

The Use of Video Taped Lectures and Web Based Communications in Teaching

A Distance-Teaching and Cross-Atlantic Collaboration Experiment

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ABSTRACT

We have conducted an experiment to discover how we can co-teach the course "Engineering Design Problem Formulation" simultaneously at the Delft University of Technology (The Netherlands), and at Carnegie Mellon University (Pittsburgh, USA). We have formed teams that involved students from both countries, and we have experimented with long distance collaboration. In doing so, students would learn to cooperate with people at another (time zone) location with a different cultural background, and, in addition, they would help the teachers of the course to develop insights into long distance collaboration. CMU lectures have been recorded with a digital video camera, and PowerPoint slides accompanied each lecture. The movies were used by the Delft teachers by running it in class along with the PowerPoint slides, and stopping often to discuss the material as the movie progressed. We also made four person international student groups. The entire international group met once at the start of the course, using video conferencing. During the course, the groups communicated through phone calls, e-mails, and chatting. In addition, everyone in the course used the web accessible document management system LIRE' (developed at ICES, CMU) to capture, organize and share all documents anyone produced throughout the course. The tools used in the course, and the collaboration experience were evaluated through a questionnaire among the students, and the results are presented in this paper.

1 INTRODUCTION

In recent years, the possibilities for distance teaching have increased tremendously. The widespread availability of the Internet and the ever increasing bandwidths for telephone lines have allowed the use of rich media even over long distances. In teaching, we think it is vital to use many different forms of information and knowledge storage and retrieval methods, as students bring their own preferences for knowledge gathering and storing. In addition, we believe that one should exploit the various ways of getting the knowledge across in old-fashioned class room type settings.

This paper describes an experiment into using rich media to teach a course at two places in the world simultaneously. The first motivation for doing this experiment was the wish to teach a course at the Delft University of Technology that had been taught successfully for years at Carnegie Mellon University. Briefly, the basic objective of the course is to teach formulation of problems in engineering design. The students work in groups and part of the experiment was make students aware of cultural issues that influence the formulation of design problems. The second motivation for doing this experiment was to explore the possibilities and challenges that would be posed by making the students cooperate “across the Atlantic Ocean” with a 6 hours time difference.

The international course was run for the first time in the Fall of 2000 for approximately thirty students. We will describe the contents of the course in somewhat more detail in the next section. It will provide the background for evaluating our rationale for using particular tools during the course. The third section elaborates on the way we have taught the course. It is concerned with the preparation for the course as well as with some of the practical problems that we ran into while preparing and teaching the course. We have evaluated various aspects of the course, through a student questionnaire. The results of the questionnaire concerning the organisation are also described in that section. The fourth section explains how we formed international groups, and how these groups have collaborated in doing the assignments for the course. The results of the questionnaire concerning the collaboration and communication aspects are also described in that section. Finally, we will draw some conclusions and we will point to changes in teaching the course next year, in section five.

2 CONTENTS OF THE COURSE

The primary object of this course is to teach the process of problem formulation and the role of mathematical and other modeling techniques in engineering design. We do not ask the students to solve problems, only to formulate them. To this end, we have adopted a strategy by which the students are made to focus on articulating the design problem using a four part description of design problems that have the following components: goals (objectives and constraints), tests, design space, and starting points. Here, the pedagogical objective is to get the students to understand that articulating the right problem based on a process of negotiation and clear articulation of the problem among the stakeholders and the design team is more important than being able to solve perfectly the wrong problem. This is in line with Bucciarelli's (1988) argument that rationality in design cannot be assigned just to the mathematical solution process. Articulating the right problem is an integral part of rationality and is a socially negotiated process. With this perspective on the formulation of design problems, the cross-continental experiment described in this paper brings to fore the issues of social values and cultural assumptions that play into the formulation of engineering problems.

This course attempts to raise awareness of this issue raised by Bucciarelli (1988) directly by providing students an opportunity to start by formulating a number of small assignments initially and then escalating to group based large assignments that often include uncovering the formulation of an existing design project as well. The large assignments include design problems such as design of transportation system for Pittsburgh, design of water/sewage system for a new development near Amsterdam (IJburg), and others. Each week the students present their solutions to the class and thereby watch how other group members approach similar or even the same problems. The instructors serve as stakeholders for many of the problems. We lecture the students in the use of mathematical characterization by teaching methods from optimization, game theory, information systems, and ethics in design through exemplars from real design problems.

In summary the purpose of the course is to create an understanding of how contexts determine the scope of the problem and how mathematical and other formal/semi-formal models can be used to articulate the problem to suit the context. The emphasis here is on the critical role that articulation plays, rather than the solvability, for design problems.

3 TEACHING THE COURSE

3.1 Introduction

The engineering design course had been taught for several years at Carnegie Mellon University (CMU). In order to evaluate the utility of this course for the Delft students and to make the transition to a cross-national course as smooth as possible, the Dutch instructors attended parts of the course at CMU in the Fall of 1999. After concluding that this course would be very valuable also for the Delft University (TUD) students, we decided to set up an experiment for Fall 2000. This experiment would comprise teaching (for instructors) and taking (for students) the course at the same time at two different locations, thereby using as much of each other's material and expertise as possible. In addition, we set out to avoid any duplication of work in the sense of developing lectures and assignments. A month of work and planning in the summer of 2000 was needed to get the course on track with respect to its contents and organisation. Besides the technical issues that had to be solved, upon which we will elaborate in section 3.2, we had to overcome organisational intricacies, such as timing and schedule differences. The latter, however, will not be discussed in this paper.

3.2 Video-taped lectures

In preparing the course in the summer of 2000, we learnt about experiences with video-taped classes that were gained by other distance-teaching activities (Brown and Duguid, 2000). In the example provided by Brown and Duguid, a course that was taught at a university was video-taped and used at a company for distance-teaching. After the finals, the group that had only used the video tapes turned out to have scored much higher than the local group at the university. After investigating why this had happened, the instructor found out that the mechanism of knowledge transfer had been dramatically different for the company group. Instead of watching the video tape as it was recorded in class, i.e., without pausing the tape at any time, the group had paused the tape frequently to discuss the topic at hand amongst themselves. Then, after a brief discussion, the tape would be started, and they would pause it again some time later, to discuss another issue. In this way, the students were confronted with the material in a more interactive way than they would have been in an ordinary class room setting. This experience led us to believe that this approach could be beneficial for our course as well.

We decided to video tape the class room lectures at both TUD and CMU, which could then be used in the other class, in a similar manner as we reported above. Due to technical

difficulties, however, the classes at the TUD were not taped, and the experiment could only be run in “one direction”. The classes at CMU were all taped using a digital video camera. The recordings obtained were then converted into Quicktime format, and made available through an FTP site. The TUD instructors downloaded and used the files in class. By regularly pausing the video clip and discussing the subjects with the students, we were able to give the students two points of view, or two different explanations for a subject. Class would take somewhat longer than a regular class would have taken, but the extra time was considered to be worth it by the instructors and by the students. Students were found to appreciate the two views or two different explanations about one subject.

The FTP site containing the video clips was also available for the students from both universities. We have found, however, that they have hardly watched the clips by themselves. An explanation may be found in the fact that the TUD students had already seen the clips in class, and that the CMU students could talk to the video instructors in a “live” fashion. In our questionnaire we polled the students as to what the role of the video clips should be, i.e., as a *replacement* for class, or as an *addition* to class. The results of the questionnaire may be biased, though, by the fact that only few students had watched the clips on their own. The following figure shows that, when asked, students have no definitive preference for either of the two options, as both score mainly in the middle categories. When we take into account that students had hardly watched the clips on their own, a light preference may be ascribed to the role of the clips *in addition to* classes.

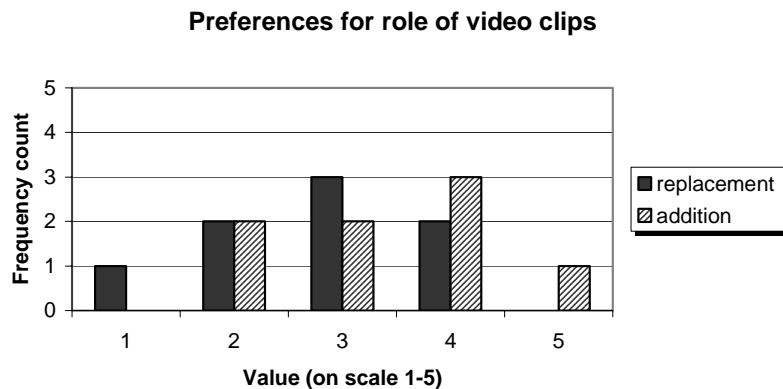


Figure 1. Students’ opinion on the role of video clips on a five point scale.

Quoting from the questionnaire when asked for strong points of the use of video clips:

- “It’s a very good part of the class especially with the comments from the teacher while watching that.”

- “You have control over the material you find difficult.”
- “Get to know different perspective on the same subject, which has been taught in class”

Some of the weak points mentioned were:

- “Lack of interaction”
- “You can’t ask questions”
- “Large files”

The last remark in the list above, underlined that the clips were very large, often larger than 200 Megabytes. The students, therefore, may have been hesitant to download the clips to their home computers. When asked for the preferred format of the clips, the students were given two variables: the length of the clip (short key issues, vs. full lecture length), and the recording setting (class setting incl. class interaction, vs. studio setting). The results of the questionnaire are shown in the following figure.

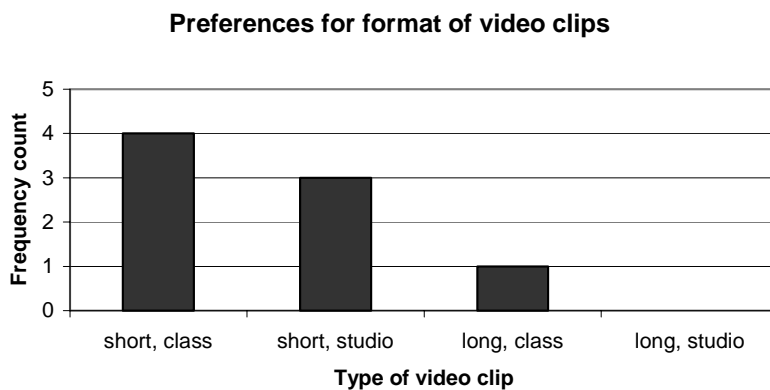


Figure 2. Students’ preferences for the format of video clips.

It is clear from this figure that the students prefer short clips over full lecture length clips. There is no clear cut general preference, however, for a recording setting. The preference for short clips may also be rooted in the download facilities of the students, as mentioned above. We have also polled the students as to which distribution method for the video clips they would prefer, and we gave them a choice between FTP, streaming on a web site, and a CD-ROM. Students significantly prefer a CD-ROM over the other options (see Figure 3).

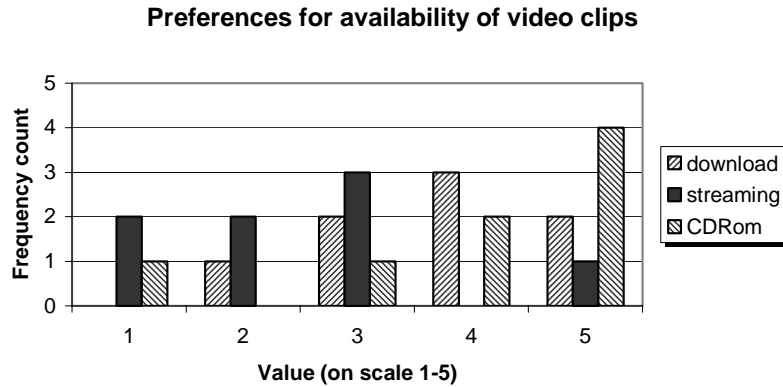


Figure 3. Students' preferences for the availability of video clips on a five point scale.

For next year's course, therefore, we hope to produce a CD-ROM using the video clips we have recorded in the Fall of 2000.

3.3 Video conferencing

As became apparent from the previous section, we have not chosen to use video conferencing in order to teach the course at the exact same time at both places. Besides the practical problem of timing, given a six hours time difference, the quality of real time video conferencing was still considered to be too poor to allow teaching a class while keeping all the students' attention. The students were going to work in groups, however, so we organised an informal video conference meeting at the start of the course. In this meeting, we introduced the five instructors to both classes and we let the students that were grouped, talk to each other. In doing so, we hoped that electronic group members would become real life persons, enhancing the cooperation and communication in the group. We have also offered each group another 'private' hour of video conferencing, but no group has taken that opportunity. Apparently, the design processes in this course could be run without seeing each other. Section 4 will elaborate on the collaboration in the groups.

3.4 Sharing lecture slides and student presentations

The lectures taught at the two locations were supported by electronic lecture slides (PowerPoint format). These lecture slides were shared among the instructors, so that the effort in producing them would be minimized. In addition, the lecture slides could then be shown alongside the viewing of video clips in class. The video recording could thus be centered on the instructor, in stead of capturing both instructor and slides in one frame. The presentations created by students, were also prepared in PowerPoint, so that both sides of the team could

present the same presentation. Both instructors' and students' presentations were stored in a web-based document management system, LIRE', developed by the Institute for Complex Engineered Systems (ICES) at CMU. This systems allows the users to easily share documents and to keep track of the history of documents. The accessibility through the web made it an appropriate tool for sharing documents for the students. The communication tools used will be evaluated in the next section.

4 TAKING THE COURSE

4.1 Introduction

The elective course was offered to senior level engineering students and Ph.D. students. The students who wanted to participate were told at the start of the course that they would be entering an experiment in international teaching, and in the use of rich media. At CMU, approximately twenty students enrolled, and in Delft twelve students started with the course. Reasons for enrolling were found to be both the attractiveness of the contents of the course, and of the experiment that was going to be run with the "other side of the Atlantic Ocean".

We have formed six mixed groups, i.e., two students from CMU and two students from TUD, using the personality and group formation theory by Myers-Briggs (2000). In this way, we hoped to form balanced groups, and we were able to teach the students that group formation is an important aspect of collaboration. Given the larger number of CMU students, we also had two "reference" groups, completely based at CMU.

This section describes the way we designed the collaboration between the group members in the international groups. We will expand on the methods and tools we used, and our reasons for using those. We will also present the results of the questionnaire that was held amongst the students afterwards concerning the use of these collaboration tools.

4.2 Collaboration

The students in the international teams were required to use LIRE' as their document management systems, and we distributed the email addresses of the group members. Without our interference, however, most groups took up other, more direct types of communication while making the assignments. Many of the groups reverted to chat possibilities over the web, for example through NetMeeting. Some groups even made regular phone calls to make speed up the communication process. The six hour time difference between the two halves of a group turned out to be a major source of frustration in the beginning, with students

complaining about slow responses from the “other side”. We have had to adjust a couple of deadlines to accommodate the slow progress of some groups, due to the time difference. Figure 4 shows the students’ preferences for the various tools used in collaborating with the other half of the group. It confirms the need for combined use of email, and chat or phone possibilities.

Figure 5 shows the average time spent on the various tools by the students. Emailing still takes most of their time, as most problems and discussions took place through this medium. Direct communication was only used for final decisions and for fine-tuning of the report.

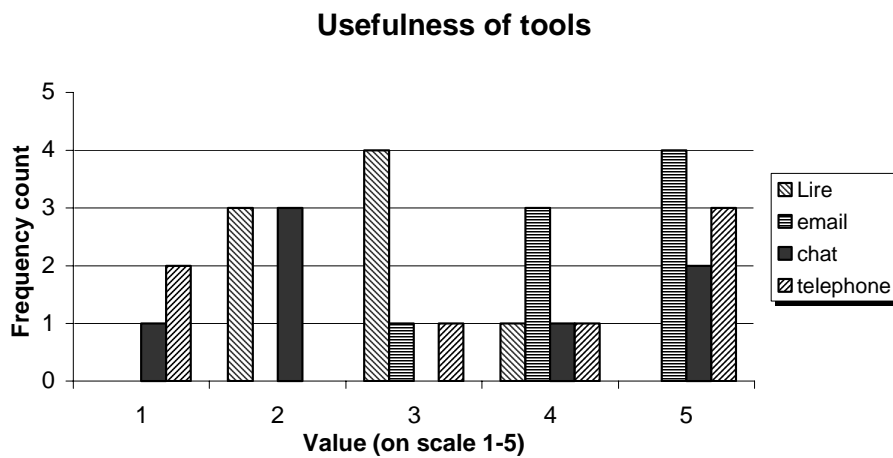


Figure 4. Students’ opinion on the usefulness of various tools on a five point scale.

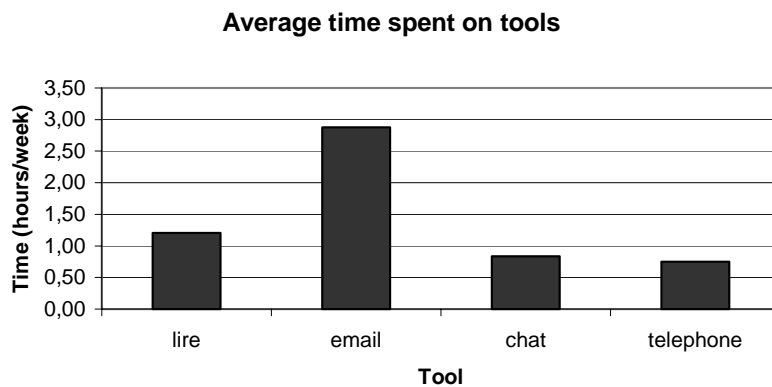


Figure 5. Average time spent (in hours per week) on various tools by students.

We have asked the students to report some strong points and some weak points of the collaboration tools they used. The following quotes about strong points were taken from the questionnaires:

- “Discussion by chat and phone is very useful. It makes people feel like to have a real discussion with each other in spite of long distances”
- “LIRE’ is a very useful tool to exchange documents”
- “Not location bound”
- “Easy to keep record of discussions and helpful in tracking the progress”

Some of the weak points that were mentioned comprise:

- “Emails: you won’t get instant reply, you need to spend more time in explaining and writing your views. Delays the whole project”
- “They don’t integrate seamlessly”
- “Difficulty in expressing yourself”
- “Sometimes boring and confusing when all the team members chat together and press their own ideas”

We have also tried to check whether the cross-atlantic collaboration had any beneficial or detrimental effects on the final grades of the students. The final grades of the two reference groups, i.e., the groups that were completely based at CMU, were similar to the grades of the international groups. In fact, the international groups scored both the highest grade, and the lowest grade of the entire class. We can conclude from this experiment that the, sometimes difficult collaboration, had no large detrimental effects on the grades of the students. We have also asked them what they saw as an added value of the international collaboration. Some examples of their replies are:

- “Looking at the future where people from different continents would have to work simultaneously on the same projects, this was a nice experience”
- “Exciting, multicultural, educational, real life experience”
- “Get to know how two different cultures and locations plays a significant role in team dynamics”

5 CONCLUSIONS

5.1 Fall 2000 experience

The experiment we ran in teaching a course at the same time in two countries has been an educational one. We found that the use of video clips, in the way we used them in a classroom has an added value. Students, as well as instructors got different views on a subject, which improved the understanding. The students did not use the video clips as background material, which was an opportunity we had expected the students to use.

The collaboration between the international groups was rather problematic in the beginning, as students had to get used to the use of the various tools. With emailing, in particular, took some getting used to the time delays in the responses they got. Interactive collaboration tools, like chatting or telephoning proved to be vital for some groups.

An added value of collaborating across the Atlantic Ocean was confirmed by the students' enthusiasm for the experiment. The experience with possible future real life situations, i.e., collaborating with people at different times and places, was often mentioned to be the most valuable feature of the international course.

5.2 Fall 2001 improvements

Over the summer, we will edit the videos that were taken in class in 2000, into shorter clips. These short clips can be used next year in class, and provide more easily accessible background material for the students.

In addition, we will look into standardizing the use of chat or 'NetMeeting' options, instead of making each group invent the wheel on its own. We will continue to use a document management system and email as common communication tools.

6 REFERENCES

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