In Lassner D. & McNaught, C.(Eds.) Proceedings of ED-Media 2003, Honolulu, USA.Norfolk, USA: AACE. pp 640-643.

# Handling Material in Learning Activities: The Knowledge Infrastructure KOIN

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**Abstract.** This paper focuses on the software support for handling materials during learning activities. Learners must be provided a rich learning environment offering not only material, but also an opportunity to discuss this material and relate the material to own experiences and actions. Materials must also be storable for further reference. As these requirements are contradictory, they are difficult to meet with a single solution. This paper presents an integrated approach, relying on the combination of different support technologies. A platform for handling material in a cooperative learning activity, the Knowledge Infrastructure KOIN, is presented as key part of this integrated solution.

## 1. Introduction

Learning activities depend on working with materials. In any instructional or learning situation, some kind of material – a book, a lecture, some papers, increasingly in digital form – is used by the students. The material is worked with; it is read, listened to, discussed and commented. Many didactic methods include some form of own production of material, such as a report, a presentation or the production of some digital objects as practical exercise. Even within the strict instructional setting of a lecture with oral exam the students work with materials. This may be their own notes made during the lecture, which they later reorganize and condense as a preparation for the exam.
This paper focuses on the software support for working with these materials. We argue that the support provided by common tools for handling materials is not sufficient, as they usually fall short in supporting two important aspects of the work with materials: the reorganization of material during the learning process and its storage for later reference by the students. We present an integrated approach which uses different kinds of media to handle and organize material for learning activities. The key part of this approach is a cooperative learning platform, which supports cooperative re-organization of the material as well as the generation of individual reports for later reference.

## 2. Use of Materials in Learning Activities, Requirements for Digital Archives and Common Approaches

### 2.1 Use of Materials in Learning Activities

Learning activities at universities include the use of a great number and wide variety of materials. Although materials differ depending on course type (e.g. lectures, seminars, practicums) they can be classified in three categories:

1. *Presentation Material*. Presentation Material is the main material used in lectures, but may also be used in practicums or seminars, as input or presentation of student's work.
2. *Reports.* Reports are "output" of the learning process, ranging from a thesis written for the seminar, a report on conducted work in a practicum to short compilations made in preparation for an exam.
3. *Raw Material.* As raw material we denote all other kinds of materials, like supporting literature for a lecture or the materials for the practicum's production process.

Materials may come in all kinds of digital format, from plain Text to HTML-pages and digital video clips. Some of the materials need to be referenced some time after completion of the course. This leads to a set of requirements for handling digital material in cooperative learning activities, which will be presented in the following section.

### 2.2 Requirements for Digital Archives

*2.2.1 General requirements*
*Storage for all kinds of materials.* During the learning activity all kinds of *raw material* may be useful to include, so the archive should be able to store them. This is especially true in settings where a focus lies on individual work by students, like a practicum.
*Easy access and easy editing of the materials.* As lecturers and students often work from home, during travel or from different sites on campus, the access to the archive has to be available in all of these contexts.
*Access Rights.* The archive should provide means to attach differentiated access rights to the material.

*2.2.2 Requirements for presentation material*
*Easy Production.* Producing presentation material should not induce extra work to the teaching staff. It should also be possible to produce material without server or internet access, for instance during travel or at home.
*Reuse and versioning of presentation material.* Teachers usually repeatedly teach the same subjects, thus presentation material should be reusable. To differentiate several semesters, it also needs to be versioned.
*Presentations without special software or downloads.* As lectures may be held in a variety of locations, it has to be possible to present the material without the need to install special software.
*Presentation with and without server or network access.* Since internet access is not guaranteed on all sites, it is also necessary to be able to present the material from a CD-Rom or local hard disk.

*2.2.3 Requirements for student's work with the material*
*Addition of new material by students.* To support cooperative learning activities, students should be able to add their own material to the archive.
*(Re-)Organization of material.* If students are to work with the material, a sequence of first collecting a variety of material, from which relevant material will be selected later, is typical. Therefore, material needs to be categorized and organized after it has been added to the archive.
*Integration with the cooperation facilities - Annotation, discussion, and rating of the material.* Students need to be able to annotate, discuss and maybe rate the collected material or presentation material.

*2.2.4 Requirements for later reuse*
*Students should be able to access the material in the archive in different situations, even years later.* As the aim is to support individual learning (as a contrast to organizational learning) the students should be able to access and reuse materials in all occurring circumstances, independent of future server maintenance.

### 2.3 Common Approaches
As learning platforms, three main families of platforms are available: Web portals or Content Management Systems, Groupware Systems and Learning Platforms.
*Web Portals and Content Management Systems (CMS)* may offer viable support for the production and presentation of *presentation material* by lecturers: They support the first two sets of requirements, general requirements and requirements for presentation material. They do not, however, support the student's work with materials, and usually do neither provide cooperative functions or means to reorganize material. As many CMS provide HTML export functions, they do support the later reuse of material.
*Groupware and Community Software* like BSCW (Klöckner 2000), CommSy (Pape et al. 2002) provide support for cooperative activities and for the exchange of material, thus meeting the general requirements as well as the requirements for students working with the material. They usually do not support the provision of presentation material or later reuse of material.
*Learning Platforms* like LearningSpace[1], Blackboard[2] and WebCT[3] provide a combination of authoring environment, delivery funcionality and annotation/groupware facilities, which can be used for presentation

[1] LearningSpace: http://www.lotus.com/products/learnspace.nsf/wdocs/homepage

material in face-to-face learning situations. Most of them do not support adding and exchanging materials by students nor the exchange of arbitrary files.
Finally, all of the mentioned approaches have to be questioned in terms of *durability*, as most of them do not allow for adequate export of materials.

## 3. Our Approach: Integrated Archives

The stated requirements are in some respect contradictory, since annotation, discussion and reorganization are best realized with centralized, server-based solutions, while independent presentation and reuse by students are only realizable with server-independent solutions based on common file formats.

The solution we found is an integrated approach, aiming at combining different solutions to maximize the advantages and minimize the described drawbacks of the different approaches. The approach consists of four parts: a *portal*, a format for presentation material, called *Micromodules*, a web based cooperative hypermedia system *Knowledge Infrastructure* KOIN and finally *reports* exported from the KOIN.

### 3.1 The Portal "Media Informatics"

The portal "Media Informatics" provides a unified access for students and professors to teaching and learning material. Besides the access to the micromodules and the KOIN described in the following sections, the portal holds general information on the curricula, additional material for self-study and material added by students.

### 3.2 Presentation Material Format: Micromodules

Micromodules are HTML-based presentations of units optimized for presentation in class (See Figure 1). A lecture is build out of several micromodules. Micromodules may be exchanged between different lectures as well as between different teachers. We chose the HTML-presentation instead of using any kind of platform or XML-based solution out of the following reasons: As plain HTML-files, micromodules can be edited with any HTML-editor and therefore be authored at almost every workplace.

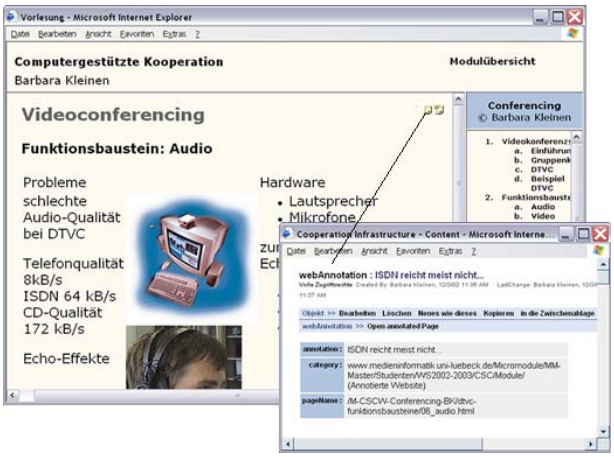


**Figure 1: Micromodule with annotation in KOIN**

### 3.3 The Knowledge Infrastructure KOIN

The Knowledge Infrastructure KOIN is based on a web based cooperative hypermedia system called "Cooperation Infrastructure (CI)". As such, it offers cooperative tools to the students, like bulletin boards, chat, or awareness support. The Knowledge Infrastructure extends the CI by three material archiving functions: the File-O-Rama allowing storing of arbitrary material, the annotation facility to include and link external material as the micromodules and the report functionality allowing to export material for later reuse.

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[2] Blackboard: http://www.blackboard.com
[3] WebCT: http://www.webct.com/

*3.3.1 The File-O-Rama*

The File-O-Rama allows for arbitrary files to be stored on the KOIN server. The files are organized in a virtual file system, visualized by a tree view in the left part of the screen. In File-O-Rama students can collect and organize all kinds of working materials. To support the work on multimedia content, the handling of very large files is especially supported. A hypermedia node is attached to each file, providing space for all kinds of additional information. As hypermedia nodes, they can be linked into the hypermedia network of the CI and be easily referenced in discussions etc. within the CI, fostering the integration and reflection of materials.

*3.3.2 Annotation Facility*

The KOIN's annotation facility allows for the annotation of arbitrary web sites. If these sites are viewed via the KOIN as annotation proxy, small icons indicating existing annotations are included on each site. The annotations are linked to the relative site name of the pages and are thus robust in terms of changes to the page as well as relocation of the whole micromodules. Annotations are, again, nodes in the hypermedia network of the Cooperation Infrastructure and can thus be integrated into discussions and all other objects within the CI. Annotations are therefore not only a tool to attach annotations to websites and especially the micromodules, but also a way to include external material into the hypermedia network.

*3.3.3 Reports*

Reports can be short papers in which the students summarize the course for themselves, presentations in the micromodule-format, as well as seminar papers. They are a way to condense and export material from the KOIN archive. Reports are hierarchically structured subsets of the hypermedia network. The hierarchical structure can be visualized using generic means to edit hierarchical structures, as a tree view or with interactive tools, like a MindMap view.

Reports created within the KOIN can be exported as XML-, HTML- or PDF-files. As such, they can be kept and altered by the students for later reuse, independent of the KOIN server. As they are composed by the students themselves, they consist only of reviewed material.

**3.4 Integrated Solution**

By providing a solution consisting of different, yet integrated parts, we were able to meet the proposed requirements. The KOIN provides a means to store arbitrary material protected by access rights, and the HTML-format micromodules make presentation material independent of server availability. KOIN integrates micromodules and other materials, providing support to work with these materials by discussion, annotating and reorganization. Export functions (micromodules and reports) enable students to archive their own condensed view for further reference.

## 4. Conclusion and Further Work

This paper pointed out the importance of teaching and learning materials in university learning activities. We found that single solution – neither a groupware product, a web system like CMS nor portals – will completely satisfy the needs for handling and archiving materials within learning processes at universities. We therefore developed an integrated solution including a web portal, a format for presentation materials, called micromodules and a cooperative hypermedia system (Knowledge Infrastructure KOIN) supporting collaboration, annotation and the export of generated reports.

We have used and evolutionary developed the described approach during several semesters now, showing the feasibility of our approach. Further work will include improved support for material reorganization and adaptation of export and report formats.

## 5. References

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