

# Learning in Desktop Video-Conferencing Environments

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***Abstract:** Luleå University of Technology has since 1997 used net-based learning environments based on desktop video-conferencing tools to distribute courses to students. It has been claimed that the environment gives remotely attending students equal possibilities as traditionally attending students to take an active part of a course, as well as enhancing the learning experience for all students. This is in part true, but in reality there are many pedagogical and technical obstacles to overcome before a course can be seen as successful. This paper identifies a number of problems, which will be considered from both a pedagogical and technical perspective.*

## 1. Introduction

The use of information technology is today an integrated part of higher education in Sweden, where electronic distribution of information to students is maturing as usage is increasing. However, a common deficiency found in the use of net-based learning environments is the lack of support for spontaneous interaction between students as well as between students and teachers. Functionality like real-time textual chat and video-conferencing enhance the possibilities for communication, creating environments that not only distribute static information but also allow a higher level of interaction. The potential of modern environments for net-based learning is large, but the question is if we take advantage of that potential by the way we use them today.

There is a common belief that use of information technology will enhance and stimulate learning. That belief has little foundation, as we cannot say for sure that the impact from information technology on learning is positive. Some authors suggest that it is hard to see if the information society has improved learning at all. The truth would rather be that technology alone, no matter how futuristic or exciting, does not automatically improve the learning process (Dertouzos 1997, p. 177).

There are three classical motives for the use of information technology in learning (Broberg 2000) are economical (learning more at a lower cost), learning efficiency (learning more during less time) and bridging distances in time and space (learn at anytime, from anywhere). These motives hardly apply to communicative learning theories and methods such as collaborative learning, problem-based learning, in-depth learning, etc (Koschmann 1996).

Today we have an ideology where communicative learning theories are connected to information technology but the fact is that the ways we use information technology do not lead to communicative learning. Different studies identify several problems with using net-based learning environments (Dertouzos 1997, Healy 1998, Phipps & Merisotis 1999 and Synnes 1999). There are today few, if any, sufficiently complete net-based learning environments based on pedagogical theories and methods that are built in a user friendly way. There are still several basic issues to correct for current net-based learning environments.

In this article we will highlight the use of desktop video-conferencing in educational settings. We will discuss some of the problems we have identified when using synchronous systems in education and what kind of relation it has to learning. The reflections in the article are based on studies of one distance course at the Mid Sweden University and one campus course at Luleå University of Technology. There were eight participants in the distance course and 20 participants in the campus course. Because of the limited sample size we cannot draw any statistically ascertained conclusions. Instead the results should be seen as indications and not as general conclusions. Students answered questions via questionnaires about their experience of using desktop video-conferencing. The distance students answered a questionnaire at three different occasions: in the beginning, in the middle and at the end of the course. The campus students answered a questionnaire at the end of the course. An interview was also done with the teacher in the distance course. The motives for using desktop video-conferencing environments differed between the courses. In the campus course the main motive was to distribute lectures. In the distance course focus was not directed only on distributed lectures. Collaboration and

communication between students was a major goal. In order to achieve the goal the course was designed around group work and tasks that should be discussed in the desktop video-conferencing environment. Both group of students had good experiences of computers and of using asynchronous tools in educational settings.

## 2. Background

The net-based learning environment used at Luleå University of Technology is Marratech Pro. It consists of a number of integrated tools for synchronous communication with audio, video, whiteboard, text-based chat and web pages (synchronized browsing used for slides during presentations). The environment is highly flexible and is used for anything from small electronic meetings to large distributions of presentations. Everything can be recorded and later replayed either to a single user or to a group of users. This adds to the flexibility as teachers can prepare recorded material for the students to discuss in groups. Figure 1 depicts a recording of a class in Spanish for secondary school students.

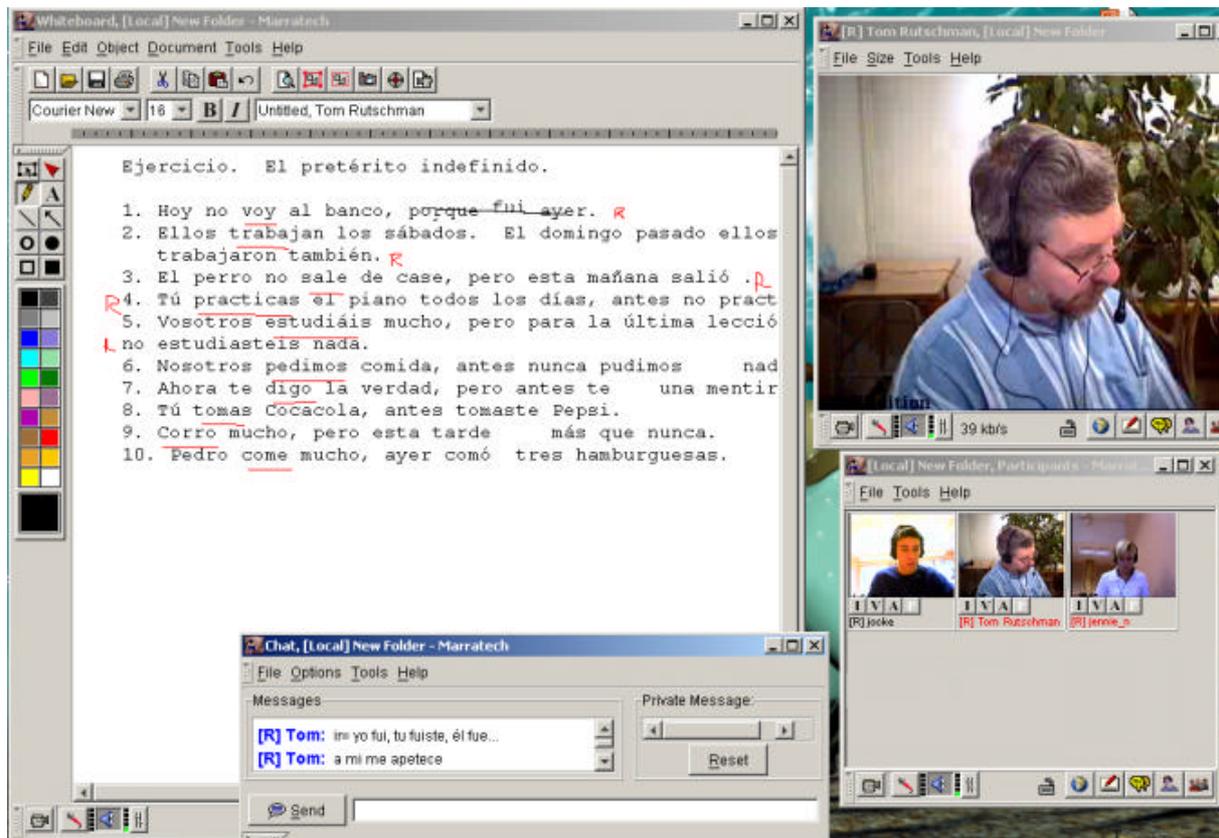


Figure 1, a recording of a class in Spanish for secondary school students.

As described in Synnes 1999, the environment can be used for large-scale distributed lectures (the traditional method of giving lectures, but also project presentations and seminars), virtual communities (continuous sessions, which all participants of a course joins when active), virtual teachers rooms (virtual corridors where most teachers can be reached during office hours) and virtual group rooms (a session per group, which students join when working in groups).

The environment uses a network technique called IP Multicast (Deering 1991) to distribute data efficiently between all participants. If IP Multicast is not available, then clients can either connect directly to each other (with the limitation of only two clients in the same session) or via a proxy server (with no limitation on the number of clients but with an increased use of bandwidth).

### **3. Some reflections from the study**

The current environments for net-based learning use both asynchronous and synchronous interaction between students as well as between students and teachers. These environments are widespread, especially the numerous asynchronous environments. The usage of them is however not optimal.

One major issue is many students' inability to communicate and discuss within these environments. Research shows that activity and communication in net-based learning environments is low. This means that a positive climate for learning is reduced, as interaction is one of the enabling factors for learning. Haythornthwaite et al 2000 showed that only a minority of students developed patterns for communicative learning in electronic discussion forums. The majority of the students was not engaged and therefore did not develop patterns for communicative learning. It seems that activity is an essential part in the learning process in net-based discussion forums.

Other studies had found that the activity and communication between participants in net-based learning environments seem to have a strong connection to pedagogy. Research on text-based learning environments in higher education found that higher level of pedagogical steering and control lead to higher and deeper dialogue between participants (Hammond 2000, MacCabe 1998).

Most research from pedagogical perspectives is based on asynchronous discussions or real-time text-based chat. However, our experiences from desktop video-conferencing follow the same patterns. We can identify a risk that desktop video-conferencing lead to distribution of lectures instead of communication and reflection. Teachers use desktop video-conferencing to deliver lectures that tend to become more static than classical (i.e. non electronic) lectures, since the combination of the teachers' often pre-made material and the medium lead to little improvisation and dynamics. The poor pedagogical standpoints and the teachers inability to use desktop video-conferencing in a way that stimulate communication clearly lead to minimal or absence of discussion.

An experience from the campus course was that the students did not like lectures delivered via desktop video-conferencing tools. One student said: "The microphone puts on too late too often which tend to give an impression that the lecturer stutter and seem to be uncertain". Technology is a critical point, especially when using desktop video-conferencing tools, as non-robust technology quickly becomes a major source for limited activity and negative quality of the discussions. In the campus course a majority of the students pointed out that the technology did not worked. They said that the video and sound were not good enough when they tried to follow the lectures.

The non-robust technology also had impact on the ability for students to communicate with each other. One example was the limited communication within the groups in the distance course. Group work was one important aspect of the course pedagogy, but electronic communication within the groups did not work during the course because the technology never worked properly. One of the students said: "It became hard to cooperate when the technology was not functioning for some of the participants". The students' group-work was not satisfactory as they thought it should take place before the start of the course. For example, seven out of eight did not know what the others in the group were working with while the course was running. The result shows that network and desktop hardware issues lead to problems for the students to use the synchronous tools. This made real-time communication hard to achieve and the students had to fall back on an asynchronous environment they had used before to solve the group-work.

The result from the campus course confirms earlier experiences from courses at Luleå University of Technology where courses have been conducted as distributed courses; There need to be a clear incentive for using the technology or the students feel forced to use the environments. The result is a further lack of involvement, as they can always meet the teachers or fellow students physically. Research from communication environments at workplaces shows similar patterns, where staff does not use the technology if they cannot see what it improves or solves (Henfridsson 1999).

## **4. Technical issues**

### **4.1 Network issues**

One of the issues regarding video-conferencing tools is network quality. Without sufficient network resources (bandwidth) or reliability (a non-lossy network) it is practically impossible to make such an environment work. Before planning a distributed course, it is therefore necessary to make sure that the sufficient network resources are available, or a course could end quickly as a failure.

A network with low reliability (with an high amount of loss of traffic) will quickly render the environment more or less useless. A loss rate of 1-2% will make the audio tiresome to listen to. This could be partly solved by repair schemes such as repetition or interpolation, but it still affects the audio quality notably. There are other schemes for avoiding loss, such as sending redundant data or splitting the data in important and less important parts, but most of these methods add to the network load and will make the situation even worse. Therefore it is

important to maintain the network uncongested, which could be done by limiting the allowed amount of sent data per session.

The possibility to use IP Multicast is good (as it dramatically reduces the network resources used) but the technology itself is complex to setup and maintain. The result is often that the network is either saturated by faulty traffic, the data is only transferred one-way (all traffic in one direction is completely dropped), no data at all is transferred (all traffic is completely dropped) or that data is dropped at certain intervals.

The network issues are too advanced for most teachers to manage, especially when using IP Multicast, so there is a need for a network support group to maintain the network. This is however not a simple task to achieve because network maintenance is often multi-organizational and involves policies for firewalls as well as other security considerations.

#### **4.2 Desktop hardware issues**

Another issue regarding video-conferencing tools is the fact that audio hardware is practically hard to setup without risking feedback or noise. This is the top reason why people find using these environments complex – it simply requires experience to successfully setup the audio levels to avoid problems. Wizards or setup tools are available in some environments, which are good. These are however seldom used by especially inexperienced users, which are the ones that need them the most.

When it comes to installation, we face another problem. The environment is rarely written for a precise hardware, so in addition to the environment the user have to manage the operating system and its drivers (Note, video drivers under Windows are especially hard as they might need secondary support from the system, such as DirectX drivers). This might be an obstacle too big for many to overcome, and they need support to get everything working on their desktop.

A solution to avoid exposing the users to hardware issues is to install machines in study centers or to let a support center take care of installation and maintenance. Another solution is to require that the students first take a course on the environment itself, including how to install and maintain their own system.

#### **4.3 Environment issues**

A common reaction to the video quality used in low-bandwidth configurations of vide-conferencing tools (typically maximum 100 kbps of video) is that it looks bad. People are comparing the video quality to what is achieved on a TV broadcast, and off course that is perceived as much better. The result is often a loss of interest, a conclusion that is supported by the fact that few students watch a complete recording of a lecture (Synnes 1999). The audio quality suffers from the same comparison, but not to the same degree. There are two ways of handle this issue. One way is to increase the perceived quality by sending more data or using a more effective codec. The other way is to involve the student, simply activating him instead of using the traditional passive lecture model.

Another common reaction is that the student does not know when other students are on-line, as they rarely join the virtual community (the virtual corridor or shared continuous session). They often want to know who is present in the virtual community before joining. This issue is simple to remedy; present the users with information of who is within a session before joining it or to have a 'buddy list' that states what sessions the buddies have joined. Similar functionality exists in many other environments.

At last a general technical issue of a very human art namely ease of use. If the environments are not simple to use, then fewer of the students will take part of the course content. In earlier work we found that some students gathered in groups to watch recordings of lectures they missed (Synnes 1998, 1999). At first it looked like they gathered together to be able to discuss the lectures, but after some time it has come forward that they perceived the environment as complex and therefore joined a student who knew how to manage it. The flexibility of the environment used was in fact playing against itself in this case. A less flexible but simpler to use version of the environment should be considered for future use in educational contexts.

### **5. Discussion**

The results of this study indicate that we do not currently use desktop video-conferencing in ways that will stimulate communicative learning. There are obvious needs for a net-based pedagogy, which involves course design as well as the act of teaching in desktop video-conferencing environments since the learning situation differ from the traditional classroom situation. The results from the distance course indicate that not only non-robust technology reduces communication, as it also indicates problems to achieve independence of space and time when using synchronous tools. The distance students had irregular working habits, hence few student were on-line at the same times. As a result the students had few to communicate with when they were able to connect which decreased the motivation to connect. In the future the course design with synchronous tools have to focus much more on how to plan and design courses and part of courses that are adaptable to distance students. The

teacher in the distance course says that he would have planned the teaching more rigidly with special times for communication in order to stimulate virtual meetings.

The network problems during the distance course and the distance students' problems to synchronize their work increased the need for asynchronous tools, which can stimulate group work even if the students do not meet each other via synchronous tools or physically on a regular basis. One interesting reflection from the teacher was that he claimed that synchronous communication could make the tradition of seminars possible in order to stimulate reflective learning in distance education and thus complement the use of asynchronous tools.

These reflections indicate that it is possible to combine synchronous and asynchronous tools in order to stimulate communicative learning. There is therefore a need to study if synchronous communication can stimulate the tradition of seminars and how asynchronous and synchronous tools should be integrated in order to find a balance between them for different learning situations and for different groups of students. Otherwise we will end up with environments that no one uses.

## **6. Summary and Conclusion**

This study indicates that insufficiently functioning technology (due to network problems and incorrectly setup hardware) in combination with poor pedagogy lead to ineffective learning situations. Research on distance education has found that pedagogy is more important than technology in order to affect learning (Phipps & Merisotis, 1999). We agree but will also claim that technology must work properly if the students should have the chance to learn at all. The use of unstable technology clearly affects the learning situation negatively for the students, which focused too much on the failing technology instead of their learning tasks. An example is that the students during the campus course refrained from using the synchronous tools due to problems with perceived audio and video quality. The teacher in the distance course said that the motivation among the students was reduced because of the problems with the network and hardware. Some important aspects of a good learning environment were put aside because of the problem with the underlying technology. It is therefore important to consider basic issues such as reliable technology and infrastructure, guidelines and pedagogical methods in order to develop easy to use learning environments that include desktop video-conferencing.

We can see that many issues raised for asynchronous environments also are valid for synchronous environments, such as low on-line activity and lack of motivation.

An important conclusion is that there is need for continuous support during a distributed course that uses more advanced technologies like video-conferencing tools. This is important not only for the setup and maintenance of desktop computers and the net-based learning environments, but also for support with pedagogical issues such as recommendation of course design and pedagogical methods and training. It is at least as important to educate the teachers about the technology and pedagogical aspects as having a working net-based learning environment. Using the most suitable pedagogical techniques is simply as important as the material to be studied, and perhaps even more so than for traditional courses.

Despite many shortcomings in current examples of distributed courses, this study shows some interesting results indicating that a combination of synchronous and asynchronous methods can be fruitful in net-based learning environments. In conclusion, attaining an effective environment for net-based learning includes not only working technology but also a well-planned course where the incentive to use the technology is clear.

## **7. Future work**

The result of this study and the conclusions we have made has to be seen in the light of the small group of students that has been studied. We are aware of the shortcomings in validity and reliability in our results and further research in larger scale has to be done to get more valid and reliable data. It is clear that research has to consider both the pedagogical point of view as well as the technological, which other researchers also have suggested (Romiszowski & Mason 1996). We have in this paper identified some of the shortcomings and also, in general terms, discussed important aspects that may help us to overcome problems and help us to develop and modify net-based learning environments in the future.

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