 - keeps in any case the animation of the slides (building up slides / mouse movements);
 - enhances possibly the image quality (audio quality was satisfactory);
 - maximizes the amount of lectures per disc;*i.e. streaming video on CD;*
- the interactive electronic discussion lists have to be extended with more features;
- a minimal live interaction with teachers / assistants should be safeguarded;
- participants should be tightly kept into a study rhythm in order to avoid ‘free lunch’ behaviour.

The Streaming Video framework.

The lecturer typically prepares his/her lecture in Powerpoint (or similar: pdf,...), and breaks it down in pieces (‘paragraphs’) of some 5 to 15 minutes, depending on the topic at hand. Thereby he/she utilizes the whole scale of animations (slides transitions,...) available, albeit obeying some basic rules about fonts, colours, picture sizes,... He/she gives his/her lecture (cut in ‘paragraphs’ as said) live in the multimedia studio (eventually for a ‘live audience’), whereby he/she freely uses mouse / cursor movements to clarify his/her lecture. The presentation is captured from the computer output (vga...) itself together with an image by a professional video camera directed to his/her head. The studio technician mixes in real-time the computer output with the image of the teacher (being it in full scale, being it as a ‘stamp’ picture-in-picture) resulting into one digital signal recorded onto a digital Dvcam tape.

One of the important aspects of this recording system is that – starting from a lecturer with slides at hand (the ones he normally uses in old-style lectures) - the extra workload on the lecturer is kept to a very strict and acceptable minimum. *We postulated beforehand that the preparation time may only be as long as the lecture time itself*, i.e. the total time may be maximum the double of the lecture time.

Post-processing is done as follows:

- the video-fragments are read from the Dvcam, via I-Link (Firewire), into a MPEG-2 video editing station for real-time compression to MPEG-2, 4 Mbps (IPPP).
- these MPEG-2 video fragments can be edited if necessary; normally this is never done;
- the finished video fragments are compressed to the RealNetworks[®] video format (chosen because of its neutral computer independent platform); thereby the choice of optimal conversion parameters is very critical: i.e. they largely determine the quality of the resulting sound and image, and consequently indirectly the amount of space occupied on the CD;
- the RealNetworks video files are incorporated as multimedia objects in a standard HTML document, together with the other learning material as one CD-R master copy:
 - the powerpoint files as such (or pdf’s thereof), so the student can visualise it eventually in full screen resolution or print it out;
 - per video ‘paragraph’ a short description of the contents;
 - the background material: course texts, URL-pointers, book references, exercises, solutions, application software,...
- the net result (for the IT course) was an image with the following characteristics: 512 kbps / 12 fps / 512 * 348 pixels / 3 (wall)hours of lecture per CD;

- the master CD-R is multiplicated and labelling is done in a CD multiplication robot.

Compared with off-the-shelf commercial products for streaming video, the main difference is that the full animation both with slide transitions and cursor movement are maintained on the CD, giving huge educational benefits, since the student's attention is constantly kept during the lecture: the animation is really *the glue* between the lecturer's voice and the image.

Although originally not intended, it turned out that some companies put a copy of the CDs on an internal streaming server (provided the bandwidth of their intranet was sufficient).

The overall course structure.

The IT-course was composed of 5 distinct modules: *A: computer architecture / P1: programming / P2: information and programming structures / O1: analysis and design / O2: object-oriented software development*. The layout of each of the 5 modules was identical:

1. one *videoconference* session: the purpose was to get the students acquainted with the physiognomy of the lecturer, and to create a practical opportunity to distribute the CD-sets to the students;
2. '*home study*': a number of weeks for asynchronous learning by the student;
3. *lab exercises*: on Saturdays (to avoid traffic jams) students came to the university to perform hands-on training on PCs under the guidance of qualified university assistants;
4. one *live feedback session* (also on Saturday's): were the students could forward final questions / remarks to the professors;
5. time for *project work* and final *preparation time* for the examination;
6. the *examination*: the form depended somewhat on the module: some were written exams, some were PC-exercises, some were projects.

The course language was English.

The table below summarizes the course load as calculated.

Module	Theory		Lab exercises	Feedback	Project / study	Total hours	Number of weeks
	Videoconf.	Home					
A	3	18	6	3	18	48	4
P1	3	18	12	3	42	78	7
P2	3	18	9	3	42	75	7
O1	3	12	9	3	30	57	5
O2	6	29	15	3	70	123	11
Total	18	95	51	15	202	381	34 i.e. 11 hrs/ week

The course structure was furthermore complemented with enhanced discussion lists (Agora): one per module, and one global for organisational aspects. This platform enabled interactive discussions among students and with the professors / assistants. It was largely used during the course: e.g. for module A, some 197 messages / answers were posted. For each module an assistant professor was assigned as an *online coach*, who was continuously available to the participants in a module, but *only for a fixed amount of weeks*: after the predetermined period the list was closed. This mechanism intended to put some strain on the students to stimulate them studying the corresponding module during the period as scheduled, at the same time giving them enough freedom to do their own time-management. The discussion platforms and the way they were implemented, were thoroughly dis-

cussed beforehand with the industrial partners, and was also seen as a substitution of the social control among students during in-house videoconferences (as in the previous course issue).

The course was subscribed by 206 students (approximately 150 students per module), 70 of which finally received the academic certificate after successful examinations and project work. Organisationally the course was self-supporting.

Currently, in the preparation phase of other similar courses (telecom / environment), we have screened the market for new commercial streaming video products. After confronting a panel of specialists in human communication with those products, currently our in-house streaming video system came still out as being the best, precisely because of its more direct interaction with the student during the learning process. On the other hand, most of today's commercial products use static images (e.g. jpeg encoded powerpoint slides) as learning material, thereby consuming the available bandwidth more economically, and hence providing better image (resolution) quality and more learning (wall)hours per CD. But they all clearly lack animations and cursor movements, which, especially in technical courses (with many drawings and schemes), is of the utmost importance to catch the audience's attention. Meanwhile, our technical staff has optimised the video encoding parameters, leading to a drop of bandwidth from 512 kbps to 200 kbps without significant loss of image and sound quality, thereby resulting into an equivalent increase of the number of lecture (wall)hours per CD.

Project Evaluation.

As in the first issue of the course, a new student evaluation was carried out by the department of (human) communication sciences at the Ghent University (prof. Els De Bens and prof. Gino Verleye [2]). Although the inquiry dealt with all aspects of the course (including content and teaching skills of the learners), only the results on the course format as such are presented below.

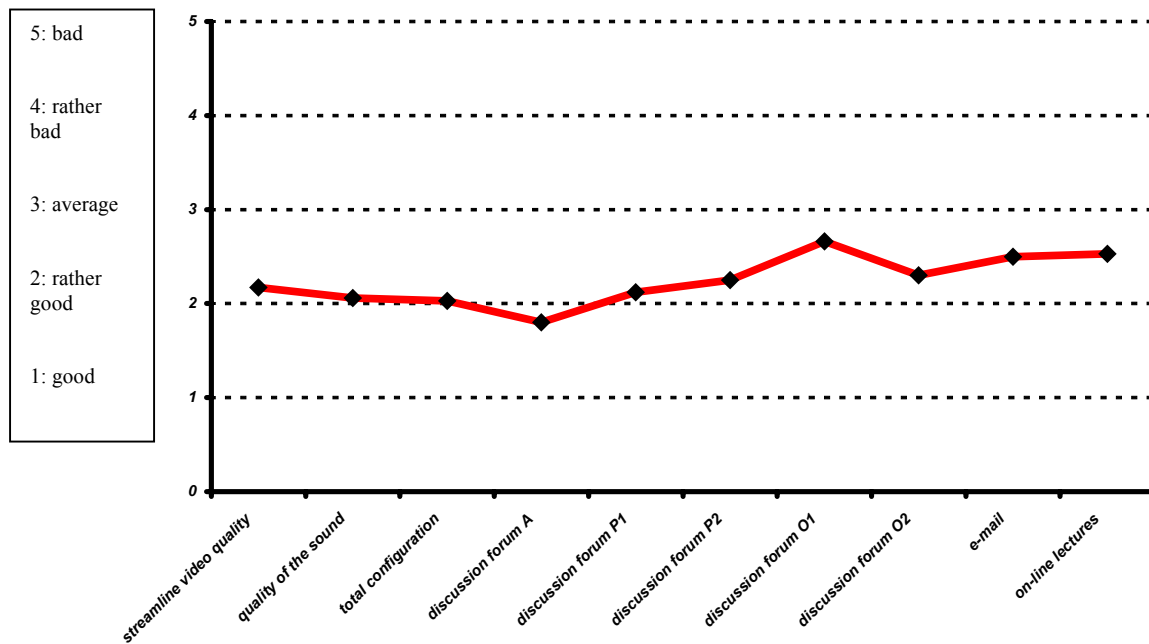
(Legend: ++ Fully agree / + Agree / 0 Neutral / - Disagree / -- Fully disagree)

Attitude towards CD-Rom supported education.	
<i>This kind of education bridges distance as well as time. It's a solution for the mobility problem.</i>	++
<i>This kind of education gives me enough opportunities to ask questions in a direct and interactive way</i>	+
<i>This kind of education stimulates interactivity and contacts among the students of the course</i>	0
<i>This kind of education stimulates interactivity and contacts with the teachers</i>	-
<i>This kind of education implies a very isolated situation for the students of the course</i>	0
<i>The personal freedom as far as time management is concerned (following your own rhythm to study, and choosing moments which fit you the most) is definitely a strong advantage of this kind of education</i>	++
<i>This kind of education is a weak substitute for the traditional way of 'live contact'-education</i>	--
<i>I would prefer a 'live teacher' to CD-Rom-supported education</i>	-
<i>The Cd-Rom has no added value as compared to a videotape</i>	--
<i>This way of education implies a lack of social control by colleague students</i>	0
<i>One needs a high dose of self-discipline to finish a course which is given in a Cd-Rom-supported way</i>	+
<i>Cd-rom supported education is only interesting when it goes together with a sufficient degree of and possibility to interactivity and asking questions (discussion fora, short term-answered e-mails)</i>	++

Quality of E-mail and discussion forum.

	e-mail	discussion forum
Good	41.7%	47.2%
Average	22.2%	30.6%
Insufficient	8.3%	8.3%
n.a.	27.8%	13.9%

Evaluation Cd-Rom-features



The conclusion of the evaluation is clearly an overall satisfaction degree, which was also confirmed for the other aspects (content, teaching skills). The course format was regarded as an ideal way for people with a busy professional life:

- to bridge time and distance;
- to keep the liberty to follow its own rhythm and to determine its own study moments;
- to have interaction possibilities among each other and with the teachers.

People commented on some facts as follows:

- although a rhythm has been imposed, you need a good dose of self discipline;
- interactive exercises on the CDs would be desirable in future;
- although many moments of contact between students (class room exercises) were built in, there was some feeling of isolation, also because the doorstep to go onto the discussion forum is for some people to high (afraid for 'silly' or 'rtfm' questions);
- on the one hand you have the freedom to study the CDs when and how you choose yourself, but on the other hand you have to study them (and not few) *nevertheless...*;

It was summarized by one respondent as follows: *"The advantage of personal time management and the solution for the mobility problem is more important than the lack of personal live contact with the teacher. There are still the lab sessions to communicate with experienced people"*.

Internationalisation.

Due of the ability of the course format to bridge time and distance, and to overcome mobility problems, the developed material is extremely well suited to be used in countries where mobility is restricted. Contacts are currently being made with universities outside Europe in order to use the material in IT programs. Bethlehem University in Palestine, for example, is highly interested in using the developed material to strengthen their IT program. Under their proper guidance, and provided they could (re)build up the necessary infrastructure and distribution channels, it is hoped that the material would bring leverage to many youngsters and professionals in Palestine.

Current activities.

Since the beginning of 2002 the Institute – in cooperation with the department of Information Technology of the Ghent University - has started an e-learning project to encompass the current format by a global e-learning architecture.

e-Learning can be viewed as the online delivery of information, communication, education, and training. It makes use of a network (LAN/WAN or Internet) for delivery, interaction, or facilitation. e-Learning provides a new set of tools that adds value to all the traditional teaching and learning experiences and processes.

The e-Learning framework that is put forward will achieve integration and interoperability of separate systems. Our vision includes a system that will involve a learning management system (LMS). The LMS integrates various tools and processes. It provides an integrated platform for content, delivery, and management of learning, as well as accessibility by users: i.e. a system that will automate the process of learner enrolment, registration, monitoring, transcripts, schedules, and reports. The system must also incorporate evaluation, assessment, and testing capabilities.

In addition to the LMS, the framework will include a content composition and integration system. This system will mainly consist of a content repository. This repository will be based on reusable components. The reusable components will be arranged in a flexible hierarchy to create material or courses tracks. It is also intended to create another repository to manage and contain the content meta-data: i.e. all the rich and built set of course units the Institute for Continuing Education has developed in the foregoing years.

A learners management system is another integral part of the envisaged e-Learning framework. This system will be built using a learner's repository. This repository should be set up in a way that makes it possible to be linked to a legacy database.

The target is to build a system that is extensible in the sense that it must be able for additional components to be integrated easily using some form of open and component-based software architecture.

Conclusion.

The experiences with the IT course based on streaming video, surrounded by e-coaching, hands-on exercises, live feedback sessions and project work demonstrated that – even if technology and bandwidth are still far from ideal – a workable framework can be set up. The appreciation of the students and the successful study results proved that an intensive study-load of 11 hours per week during one year for fully employed people could be digested by distant learning in that way.

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References.

1. Large Scale Permanent Education Programme in IT in Belgium, L.Boullart, 18th Eucen European Conference on Changing Work and Educational needs, University of Joensuu, Finland, December '99.
2. Evaluation of the Post-academic Interuniversity IT Course 2000-2001, E. De Bens, G. Verleye, Internal report at the Ghent University (in Dutch), Institute for Continuing Education (IVPV), Ghent University, Belgium.

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