

## OVERCOMING TECHNICAL FRUSTATIONS IN DISTANCE EDUCATION: TELE-TASK\*

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### ABSTRACT

Modern information technologies are transforming the way people learn. E-learning provides new possibilities for personalized learning at home or in the workplace, reduces the need for costly classroom training, and enables an optimal balance between traditional and innovative forms of knowledge transfer. But facts have proven that content creation for online courses is time-consuming and costly. Also most of them are not easy to call up. A simple and efficient solution of content creation for online courses is strongly required. Our new system, tele-TASK [1]- Teleteaching Anywhere Solution Kit, paves the way for these requirements. With the help of the new developed system tele-TASK a new, drastically simplified entrance technology for on-line lectures has been reached. Not only contents of teaching, which are presented to the students in the lecture-room by either a whiteboard or a video beamer are delivered but also video and audio of the lecturer. For tele-TASK a special hardware (T-Cube) is now available, which permits the creation of Real or Mpeg4 streams in different bandwidth ranges on the fly. Thus a pre-installed standard player can be used.

### 1. NOWADAYS E-LEARNING

Our society today is characterized by what is called „informational society“. Our communication culture and information organization is going to change, as the importance of the internet is growing. As in the term of the ‚informational society‘ is expressed knowledge is a central aspect of people`s lives, that is – as soon as it is learned – antiquated. So people are forced to lifelong learning not to miss their connection to future developments. At the same time globalization calls for mobility and flexibility. In consequence the processes of learning have to be adapted. They have to be untied from time and place.

E-Learning creates new possibilities. So Urry talks about the begin of the ‚computime‘ [2]. Knowledge is de-territorialized and turned into bits of information resulting in ‚information blizzards‘ [3]. Besides the mentioned flexibility the use of New Media changes the processes of learning, too. Tele-Teaching is one of this new modes.

The public and scientific opinion in reference to E-Learning is ambivalent. While some authors emphasize the revolution of our work via E-Learning, its cost-effectiveness and its greater social inclusion, others speak of a crisis of E-Learning and its little acceptance. Certain is that E-Learning changes the quality of learning experience itself.

The reason why critical voices are raised is the fact that many of realized E-Learning projects don`t overcome the status of a pilot project. Why? The answer is given by Hohenstein & Tenbusch [4]: They are missing a perspective paying attention to the functional and structural qualities of a system. In the development of an E-Learning project it is unalterable to consider the aspects ‚organization‘, ‚man‘ and ‚technique‘ equivalently and simultaneously.

ORGANIZATION	MAN	TECHNIQUE
Environment	Personality	soft-/ hardware
- culture of learning	- qualification	- infrastructure
- structure	- acceptance	- quality
- process	- motivation	- meshing

see Hohenstein & Tenbusch 2002 [4]

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## **Organization**

Initiators of E-Learning projects should be prepared to changes of structures and processes as a result of the introduction of media based learn methods.

## **Man**

A successful realization of E-learning projects presupposes the analysis of target groups.

Wilbers [5] distinguishes several dimensions concerning the requirement on the part of potential users: the principle of learning, the principle of curriculum and the principle of competence.

The principle of learning contains personal styles, aims, the speed of learning and motivations, that have to be analyzed as conditions of the field of work and learning. Trainers must ask for the available technical knowledge of the future users. Those have to know and understand the important terms. Furthermore, they have to be able to apply the central tools. Moreover the experiences of the learners with the internet have to be examined as their experiences with online-teaching, the use of learn programs, the use of web-based services.

Curriculum principle means the consideration of the learner's future professional situation. The principle of competence is seen as the task to get a picture of the competencies that should be realized and their connection to further aims.

## **Technique**

The technical conditions have to focus on human needs. They have to support the users in facilitating the processes of learning and working. E-Learning should integrate - concerning man - all processes of management of information and management of working, -concerning organization - administration and winding-up, the culture of organization and its aims.

Existing communication structures are to be proven if there is a possibility for implementation. The technical infrastructure functions as a „City of knowledge“ [4].

An E-Learning project is successful, if it stands the test in all three mentioned dimensions. Changes in one of them must effect changes in the other ones [6].

Now we will concentrate on our project TeleTASK. We want to introduce you to our ideas, that lead to a successful realization of our teleteaching project.

## **2. THE TELE-TASK CONCEPT**

The tele-TASK system was originally deployed for recording, transmission and archiving of the computer science lecture "Information security in open networks" at the university of Trier in the summer semester 2002. High access numbers express the perfect problem-free and easy possibilities of using tele-TASK. In this semester another lecture titled "Internet security" is being offered at the University of Trier and simultaneously transmitted to Beijing University of Technology, China. Here Chinese students take part in the lecture via Internet together with students in Germany. Practical testing proves that our solution is successful.

In the following, we would like to introduce the new "easy to use" internet based teleteaching package tele-TASK, which accomplishes all requirements to modern teleteaching systems. Furthermore, we will present the complete all-in-one solution "T-Cube", which allows you to create online-courses on the fly without previous training for students and operators(!).

In reference to the target group analysis we expect to have students, which are able to use a standard web browser. We will later see, that tele-TASK has no further requirements subjected to the technical abilities of the learners.

### **2.1 The Content Creation Problem**

Today, there are several ways of electronic content creation for online courses. The most common way is to create the content of the lecture for web-use by means of creating static or dynamic web pages with HTML or PHP. The disadvantage of this method is the extremely high cost for development. On the average, one can calculate one person working for a half up to a full year for the preparation of electronic learning content

for only one course. By assuming that course data, esp. in computer science, changes very fast, costs for updating will occur.

Other possibilities for content creation are the specific application development (e.g. Java applets for web-use) or the use of multimedia production tools (e.g. Multimedia Toolbox [7]), Macromedia Flash [8]. But these solutions all have one thing in common: \textit{high costs}.

To avoid such high costs, systems for the creation of electronic course content during a normal lecture were developed. TTT [9] and AOF [10] are examples for this approach. The big advantage of those systems are the reduced costs for the creation of electronic course content. As we discussed in the sections before, a very important feature of e-learning systems should be the easy practicability. When analyzing those two tools for this important requirement, we see that it is not easy for operators or students to produce or access the electronic content. In field experiments we determined that the programs restricted users in various ways. The most important restriction was the need of installing special programs to access the content. In the case of TTT also JAVA and JMF had to be installed. Even computer science students were not able to do so.

## 2.2 Online Lecturing Needs

As described in the previous section, past teleteaching systems limit operators and users to various ways. On operator's side the lecturer is often rigidly bound to an operating system or to necessary bandwidths. Also widely spread is the restriction in using special presentation systems [9,10], e.g. PowerPoint, which finally leads to the lecturer's degradation to a slide commentator. Today, a good lecture should contain dynamic contents, such as animations and demonstration programs, as well as arbitrary information from the WWW. An unrestricted use of all usual operating systems is also desirable.

On the users' side, students and other interested persons, who want to retrieve courses via the Internet, should not be subjected to the torture of complicated installation and operating steps. In the winter semester 2001/2002 for the first time teleteaching systems [9] were tested and used at the local chair. All applied systems were very difficult to install and to use, due to the need for Java or other software packages. In addition, a lot of programs were very instable. The experience showed that even computer science students were not able to furnish and operate such special software packages correctly. Proceeding from these observations, we improved the development of a less limited, better applicable and at the same time more efficient teleteaching software system. Apart from the requirement of easy to use, a transmission of the lecture should be possible down at the modem speed, since not every student has a wide-band Internet connection. The use of standards, the permission of any operating system and any presentation software are also required for the development of a new teleteaching system.

The following list shows the requirements of a modern tele-lecturing system in order of their importance:

- ✓ Complete mapping of the classroom situation (Beamer, Video, Voice)
- ✓ Simple usage for the student. Most desired is:
  - Use of standard pre-installed software
  - Platform independency
- ✓ item Simple usage for lecturer. Most desired is
  - "One-Push-Button" technology
  - Integrated all in one solution
  - Usage of own equipment (e.g. Laptop)
  - Web integratable
- ✓ Modem speed is enough for a transmission
- ✓ Online (live, on-demand) and Offline (CD,DVD, Download) capable

At the University of Trier, at the chair "Theoretical concepts and new applications in computer science", a new teleteaching concept has been developed and tested, which grants an entrance to on-line lectures in the simplest possible way and breaks down the barriers for producing and accessing distance learning content. Tele-TASK represents itself as a result of these considerations and developments. The experiences in the field use in the summer semester 2002, the reactions of the users and the high access numbers confirm the quality of our concept.

## 2.3 tele-TASK Content Creation

Based on the above considerations, we thought about electronic content creation with the needs of online lecturing and the reduction of the traditional costs in mind. Our basic idea is, to use the original lecture to produce e-learning content on the fly. But the most important requirement was the easy use for operators and end-users. The complete classroom situation including the desktop of the presenters computer, the video and the audio should be mapped into electronic course material. We desire to transfer the complete course live and on-demand to the internet. Also for offline usage, the course data should be saved. Figure 1 shows the structure of the tele-task system.

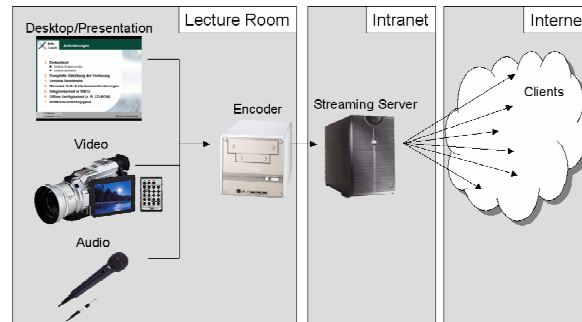


Figure 1: Structure of tele-TASK

In the following we show the different parts of the system.

### 2.3.1 Transmission of the desktop

Various online lecturing systems (see Real [11], Microsoft [12], AOF [10], ...) have to run on the presenter's computer. In these cases special requirements are claimed to the presenter's computer. Often, those solutions call for special operation systems, special presentation software or high CPU power. In the case of non computer science lectures this presents a big problem. Most lecturers are unwilling to install anything new on their computer, or they do not have permission to do so. The solution is to deliver the desktop to another computer. This transmission is done with VNC [13]. VNC allows to transfer a desktop, no matter which operation system, to another computer without the loss of quality. To reduce the bandwidth we are using tightVNC [14] which transfers less packets than original VNC and it also compresses the packets. On the encoding machine, the desktop is processed further more.

### 2.3.2 Capturing Video and Audio

tele-TASK supports two different ways of accessing videos. The first solution is to use a video device connected directly to the encoding machine. By using the Microsoft DirectX library [15], we can access any video device connected to the encoding machine. This could be e.g. a cheap webcam, an analog video camcorder or firewire videocamera. The system supports multiple video devices which could be switched during the recording. Video resolution can be set up for each device separately. Audio can be delivered via Firewire over the videocamera to the encoding machine, or by the analog or digital audio input. The second way of transferring the video is to send it over the network. tele-TASK provides a tool for transmitting and receiving video and audio over the network. In those cases, the encoding machine can be set up in different locations.

### 2.3.3 Synchronisation of the streams

The encoder consumes altogether three streams (video, audio and desktop). The developed tele-TASK software package combines the three input streams. Figure 2 shows an example for the arrangement of 4 Streams (Video, Audio, Desktop and Table of Content). The arrow shows the coherence between the video

and the desktop stream. A student is easily able to recognize the actual discussed part of a slide by comparing the slide to the video.

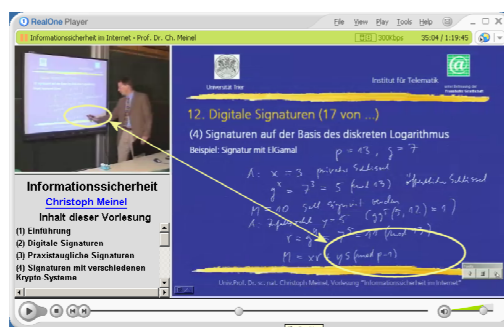


Figure 2: Lecture Playback in RealOne Player

Video and audio are synchronized to each other and then treated as one stream. The synchronisation between audio, video and Desktop is thus guaranteed. A text stream can contain additional information in the form of e.g. links or tables of contents. The operator of tele-TASK can position and dimension the streams freely (see figure 3).

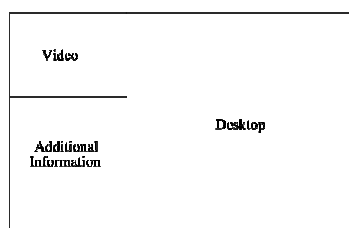


Figure 3: Layouting the streams

Usually the video stream is put in field 1, the desktop stream in field 2 and the text stream in field 3. The composition of the streams is done by SMIL (Synchronized Multimedia) [16]. By supporting multiple input devices (Video, Audio and Desktop) it is possible to change the layout dynamically. In case of presenting high quality video scenes during the presentation, the desktop can be hidden and the video can be set up to fullscreen mode. Such cases often appear in medical presentations.

### 2.3.4 Output Formats

After assembling the input streams, tele-TASK encodes them into a standard format. Currently 3 different formats are supported:

1. Real output
2. Special low bandwidth format
3. MPeg4

The Real output directly supports the Real streaming server. Real streams can be set freely to arbitrary bit rates. Praxis has shown that 250 kBit/s is enough for high quality online lectures including video, audio and desktop. The software computes the Real stream in real-time, saves it to hard disk and streams it live to a streaming server.

Parallel to the real encoding, tele-TASK encodes a special version for very low bandwidth. With only 38Kbit/s it is possible to provide video, audio and a perfectly rendered desktop. The only cutback is that animations on the presenter's computer cannot be shown. During a normal slide presentation the desktop doesn't change a lot. The idea is to scan the desktop for changes and only the changes are saved and sent to the client in a compressed way. Figure 4 shows a slide in which two new lines have appeared.

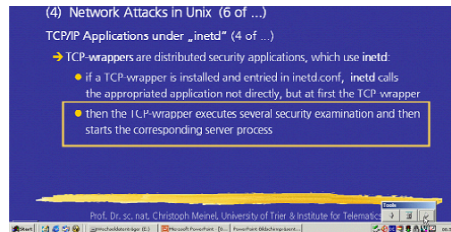


Figure 4: Slide with two new lines (marked)

tele-TASK grabs out the changed area and computes the exact difference between the old and the new state. Figure 5 presents the exact difference between the two states.



Figure 5: Changes between two slides

Only the white areas are saved and sent in a compressed way. For 90 minute slide presentation including annotation we save and send about 200 to 300 desktop updates. In total we need about 1 Megabyte for the complete high quality (about 600\*400 Pixel) desktop. [17] shows an example.

The last output format of tele-TASK is MPEG4. The software computes MPEG4 streams in real-time. Like the Real output the MPeg4 stream can be saved to harddisk and sent to a streaming server. Apple provides the free and open-source MPeg4 streaming server Darwin, which can be used directly.

*For each output format the usually pre-installed standard players like Realplayer, MS Mediaplayer, Quicktime Player can be used. By supporting these standard players, we fulfill the most required feature: Make the access as easy as possible for end-user.*

## 2.4 T-Cube – Make the production as easy as possible

Besides of the easy call up of learning content for the student, another quite important feature for distance education is to break down barriers for the production of electronic content. With T-Cube, a high integrated easy to use device based on tele-TASK is given. The T-Cube is a small computer in the shape of a cube. The T-Cube has two network devices. One is for connecting to the local network and the second for the presenters computer. The interface for the local network has to be configured once by a system administrator. The second one provides a direct connection to the local intranet, not depending on the network settings on the connected laptop. This feature is also done by tele-TASK. It masquerades the range of all IP-addresses including the faking of all possible gateway IPs. The big advantage is that every lecturer can use his own laptop without configuration. The laptop can be connected directly to the T-Cube and has access to the local intra-/internet without having to be adjusted. This is very important for conferences where presenter want to use their own laptop.

Once connected to the T-Cube, a small software is started on the laptop via a web-interface. This software allows to export the desktop and to control the T-Cube. By the use of hotkeys the lecturer can start/stop/pause the lecture. By using the integrated solution the lecturer doesn't need much knowledge about the system in use. He can easily start and stop the session by himself.

Cameras and microphones can be connected directly to the T-Cube. The streams can be sent to the streaming server and saved on a local harddisk parallel. After a presentation a CD/DVD with the recorded content is burned automatically. The configuration of the tele-TASK software can be done by a webinterface or by an external program. The T-Cube does not need a monitor, keyboard or mouse. It is just a black box which can be switched on and off.

### **3. TELE-TASK IN PRACTICE**

#### **3.1 Successful transmissions with tele-TASK**

After testing and using other tele-lecturing software in the beginning of 2001, tele-TASK is in practical use since summer semester 2001. For the first time, tele-TASK was used for the course "Information Security in Open Networks". Especially aspects of cryptography were explained. By using an electronic white-board, the lecturer was able to write complete mathematical proofs onto the slides. The whole course including video, audio of the lecturer on his laptop's desktop was digital recorded and sent live to the internet. In comparison to the former used system, we registered a dramatic increase of live and on-demand accesses. In user surveys we realized, that the reason was an easier calling up of course content. Students were using the system in case of time overlapping courses, so that they were able to join both courses. Also at the end of the semester students used tele-TASK course material in order to replay complicated sections of the course. tele-TASK was also used to record two conferences about e-Payment and e-Medicine at the Institute for Telematics in Trier, Germany. Each time overall 200 people joined the conferences live in the internet. In the winter semester 2002/2003 the University of Trier is holding a course about the security concepts in the Internet with tele-TASK. This course is simultaneously transferred to Beijing, China. There, at the University of Technology Chinese students are joining together with the students in Germany the lecture. The quality of the recorded lessons was so high that lots of students all around the world joined the lessons via the internet. In the time of 9 month we got about 40.000 hits on electronic tele-TASK content. The high access numbers and the positive feedback of students and other learners proof the success of the concept.

#### **3.2 On operator's side**

tele-TASK is a complete program suite for providing high quality teleteaching. The package contains all necessary programs and tools for generating streaming material for the web. The whole system works like a one push button automat. It takes less than five minutes to set up the T-Cube and the technical environment. The complete equipment fits into only one small bag, so that it is possible to offer teleteaching anywhere you are at. In practice, the streaming server is not at the same place as the encoder.

Once tele-TASK is installed, nearly any lecture can be recorded. A lot of universities are talking about offering tele-lectures. But if you want to find something in the web, you will have to prepare for a long search. With a system like tele-TASK a university or an institute for further education can allow the students to access and replay all courses they want to see. Also, it is very easy to make the lessons available offline. Only one CD-ROM contains about 6 hours of recorded courses including video, audio and the desktop of the lecturer.

The intuitive use of tele-TASK makes unnecessary to train the lecturers. By the use of an electronic whiteboard (e.g. Smartboard) the lecturer can easily annotate his slides with electronic pencils. Another big advantage for the lecturer is the kind of copyright on his lectures. By making scripts of a lesson available online, the copyright trademarks are not protected. Everyone can copy and paste the text to his own documents. With streaming data, it is much more complicated to do this.

#### **3.3 On users side**

By integrating tele-TASK documents into webpages makes a calling up very easy for the consumer. By clicking on the corresponding link the player starts up automatically and plays the lesson. In comparison with other teleteaching systems, tele-TASK is very easy to use. Even laymen are able to access the lectures through the internet. The experience with other teleteaching software, which was complicated to use on operator and viewer side, taught us to provide an "as easy as possible" technology for the consumer side. The positive feedback and the high access numbers shows the effectiveness and efficiency of tele-TASK.

## 4. CONCLUSIONS AND FURTHER WORK

With tele-TASK it is possible to provide high quality teleteaching without a large technical and financial expenditure. The use of standard pre-installed players makes an access of contents independent of time and place easy. The past users emphasized the simple applicability of the system. Especially the high-quality and the smooth transmission of the Desktops speak for an expansion of the employment on the range of further training (e.g. training courses for Linux, Word, or other programs). Two big advantages make tele-TASK very useful for further education. Online courses can run separately from and simultaneously to traditional forms of courses. The number of potential attendees increases dramatically. Further, after a course CDs with the recording can be given to the participants.

Currently we are developing automatic content extraction for tele lectures. With the help of XML and RDF we are building semantic networks of words and topics. Once having such semantic networks, new possibilities for learning, searching and accessing of information are given.

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