

# How Can We Use Hypervideo Design Projects to Construct Knowledge in University Courses?

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**Abstract.** In this paper a course concept based on collaborative construction of hypervideos is presented. The course concept integrates a) hypervideo technology development, b) research on learning with hypervideo systems, and c) the application of research on knowledge acquisition by writing texts or hypertexts to hypervideos. We demonstrate how collaborative construction of hypervideo can support knowledge transforming processes (see Bereiter & Scardamalia, 1987; Stahl & Bromme, 2004) in university courses of psychology students. In the first part of the paper a hypervideo system that enables collaborative design activities by users is discussed. Afterwards the course concept is presented in detail. Evaluation results are consistent with our assumptions. The course concept showed to be successful and well appreciated by the students.

**Keywords:** Collaborative hypervideo design, knowledge transforming, hypervideo.

## INTRODUCTION

Hypervideo is defined as *video based hypermedia* that combines non-linear information structuring and dynamic audio-visual information presentations (videos presenting realistic images or animations). In hypervideos, video information is linked with different kinds of additional information (like written or spoken texts, pictures, or further videos). Users can mouse-click on *sensitive regions* within the videos to access the additional information (see figure 1). One main difference between sensitive regions in a hypervideo and links in a hypertext is that the sensitive regions have spatial and temporal characteristics. This allows highlighting a specific object or person within the video for a predefined timeframe. The main difference between videos in traditional hypertexts and hypervideos lies in the importance attributed to the video itself. In hypertexts videos are often illustrative and optional. In hypervideos, video sequences form the "backbone of the system" (Zahn, Schwan & Barquero, 2002). Thus, videos and the additional information elements are interwoven in ways that videos can be viewed interactively and navigated in non-linear order.

Defining hypervideo-links in a video sequence enables an author to refer to a specific object / person within the video by providing additional information. We have extended this concept by developing a cooperative hypervideo system that supports the collaborative authoring of hypervideo systems where group members can share their ideas (Zahn & Finke, 2003). The system provides specific facilities to jointly elaborate on video materials and to change a hypervideo presentation according to the development of knowledge present in *any* group. In this sense hypervideo can be defined as *dynamic information space (DIS)*, which can be changed and extended as a basis to share knowledge and to communicate. The dynamic information space integrates interactive videos, additional information and communication.

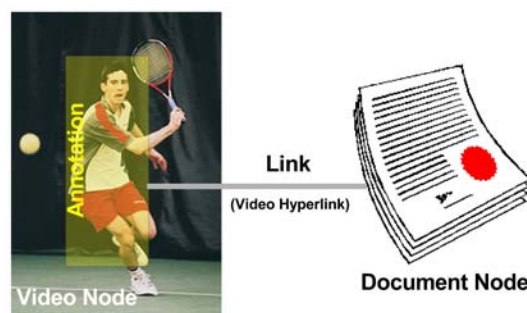


Figure 1: Concept of hypervideo

Our human computer interface concept is based on a view model. The model allocates separate views within the graphical user interface to access certain parts of the dynamic information space in form of the different node

types within the DIS: *Video nodes* are video sequences with sensitive regions which are presented in the video view. The existence of a sensitive region is announced by its visualization within the video display. Since it might be disturbing in some learning situations, the user is in charge to initialize the visualization process of sensitive regions. Hypervideo-links can be activated by clicking on the corresponding sensitive region with a mouse pointer. Furthermore, the video view allows users to generate own sensitive regions. *Additional information* are presented in a separate view and can be of different media types like texts, images, animations, audio recordings, etc. It is possible to link multiple nodes with additional information to one sensitive region within our system. *Communication nodes* describe the conversation between users and are therefore highly contextualized. The communication view presents the group conversation in form of text based dialogs (chat). A dialog is always related to an object in the video or to a specific information node. In addition, a fourth view is introduced that enables the disclosure of the *hypervideo-structure* in order to support user orientation within the graphical user interface. The arrangement of all node types within the structure is visualized in a text-based manner. Users can browse the navigation view and activate hypervideo-links, which will lead to the presentation of the content in the associated views.

These facilities, in turn, can be utilized in formal educational contexts such as projects at university, as will be described in the following paragraphs.

## COLLABORATIVE HYPERVIDEO DESIGN

During the last years a growing number of courses in hypermedia production have been offered in schools and universities that focus on students' collaborative design of multimedia. It can be assumed from the constructivist perspective of situated cognition (e.g. Jacobson & Spiro, 1995) that such courses allow to create a learning context, which incorporates important features to foster deeper understanding and knowledge transfer: Students have to solve the realistic and authentic problem of how to present a topic within their hypermedia in an appropriate way. They are engaged in an active and constructive process of learning, and because of the complexity of the task, that can only be solved in collaboration, they are challenged to articulate and negotiate meaning with their fellow students.

However, the production of hypermedia is a highly complex task: It is not easy to maintain the balance between thinking about the content to be processed and thinking about design features of hypermedia (Dillon, 2002). Accordingly, problems that arise in such projects include that either too much attention is paid to the design of hypermedia while the contents are only included with 'copy & paste' (Bereiter, 2002). Or that students present the contents in a way that is inappropriate for the format of hypermedia. A consequence of both cases is that students develop a superficial comprehension of the subject matter presented by their products. Therefore it seems necessary to find an appropriate balance to encourage reflection on the contents on the one hand and reflection about the hypervideo design on the other. This assumption is made in analogy to ideas from research on writing traditional text and hypertext. Concerning text production, Bereiter and Scardamalia (1987) propose that writing can only contribute to knowledge acquisition when a text is formulated within a continuous interaction between content-related knowledge (on the topic addressed in the text) and rhetorical knowledge (on the design of the text, the anticipated audience, the genre, etc.). This problem-oriented procedure (called knowledge transforming) requires authors to reflect on and extend their own knowledge about the topic. Concerning hypertext writing, Stahl and Bromme (2004) used the knowledge-transforming model as a heuristic to examine conditions and processes of learning by constructing hypertexts and to develop a course program for university courses, respectively. They argued that constructing hypertexts places special constraints on the design of the documents through the features of hypertext, the nodes, the links and the multi-linear structure. As they described in detail, the processes of writing nodes, selecting appropriate links, planning the overall structure and flexible ways of reading might result in deeper knowledge about the concepts within a subject matter, a deeper comprehension of semantic structures within the subject matter and to a more flexible use of this new knowledge.

In designing hypervideos, the rhetorical and design knowledge that can be acquired by learners is even more broadly defined than it is with writing hypertext (Zahn, Schwan, & Barquero, 2002). It is additionally important to consider which symbol system is appropriate for which kind of information, which information should be presented as dynamic information in the videos and which is better suited to be presented as static information in additional text nodes. Further on, the new link type of sensitive regions within videos determines new kinds of decisions about the setting of links and the design of an overall hypervideo structure. We assume that these reflections should contribute to an appropriate situational model of the contents to be processed (in sense of Kintsch, 1998). And this, in turn, should help students to understand the respective topic more deeply and to be able use it more flexible in transfer situations.

We ran a series of regular university courses about "*learning with new media*" at the University of Muenster, Germany to examine whether the complex task of designing hypervideos could be managed by the students and

to test, which instructional help the students needed. These courses will be described in more detail in the next paragraphs.

## HYPERVIDEO DESIGN IN REGULAR UNIVERSITY COURSES

The courses in hypervideo design are part of the psychology masters program (diploma) at the University of Muenster. They are offered as courses on e-learning. 10 to 16 students participate in each course. The topics of the hypervideos produced within the courses were ‘techniques of presentation and moderation’ in the first course and a parallel course at the University of Linz, Austria (lectured by Stephan Schwan), ‘information system about study of psychology at the University of Muenster’ in the second course, and ‘conflict management’ in the third course (this course is still running). The hypervideos have to be designed from scratch, i.e. students have to plan all the video materials and the additional information, to write storyboards and text nodes, to film and to edit the videos and to integrate the different video and additional nodes in a coherent hypervideo structure. A screenshot of one of the students’ hypervideos is shown in figure 2.

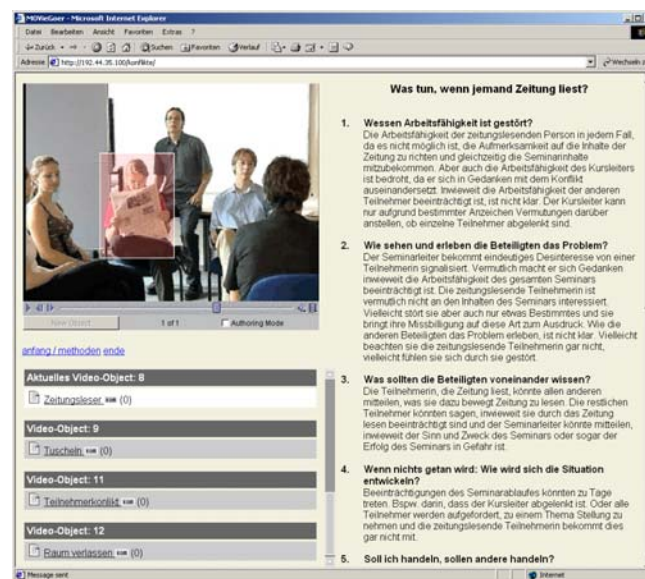


Figure 2: Hypervideo about ,techniques of moderation’

As a heuristic to structure our (second and third) courses of hypervideo design we relied on the course program for hypertext writing developed by Stahl and Bromme (2004), which is based on results from their studies on writing hypertext in secondary schools and several experiments on knowledge acquisition by writing hypertext (e.g. Bromme & Stahl, 2002, 2005, Stahl, 2001). The program of Stahl & Bromme (2004) consists of five instructional units to teach university students how to use the features of hypertext consciously. Each unit covers one aspect, which have to be dealt with during writing hypertext:

*1. Unit: Developing a basic understanding of hypervideo design.* First of all, students have to understand what hypervideos are. Knowledge about texts and genres is important for text comprehension (e.g. Hayes, 1996) and text production (e.g. Kellogg, 1994). For the new medium ‘hypervideo’ students have no schemas about such regularities, and might rely on more familiar – but inappropriate - media formats. To familiarize students with the idea of hypervideos, we shot a ‘concept map video’ that visualized the planning phases of the video nodes and the additional material (see figure 3). This video enabled students to plan, produce and revise their materials using the hypervideo system from the very beginning of their design work. Further on, a possibility for discussions was embedded in the concept map videos with help of the integrated chat-tool explained above. Students were able to comment and discuss their ideas, exposés and storyboards within the hypervideo system (figure 3). The possibility to work with the hypervideo software from the very beginning substantially enhanced students understanding of hypervideo. They developed a concrete mental model of their own hypervideo, and the materials could be successively exchanged with further versions, until the hypervideo was ready.

*2. Unit: Producing video nodes and text nodes with additional information.* Secondly, students have to decide which contents they want to include in their hypervideo and to design the video and additional nodes. The important issue that students have to decide is: Which symbol system is appropriate for which kind of information? With help of the ‘concept map video’ (figure 3) we asked students’ to plan the video nodes and the

additional material within a series of three steps: They had to develop main ideas, exposes and storyboards for the videos before we allowed them to shoot the films. Parallel to this they were asked to develop their ideas, exposes and concrete nodes for the additional material. For the additional material we asked the students to consider two general principals that we adapted from node design within hypermedia (e.g. Gerdes, 1997): Each node should only contain the necessary amount of information that refers directly to the specific video content. Further on, each text node must be comprehensible without reading further nodes. We asked students to design their additional material with these principles in mind.

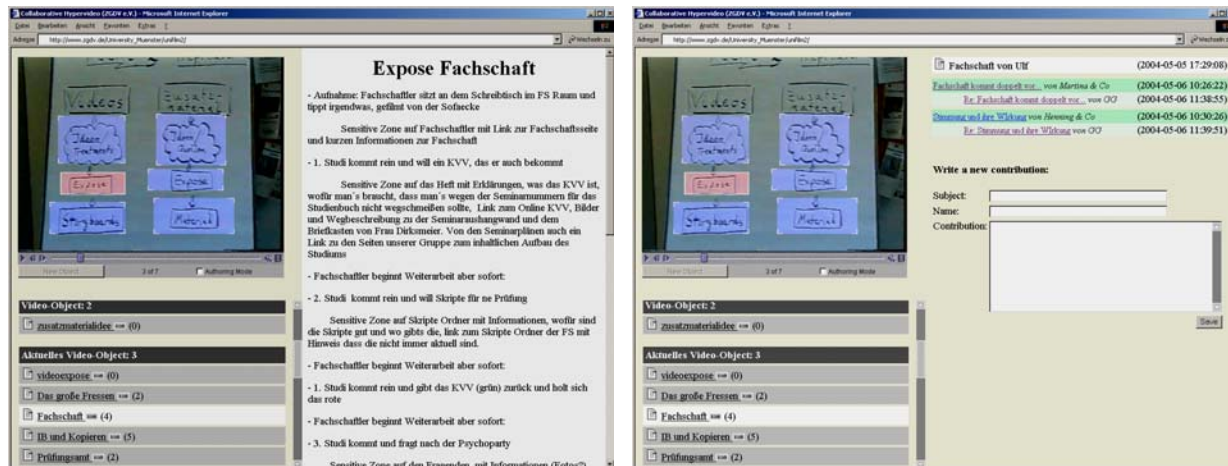


Figure 3: Concept map video: Left side: Students are able to integrate their ideas, exposes and videos from the beginning; right side: An embedded chat-tool enables them to discuss and review their material

**3. Unit: Organizing an overall structure of the hypervideo.** During the third unit, Stahl and Bromme (2004) asked their students to discuss the macrostructure (in sense of Kintsch, 1998) of the contents. Thus, the aim of this unit is to foster students' comprehension of the semantic structure. To design an overall structure for their hypervideos students had to plan the structure of each of these single hypervideos (one video and the relevant additional information) and how to structure all single hypervideos within an overall hypervideo. To plan the single hypervideos mainly refers to plan how to link the information within the videos with the relevant additional material and to decide, if references to other videos should be included. For planning the overall structure we asked the students to construct a concept map presenting the relations between all single hypervideos and the nodes with additional material.

**4. Unit: Considering multiple perspectives in the hypervideos.** During the fourth unit, the students are asked to consider different user perspectives and to present multiple ways of navigation. This idea is based on Cognitive Flexibility Theory (CFT, see, e.g. Jacobson & Spiro, 1995). CFT deals with how knowledge about a complex ("ill-structured") domain can be acquired in a way that ensures its flexible use. The goal is to stimulate learning transfer and to avoid 'inert knowledge', that is, knowledge a learner can reproduce, but fails to apply in new situations (Bereiter & Scardamalia, 1987). If authors are asked to take different user perspectives into account, knowledge might be acquired in a way that supports its flexible application. Concerning hypervideo design multiple perspectives can be included on different levels. First of all, it is possible to communicate perspectives through the videos, e.g. in a hypervideo about communication strategies it might be useful to present the same scene from different camera perspectives or to show parallel videos that differ in some aspects. In the cooperative hypervideo system it is also possible to link different additional information to one sensitive region in the video. Therefore it is possible to interpret the same scene in a video from different perspectives. On the level of the overall structure that connects all single hypervideos (see unit 3) students can plan different guided tours or different structural overviews for audiences with different perspectives. Therefore, hypervideo offers many possibilities to reflect about and include multiple perspectives.

**5. Unit: Planning and setting of sensitive regions and links.** During the fifth unit, students are asked to discuss the sensitive regions to be placed in their hypervideos and the links within the additional information units. Links have two important and closely related functions: they enable the user to navigate within the hypertext and they represent the semantic relations between the node contents. Therefore the selection of offered links has a great influence on navigation (e.g. Wright, 1993) and on comprehension of the contents (e.g. Gray, 1995). Consequently, we assume that linking nodes is a sensitive task that should result in a deeper processing of the

information content. We try to enhance the awareness and comprehension of semantic relations by asking our students to justify each link that they want to set. Students have to discuss, which kind of semantic relation they want to express by a link, and why this relation might be important in the context of this particular node.

It is important to note that each unit might result in revisions of the material developed so far. Therefore the process of hypervideo design should be seen as a circular process, even if the units are arranged in an instructional sequence.

## EVALUATION OF THE COURSES

Up to now we have little empirical evidence about the effects of the instructional units on knowledge acquisition by hypervideo design. Stahl & Bromme (2004) had developed the units as a result of their studies in six different school classes, their series of five experiments about effects of different instructions on hypertext writing and their own courses on hypertext writing with university students. Therefore it is reasonable to assume that the course design might be beneficial to support knowledge transformation in courses on hypervideo design as well.

Nevertheless we were able to run short evaluations of the courses by analyzing the design process and the products together with the students using interviews, questionnaires and group discussions. Comparing the first courses (in Münster and Linz) with the second course gave first confirmations of our assumptions. We had used the instructional program only during the second course. In the first courses the students had more freedom to decide for themselves how to organize their work. We found strong differences in the products of these courses that confirmed the appropriateness of the instructional units. The hypervideos of the first two courses included 5 hypervideos and 16 additional texts (Linz) and 8 hypervideos with 37 additional texts and 2 additional videos (Münster). The hypervideo of the second course was significantly larger with 14 hypervideos, 9 additional videos and 195 additional texts. Further on, the hypervideos of the second course included - on average - significantly more sensitive regions than those of the first courses,  $F(1, 27) = 4.13$ ,  $p = .05$  (first courses:  $M = 3.85$ ,  $SD = 2.12$ ; second courses:  $M = 6.67$ ,  $SD = 4.38$ ). The approximate time of the hypervideos in the second course was on average significantly shorter than in the first courses,  $F(1, 27) = 25.05$ ,  $p < .01$  (first courses:  $M = 301.39$  sec.,  $SD = 87.71$ ; second courses:  $M = 143.71$  sec.,  $SD = 75.92$ ). Qualitative analyses of the hypervideos confirmed these differences. The hypervideos of the students in Linz looked like instructional films. All relevant information was given in the videos and all additional information seemed unimportant to understand the videos. In the first course in Münster it was the opposite way around. In half of the videos all relevant contents were given in the additional information and the hypervideos themselves seemed unimportant. In contrast, the product of the second course looked like a real “hyper-“video.

It seemed that the students within the first courses were not able to develop an appropriate idea of hypervideos: They compared hypervideos either with traditional instructional films or with traditional hypertext. This resulted in planning activities which focused either too much on the videos, or the main focus was given to the additional material (see unit 1). This also led to significantly longer videos (unit 2) and less links between videos and additional information (unit 5). Further on, the hypervideos of the first course were “stand-alone” videos compared to the hypervideos of the second course that were integrated in an overall structure (unit 3) with multiple possibilities to navigate through the information space (unit 4).

The group discussion and the interviews with the students of the first course also revealed that they differed in their opinion about the learning outcome about the topic and the design of learning environments. From these results and our observations during the courses it seems doubtful that the anticipated knowledge transforming processes occurred. In contrast it can be concluded from interviews with the students of the second course, their products and a special designed questionnaire, that they gained substantial experiences with the design of learning environments and complex project work. They also gained a deeper understanding about the topics to be presented. To give an example, students of the second course completed a questionnaire with different items concerning their judgments of knowledge acquisition in the course. Each item had to be rated on a 5-point scale from 1 = ‘I completely disagree’ to 5 = ‘I completely agree’. Students assessed that the collaborative design of hypervideo fostered their active knowledge acquisition about the topic to be presented ( $M = 4.28$ ,  $SD = 1.11$ ), their knowledge about designing learning environments ( $M = 4.71$ ,  $SD = 0.49$ ), and their knowledge about cooperative project work ( $M = 4.85$ ,  $SD = 0.38$ ). They also rated the quality of their hypervideo on a German spectrum of school notes (with 1 = very good to 5 = insufficient) as ‘very good’ ( $M = 1.29$ ,  $SD = 0.48$ ). We further presented their hypervideo to another course on learning with new media ( $n = 16$ ) that was not involved in the design process. The students rated the quality of the hypervideo as ‘good’ ( $M = 2.00$ ,  $SD = 0.73$ ). From such results and the informal feedback of the students, we might conclude that the anticipated knowledge transforming processes occurred. These results of the evaluations can only be seen as first hints, but they support our assumptions about the necessity of a didactical concept like our instructional program.



## CONCLUSION

We can conclude that it is possible to integrate the complex task of hypervideo design into regular university courses. But it seems highly important to structure the task for the students. The knowledge transforming model gives a useful recognition of the need for balance in orienting learners to focus on the hypervideo design and learning contents of the hypervideo. We used the five units of the instructional program from Stahl and Bromme to teach the students gradually how to deal with the features of hypervideo. It was no problem to adopt it to the specific demands of hypervideos.

Nevertheless, the experiences within the courses should only be seen as a starting point for experimental research on the affordances and benefits of learning with hypervideos. A lot of open questions appeared. Thus, concerning future perspectives, the experiences within these field studies will be used to conduct a series of controlled experiments to investigate selected aspects of collaborative hypervideo design in laboratory learning settings.

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