Using the Web for diffusing multimedia lectures: a case study.

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Abstract: The typical teaching approach, at least when classes are large, is still the classical lecture. By using the new high-speed Internet lines reaching the homes, it possible is to limit some of the drawbacks of this approach. We run an experiment by diffusing via Internet a whole university course. The course was web-cast (synchronously) and delivered on-demand (asynchronously). We also produced CD's for simulating fast connections for the students who did no have one. We based our experiment on a software developed at the University of Toronto: ePresence. We report here the indications we were able to extract after the end of the experiment.

Introduction

In the past teaching has involved a strong, direct interaction between teacher and student. Massive education has made this model impossible to apply: it does not scale well when the ratio students to teachers grows exceedingly, while maintaining a small ratio is too costly. In response to this, the typical education model has been for a very long time the classical lecture: at Universities this often means that tenths (and sometime even two or three hundred) students listen to a professor, and it is obvious that in such conditions the space for interaction and for individual needs is tiny.

The lecture model is under attack by people proposing learner centred modes (see e.g. Olson & Bruner, 1996), or stressing the social nature of learning (see e.g. Branson, 1998). For a critique of the lecture model see Kerns, 2002 and Donovan et al, 1999.

E-learning is an opportunity for a change. However, the traditional lecture is here to stay for some more time: information and telecommunication technologies have a chance to make it better. One possible way is by breaking space and time constraints. Lectures happen in a classroom at a time that is rigidly fixed, and these constrictions may interfere with student's needs. For instance, working students often cannot attend lectures, and end up studying on their own on books and notes. Students may get sick and loose lectures: in some disciplines (e.g. mathematics) loosing one or two lecture may seriously compromise the understanding of the rest of the course. Some students get tired, and sometimes in spite of being present in the room they are not following the discourse, or they lose some fragment. Being able to view lectures at different times and in different places, or to re-view some portion of a lecture may help considerably. For these reasons, in the past many distance learning initiatives have been based on the diffusion of audio and video material in the form of VHS cassettes. VHS cassettes can be requested at some office, or their content can be broadcasted on TV, sometimes during the night, so that students could program their VHS recorder to receive the lesson, and use it asynchronously at a later time. Of course both these models are very limited: TV bandwidth is limited, and students cannot get the content "on demand", and, physically getting a VHS cassette would solve only part of the problem (one still has spatial and temporal constraints).

Can Internet offer a viable solution? Not until recently: only two years ago a paper reporting an research performed in Finland (certainly not an underdeveloped country!) quoted "Synchronous communication or even delivery of asynchronous video lectures was out of question because of the low bandwidths available at students' homes" (Haataja et al. 2001). Things are changing fast: the recent diffusion of DSL technology (Digital Subscriber Line) for fast Internet access is dramatically changing the limits of what can be put online. It is making possible, for the first time (at least in the old continent), to reach a vast audience by delivering multimedia content on demand.

Transport is not the only issue. The traditional VHS-based approach typically does not record a lecture held in a classroom, but prepares *ad-hoc* material: the costs are typically rather high, and a recorded course should be reused for at least a few years. Recording a traditional lecture would have lower costs, but also a

poorer quality: it is generally difficult to see well on a screen the material that the teacher presents (slides, writing on the blackboard etc.). So there is a *format* issue, concerning how the lecture is presented.

We found a solution by using the e-presence software developed at the Knowledge Media Design Institute (KMDI) of the University of Toronto. The system is able to deliver synchronously (by web-casting) and asynchronously (both on-line and through a CD) a video of a lesson or a seminar, augmented by a view of the slide that speaker is commenting, various ways to move through the lesson, and (in the case of synchronous interaction) an integrated chat. The system presents the lecture in an web browser. The browser window is divided in several areas: the largest one presents an image (typically the slide that is projected for the "local" audience and a smaller one that contains a video, where typically the speaker is shown. The design derives from the idea that the most important cognitive factors are the voice, carried by an audio stream, and the slide that illustrates the concepts that the speaker is talking about. The actual video is less important from the point of view of carrying information, although its presence may be very useful by showing gesture, expressions, and contextual indications (like when the speaker indicates some point on the slide saying "here you see…"). The video carried by the ePresence system is small so as to save bandwidth, but very fluid and sufficient for carrying the needed information (even when occasionally the speaker goes to the blackboard for drawing a sketch, or a video is projected for the local audience). The web-cast version also contains a chat that allows remote viewers to interact with the speaker (through an intermediate person), while the recorded version has some facilities for navigating an indexed events (like "go to the time when slide X is presented", or move forward or backward). More information on the system can be obtained in (Baecker 2002, Baecker et al. 2003). The system can be seen on line (http://epresence.kmdi.toronto.edu): KMDI uses is for web-casting seminars.

Our experiment consisted in making a whole first-year course (Object Oriented Programming for Computer Science) available to the students through the internet, and through other media (a set of CDs). The present paper shortly describes the first results.

The case study

At University of Trento teachers are offered tools for e-learning support. We have on-line the syllabus, a diary with the lecture topics, lecture material (copy of the slides projected in the classroom, and some additional material), a discussion forum, a bulletin board, and self-assessment tools. However, we wanted to offer something more, especially to working students who's job schedule is incompatible with the lecture timetable. Moreover, this year we had a consistent number (25%) of first-year Computer Science students following a new program called "apprenticeship". Students enrolled in this plan are hired by local small or medium-size enterprises, and simultaneously they enroll at the University. They follow a special curriculum, spending one bimester at the University (following regular courses) and each other bimester in the company, where they perform some work that can also be evaluated as material for some exam (typically laboratories). They are supposed to follow on their own (by self study, or with the help of some tutor in the enterprise) the general part of the laboratory course (typically two hours per week). An agreement between each company and the teacher guaranties that the work performed in the company has aspects that are relevant to the laboratory course. At the end of the bimester the "apprentice" must pass the same exam that is given by regular students. To compensate for the extra load given by their job, in the bimesters "at work" apprentices take only one course (instead of the regular two or three): therefore their curriculum stretches over four years instead of the regular three. Participating companies receive funds from the local government (Provincia Autonoma di Trento) in the form of tax cuts. A web-casting system would allow such students to follow on the job the two hours of the general part of the laboratory course.

We therefore decided to use innovative technology to:

- support the apprenticeship program, by delivering in the companies a (low) number of traditional lectures, letting students remotely participate to the classroom lectures (preferably synchronously, but possibly asynchronously if their work does not permit following a lecture in real time);
- help other working students by bridging the gap given by their absence during (some) regular lectures;
- support regular students by giving them the opportunity ability to recover lectures lost due to forced absence (illness, work or other time-frame incompatibility);
- allow students ability to better organize their time, deciding not to be present at some lecture (elective absence);
- support foreign students who might have difficulties with the Italian language (they would benefit from the possibility of re-hearing portions of lectures);

- provide language support for Italian students attending to courses given in English (some courses are);
- give to all students the possibility to review pieces of a lecture at any time, to check their understanding or their notes.

Secondary effects of the initiative are:

- to enrich the portfolio of the on-line learning initiative;
- to give students the perception of a better service provided by the university;
- having the possibility to show high-school students some university lectures (often we are required to "simulate" a university lecture to perspective students);

Our requirements were:

- the system should support both synchronous and asynchronous modes;
- synchronous mode should allow at leas some limited degree of interaction;
- the lectures should be easily browsed, with some form of indexing and a direct access to any time-location in the lecture;
- lectures should be available (in some form) also to students who do not have a large band Internet connection;
- production costs should be minimal, so as to eventually allow scaling the approach to most courses.

The e-Presence system fully satisfies all our requirements, and was therefore chosen as the infrastructure for the experiment. The objectives of the experiment were to:

- measure the students satisfaction level;
- evaluate on the field the organizational costs of the initiative, and find out what the ratio costs/benefits is;
- gather experience that can be precious in a possible extensive use of this technology;
- get new ideas about possible extensions of the technology or of its use.

When we started we did not really expect students to be able to access lectures from home: only two years ago a minority of our (Compute Science!) students had an Internet connection at home. By now, we were expecting all of them to have standard (56K) Internet connection available at home. We were therefore surprised to find that 22% has some kind of fast connection (7% ISDN, and 15% ADSL) that allows accessing multimedia content. A recent advertisement campaign for ADSL done by the major national phone company is evidently having success, even though not all of telephone switches enable such technology.

Students not having a fast connection at home could anyhow use computers in the University labs, or get a copy of CD-ROMs on which lectures were copied. We started by recording one lecture per CD. Later we discovered that the CD version provided by default by the system included streams at several resolution (like the Real Server does). By using only one resolution, we were able to store five to seven lectures per CD (25% of the lectures last for three quarter of hour, 75% for one and a half hour). The whole course -41 lecture hours in 23 lessons (7.5 laboratory hours were not recorded on the system)- fits in5 CDs, and would fit on a single DVD support.

Some students asked us to provide a third possibility, i.e. to allow to download the content of the CD from the net. A few working students not residents in town had problems in coming to get the CDs at the University, did not have fast connection at home but had friends with a fast connection. For those students, the possibility of asking friends to download the CD content and remotely create a CD copy was a desirable option, so we provided it.

At the beginning of the course the system was announced and shown to the students. After they were able to access the system for the first lessons, a survey was conducted to assess the expectations the students had, and to verify what kind of access they were able to have. Results of students expectations were presented in detail elsewhere (Ronchetti 2003): in summary, the expectations were enthusiastic.

We monitored the actual use of the system, and found that students excitement was not a transitory fact. We are able to identify two effects: a initial high use of the system due to curiosity, and later a correlation between the use of the system and the difficulty of the subjects. The course presented Object Oriented Programming in both C++ and Java. At the beginning the basic concepts were given, and shown in C++. The central part of the course had an introduction to Java, and in the last part the most difficult concepts were presented in both C++ and Java (but mainly in C++, which has rich and difficult elements like copy constructors, objects in stack, operator overloading, static binding etc.).

On the average, the first six lectures were viewed 73 times each (we had approximately hundred students). This very high rate was certainly due to curiosity. The last two-third of the lectures averaged 29 users. However, the in the central part of the course (that we consider to be the easiest) the use dropped to an average

of 20 viewers per lecture, while the last five lectures (containing the most difficult topics) average almost twice as much, with 36 viewers.

We also monitored the number of CDs that were requested by the students. We already mentioned that we had two formats: CDs with single lectures (that were typically available the day after the lecture), and CDs that contain collections of five to seven lectures (that were available towards the end of the course). We produced an average of 18 copies for each single-lecture CD, and 15 of each of the multi-lecture CDs, for a total of approximately 350 CDs.

We think that only a very small number of students used the third possibility we provided, i.e. to download the CD content: we did not yet have the time to analyze the web-server logs.

In total hence approximately 60 students per lecture used the system: half of them using the on-line version, and half using the CD version. Only in very few cases the real time version (web-casting) was used.

Conclusions

Although the traditional lecture model is not the best for favoring learning, it is still widely used. We found that even this traditional model can be improved by using modern technology, and in particular by the new low-cost broadband Internet connections. Our results shows that students find an added value in having a multimedia version of the traditional lecture, especially if provided through a tool that has a well-thought user interface like the e-Presence system. Contrary to what one could expect, students tend not to use such possibility as a replacement of the lecture in the classroom but rather as an integration (we did not observe an abnormal drop in the presence in the classroom). Also, the mode we used (one single person overlooking the system, controlling two cameras and performing post-processing) presented very limited costs (approximately one and a half hour per lecture hour, including the presence at the lecture) and does not require special skills, so it is an affordable expense (a more detailed discussion of costs is give in Ronchetti 2003). The success was such that students demanded that, after the experimental phase, the system stays in production. We are currently using it for two other courses, and plan to continue on the next academic year.

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