1. INTRODUCTION
We describe challenges associated with using video lectures in higher education, focusing on human-computer interaction (HCI) and e-learning. We outline how these challenges are driving current work at Natural Sciences ICT Competence Center (NIK) on improving video lectures.

The lecture is a traditional teaching mode in higher education. Lectures are used extensively in science curricula at most universities, especially when addressing a large number of students. The lecture is a cost-efficient way of presenting an overview of a topic and may foster student-teacher interaction. However, the lecture has a number of drawbacks, the mostly passive role of students being the most prominent. New directions in educational theory and empirical research [7] suggest that more active forms of learning outperform traditional lectures. Another drawback is that most lectures fail to meet the ideals of flexibility in learning time, places, styles, and pace [4].

Video lectures are an attempt to compensate for these drawbacks by making available videos of lectures in digital form, usually coupled to slide shows and sometimes including supplementary textual or graphic material. Students may access the video lecture synchronously or asynchronously within the framework of an e-learning environment or on the Internet. The main goal is often seen as enabling the student to follow the lecture independently of time and physical location, and possibly to allow for a replay of the lecture in part or in full. Here, we discuss video lectures as a supplement to traditional lectures, rather than the case of pure distance learning, i.e. where all students are viewing lectures at other times or places.

The technology used for video lectures is increasingly becoming faster and less costly, resulting in new user interfaces for accessing and searching the lectures and for collaboration around the lectures. User interfaces for video lectures have in common the combination of video and slides [1,11,12]. Other possibilities include extended video-browsing and navigation capabilities; links to simulations and visualizations; support for students making their own annotations and sharing them with others; person-to-person or groupwise discussions anchored on particular slides or parts of the lecture [1]; conference facilities and mailing lists; and facilities for measuring individual learning progress against predefined goals.

Despite the promise of video lectures, empirical research has pointed to a number of challenges with such lectures. Below we discuss these, first focusing on human-computer interaction, and then on e-learning.

2. HUMAN-COMPUTER INTERACTION
From a HCI perspective, challenges with video lectures concern efficient browsing and fact-finding in the lectures, coupling between elements of a lecture, and support of students’ collaboration around a lecture.

First, it is well known that current user interfaces for any kind of video is difficult to use for browsing (e.g. to get the gist of the content) and for locating a specific fact in the video [9]. Studies on the use of video lectures show similar difficulties. Logs of student access to video lectures at UC Berkeley [11], for example, showed that for a 50-minute class, over 60% of the replays lasted less than 10 minutes; only 10% of the replays last the entire lecture. To us, these observations suggest a failure to keep students’ attention and to give students an overview of a lecture. It seems that most commercially available video players and common video lecture interfaces support only linear video viewing, progressing from the beginning to the end of the video.

To give an overview of the content of the video, some systems provide previews of the video lecture content. Previews include keyframes extracted from videos, slide shows of video content, and overview+detail interfaces [5], giving the user an overall sense of the content of the lecture. To our knowledge, previews have yet to be used and empirically evaluated in educational video lectures.

Second, in information visualization North & Shneiderman [10] have proposed a framework for coordination between user interface elements. Their framework presents different ways of coupling interface elements, few of which are supported by commercial interfaces to video lectures or by research prototypes. For example, changing to another slide may not forward the video and supplementary material may not be shown at the times in the video when it is relevant. Support for navigation in videos through tight coupling of video timelines, slide controllers, supplementary WWW pages, and textual tables of content seem necessary to accommodate the diversity in tasks done with video lectures (exam preparation, finding especially interesting points, etc.); the framework mentioned above may help accomplish this.

Third, another challenge is to design video lectures that allow students to effectively collaborate around and discuss the lectures. One study showed that students using video lectures compared to traditional lectures miss the immediate response to questions and interactions with the lecturer [1]. One attempt to meet this challenge is the use of discussions around a video lecture [1,6]; another might be more directly providing feedback from students to lecturers on the lectures. Support for collaboration currently only allows weak links between discussions and the video lecture, e.g. as a link from a discussion topic to a specific two minute part of the video.
3. E-LEARNING

Challenges in assessing the learning aspects of video lectures concern the influence of video lectures on students’ motivation and learning, the accommodation of individual differences in learning styles, and the rethinking of the format of lectures to best facilitate learning.

First, the background for exploring video lectures is a desire to effectively and flexibly supplement the traditional lectures. Overall, it seems difficult to successfully create technical solutions facilitating a productive and positive learning experience [3]. One study showed that a majority of students felt that video lectures improved their learning experience [11], yet longer-term studies measuring learning outcomes are needed.

Second, an often-quoted reason for improved flexibility in teaching through video lectures is the better support for differences in individual learning styles. While some studies show that students feel they can learn at their own pace using video lectures [11], the drawbacks are not well described. For example, it is not clear whether students give up attending traditional lectures when video lectures are available [2]. One study showed how students in a distance-learning course felt more distressed compared to students in a traditional course; will this happen also for students that use video lectures? Currently we do not know much about how to design video lectures so as to accommodate for individual differences in preferred pace of learning, information types, and work method.

Third, the format of a lecture to be transferred into a video lecture might need to be changed. Research has explored the most effective summary of lectures in laboratory style experiments by comparing different presentation formats [9]. Perhaps similar experiments could be done with video lectures to find out if they could be organized differently: what happens, for example, if the entire lecture is broken down and indexed into 5-minute segments? Thus, empirical studies on the format of lectures are needed. Especially, we need to explore the effect on learning of different formats and whether students are better able to cope with formats different from the traditional 45-minute lecture.

4. CURRENT WORK AT NIK

At NIK, we currently work on addressing the challenges mentioned above. Concerning HCI, we explore using information visualization techniques for providing previews of video and for facilitating navigation. Techniques from information visualization—overview+detail, fisheye, and zoomable user interfaces—may help improve these aspects of interaction with video. For example, the partitioning of video into a hierarchy of smaller parts requires user interfaces where navigation between those parts are easy: zoomable user interfaces is one way of doing so. Fisheye interfaces for video lectures may be based on teachers marking up which parts of the lecture are most important—simultaneously providing previews of the lecture and supporting navigation.

To address the challenges mentioned under e-learning, we are planning in the spring of 2003 to do experiments with whole courses assessing the influence of different interfaces for video lectures on motivation and learning. We find the challenge of changing lecture format of video lectures especially relevant for these experiments.

The above discussion of HCI and e-learning challenges associated with video lectures raises the question of how such challenges are related—especially how usability and fluent interaction influence learning and motivation, and conversely. To us, current user interface problems with lack of previews, poor navigation, and modest support for collaboration limit actual use of video lectures. Conversely, the problems of e-learning must be addressed and empirically studied in order to provide video lectures that function as an effective supplement to traditional lectures with respect to students’ learning and motivation.

5. REFERENCES