ABSTRACT

Computer-Aided Teaching and Learning (CAT/CAL) environments try to support self-directed knowledge transfer in a context-sensitive way. Such kind of knowledge transfer requires enablers for (i) different perspectives on learning material as well as (ii) features for context-sensitive interaction. In order to overcome existing deficiencies of existing approaches with respect to context-sensitivity and individualized interaction we have analyzed constructivist learning concepts, such as self-directed, task-oriented learning individualization, communication and collaboration. In concluding that linking content and communication could be essential to support self-directed learning we have tuned and enriched features for individualization and personalization in a web-based learning environment. In contrast to existing approaches the solution is highly flexible, and works for traditional browsers and for hypermedia learning material. Using individual as well as public annotations self-directed knowledge transfer in web-based environment environments can be implemented in a straightforward way.

General Terms

Keywords
Annotations, self-directed learning, individualization and personalization, coupled content and communication, constructivist learning environments, advanced distributed learning.

1. INTRODUCTION

A long term goal in advanced distributed learning is to put the learner in control of knowledge transfer. Positive transfer of knowledge should also be asynchronous and place-independent, based on a many-to-many, text-based/multimedia, computer-mediated interactive software system [1]. The provision of corresponding features in knowledge transfer systems induces research and development of advanced distributed applications, such as semantic content management systems and web technology. The latter is expected to enable adaptability of learning environments and learning materials to learners needs and the intelligence to implement accurate features [2]. Advanced distributed learning is based on the idea that learners participate in knowledge transfer processes in a self-directed way. Therefore, learners and teachers do not have to be available online continuously and/or at a single location when interacting with other learners or teachers. The process of knowledge transfer is subject to (course) planning and organization, including collaboration, interaction between learners and teachers, and particular individual knowledge-transfer processes supported by individualization functionalities.

Individualization is considered to be one of the key objectives to establish user-centered Quality of Service [6], recently facilitated by learning standards such as LOM [LOM], IMS [IMS] and SCORM [SCORM]. Individualization supports focusing on content in the course of interactive and community-based learning. Individualization addresses the capability to customize content as well as to adjust technical features for navigation and presentation to user needs. Adjustments can either be achieved automatically or manually, in order to meet individual requirements. In addition, knowledge transfer systems should migrate principles and provide features of self-directed learning. They also should support the process of mutual knowledge exchange with existing CAT/CAL environments. Distribution of individualization in the scope of a software-technical view can be achieved by individualization of learning environments and courseware.

(1) Individualization of learning systems can be obtained by following points of view:

(a) Individualization of Language facilitates customization of graphical user interface to nation- or language-specific employments of system utilizers.

(b) Individualization of Representation comprises personalization of the user interface in context of specific user devices and personal deployments as well as user-dependent mental models.
(c) Individualization of Functionality represents opportunities to individualize the represented functionality by administrators or users itself.

(2) Individualization of courseware: Learning environments should provide the possibilities to individualize the course material, in order to adapt it according to learners performance and to allow them to individualize course content with theirs own, private annotations. In this paper we propose individualization of learning content, particulary annotations, as described in section (2). Certainly in electronic documents, readers should have similar tools to take notes as in printed media. For example, it should be possible to highlight important phrases or to make marginal notes. Additional functionality can be provided easily, while systems can maintain meta-information of a particular note, such as the date when the note was taken or the name of the user who took the note in multi-user systems. Notes supports learners to get a deeper understanding of the “printed” work and can be characterized by following properties: Notes can be personal thoughts concerning the text scribbled in the margins. They can be used to remember important passages when rereading sections of a text, or they can be questions, indicating that a part of the document was not understood during the learning process. Notes can also point to related ideas in other resources such as books or articles, or – in a review and revision context – they can be suggestions for changes to a document. Another finding concerning the form of annotations is the granularity of annotations. Annotations can be attached to a single word or a phrase. Sometimes, annotations relate to whole sections or chapters. The form of the annotation often offers the possibility to conclude about its function or reason. Frequently, annotations are used by students or authors to remember future attention, e.g. important text passages, that should be reread or the content of which has to be known, are annotated). In contrast, less important text passages are sometimes crossed out, whereby the semantics of different annotations are often user-specific. As a result, annotations are used to create an individual version of the textual or multimedia courseware. But annotations are also used in the context of interpretation, as for example stating agreement or disagreement within the text representation during group decision processes.

According to this, the W3C-Annotation Working Group [W3C02] defines annotations as follows: “An annotation of a web page is any object, which is displayed within or accessible from the original by following a hyperrefrence. The annotation object may be of any type and the relation between the annotation object and the object it annotates may also be of any type.” In difference, [Max94] explains annotations as „Complement of a document in order to textual or graphical notes at meta level” and [HKM97] interprets annotations in context of webbased documents as follows: “An annotation of a web page is any object, which is displayed within or accessible from the original by accessing the original.”

Hypertext is an ideal medium for the representation of annotations. Hyperlinks for example can represent the relation between an annotated document and its annotations. Most hypertext systems support some annotation facility that allows readers to make comments, to link to other material, to gather and interpret material, in summary to augment a body of interrelated material. Annotations are a possibility to overcome the distinction of authors or writers and readers of hypertext. The reader becomes an author of his/her own document whereby the role between readers and writers blurs. In a hypertext system, the possibilities of annotations by far exceed the possibilities of taking personal notes to a document.

World wide web is an ideal medium sharing knowledge and processing data ([1], [2], [14], [24], [22]). The architecture of first generation web-servers makes a clear distinction between readers and authors and therefore does not allow annotations. No arbitrary web-browsers on the market adopted any annotation functionality. Additionally, annotations taken at the client side should be stored to server-sided repositories. Subsequently, the annotations are available to the particular user any time and anywhere. The architecture of second generation Web servers such as ScholionWB+ (scaleable technology for teleteaching/learning web-based) supports annotations in that way.

Ideally, it should be possible to create annotations in a way related to traditional annotation facilities e.g. implemented through a slide laid over the original document. Unfortunately, this is not possible on the Web until current HTML standards does not allow an implementation of overlaid free-form annotations. Well-known implementations of annotations from traditional word-processing (e.g. MS Word or Adobe Acrobat Reader) were not adopted to the web until now.

The remainder of the paper is organized as follows: Section 2 proposes review design criteria to provide webbased annotations in the area of e-learning. Section 3 presents advanced concepts and related work with respect to the integration of annotations in context of individualization in current software solutions such as MS Word, Adobe Acrobat Reader, Hyperwave or Amaya. Section 4 introduces the ScholionWB+ project from a methodological and conceptual perspective. Section 5 sketches the implementation of the proposed concepts. Section 6 evaluates the achievements against standardized principles for designing educational applications and Section 7 outlines the objectives and results of the presented work, and lists further research activities.

2. Design Criteria

According to the constructivist learning-paradigm self-guided acquisition of knowledge focus on the process of learning instead of teaching. Unlike the idea of transferring defined structures of information from the teacher to the learning person this approach does emphasize the characteristic activities of the learning person in view of the material, which are strongly influenced through individual prerequisites such as motivation, pre-knowledge, interests or strategies and aims of learning. Contexts of learning, that distinguish through a generous, networked teaching material and through the chance of communicating, are very suitable for this kind of acquisition of knowledge: „Computers and computer networks provide a beautiful opportunity for subcultures to form a grow independent of geography but dependent on shared beliefs, interests, etc.“ ([3]). For example [4] found out, that students made great progressions in reading and writing while working with networked, interactive hypertext-software in three schools at different places, and that their knowledge essentially. Because of this self-guided action-oriented systems, that transfer knowledge, should contain the following features (of integration):

Individualization (In)
Individualization is considered to be one of the key objectives to establish user-centered Quality of Service (QoS) [6]: The student/learner should be allowed to individualize the content to his/her needs and associations. This requirement is traditionally implemented through an annotation concept, providing textual notes, marking, and multimedia attachments directly in the courseware. Content is either adapted to learners’ knowledge [7] or actively changed by learners including QoS as claimed by [1,2,6]. Features for individualization should also comprise the possibility for learners to learn mutually, as suggested in [8].

Communication Support (Com)
Communication is one of the key objectives for self-directed learning – accomplished by individuals and groups with virtual communication among students and students and teachers where the teachers are not the teachers any more but slip into the role of the coaches [9,10]. For Herrmann et al. [11] the support of interaction is mostly focused on communication since it is often not possible to physically experience a situation and learn by in-loco- observation. Learners rather interact at different locations and during different time slots. Typical tools for communications are asynchronous discussion boards or synchronous text- or voice-chats.

Collaboration (Coll)
Learners should benefit from the experience of others by doing research on a certain topic. But they should also be supported when performing practical exercises. A system should offer the possibility to set links to discussions or discussion contributions (questions and answers) in a discussion board or news group. This allows the students and the teachers to build a virtual team for efficient collaborative work. A further feature should be the possibility to build project groups (e.g., with particular annotations in the same view). Then, each team member can participate providing his/her notes [1,6].

Linking Content and Communication (ConCom)
For effective team work and collaboration the learning environment should be able to let the learners link content parts to communication contributions. Possible realization for this objective could be combination of annotations features with discussions and chat contributions or - the other way around – combination of discussions and chat contributions with course material resources, material from the library or other content parts.

3. Related Work

In the course of analyzing benchmark and evaluation studies, it turned out that a sound migration of hypermedia concepts with features for individualization or vice versa has not been performed so far. However, there exists a variety of approaches toward the extensive use of individualization for autonomous learning. This section introduces annotation features in text processing respectively reading applications and e-learning systems, supporting some note taking functionality by explaining concepts, but not technologies.

Microsoft Word provides functions for highlighting, marking text in different colors and commenting. With the comment function users can select a phrase and create notes to it, whereby notes can be in a textual form, but even MS Word also allows audio comments. Users can record verbal remarks and store them as a multimedia comment. After creating a comment, the commented phrase is highlighted, and if the user moves the mouse pointer over the comment, the annotation author’s name and the annotation text are displayed in a small pop-up window. MS Word maintains a list of all comments and provides hyperlink based navigation tools that allow jumping directly to the previous or next comment in a document. (In)

Adobe’s Acrobat Reader is an application for reading PDF documents, whereby the reader can enter arbitrary text as a note to a document page. The note is represented as an icon that can be dragged to any position on the document. By double-clicking the note icon, the note can be read and edited. The username of the notes author, the time when the note was created are maintained by this application for reading and annotating. To distinguish different types of notes, the user can change the color of the note icon and further notes can be exported and imported. That way small note files can be sent from the annotator to the author of a document instead of the whole PDF document. Acrobat Reader also allows creating a note summary document. (In, Coll)

Kolomnbus [11] provides computer supported collaborative learning (CSCL) primarily by means of communication, due the fact that successful computer supported collaboration is only possible if communication among learners and between learners and teachers is appropriately supported. By using the annotation-function, participants give feedback on others’ materials. Evaluation results state, that the concept of annotations was highly accepted to support the communication. Students added annotations to singles items and confirmed that they used existing content as context information which had not to be explicating again. As recipients of annotations they mentioned better understanding by reading the content and annotation at the same time. On the other hand students described problems finding the annotations because they were scattered among existing content. (In, Com, ConCom)

In Hyperwave [24] annotations have always been part of Hyperwave Information Server functionality. With Hyperwave IS/6 every user can attach annotations to documents that contain comments or additions, even if the learners don’t have write permission to the documents themselves. These annotations are stored as separate objects with their own attributes and security properties and thus they can, in turn, be annotated again. Annotations can be made to single words, phrases or parts of a document. When viewing the annotated document, sections that are annotated display an icon, that is a link to the respective annotation. Notes can be made public (viewable by all users), private (viewable only by the author) or viewable by a defined discussion group. Notes may be addressed to individual locations within the document, a document at all, or a collection of documents. (In, Com, Con)

Amaya [22] is a comprehensive browser, that lets users both - browse and author - web pages. Using Amaya you can create web pages and upload them onto a server. Authors can create a document from scratch, they can browse the web and find the information they need, copy and paste it to their pages, and create links to other web sites. All this is done in a straightforward and simple manner, and actions are performed in a single consistent environment. Editing and browsing functions are integrated seamlessly in a single tool. Amaya maintains a consistent internal document model adhering to the DTD (Document Type Definition) Amaya always represents the document internally in
a structured way consistent with the DTD. A properly structured document enables other tools to further process the data safely. Amaya allows you to display the document structure at the same time as the formatted view, which is portrayed diagrammatically on the screen. Amaya is able to work on several documents at same time and supports several standards in order that (X)HTML, native MathML (.mml) and SVG (.svg) documents can be displayed and edited at a time. The editor helps creating and testing out links to other documents on the Web from the document the user currently are working on. This feature is not limited to HTML anchors. With XLink, any MathML and SVG element can be a link, too. Above all, Amaya includes a collaborative annotation application whereby annotations can be presented as external comments, notes, remarks that can be attached to any web document or a selected part of the document. Amaya’s annotation feature is based on Resource Description Framework (RDF), XLink, and XPointer [W3C] recommendations. (In)

Besides, the technology-driven development of hypermedia for distance education (resulting in systems as listed above), in the field of CSCW, the early recognized need for socially adaptive technologies has led to an established tradition of empirical and conceptual investigations. Research results indicate [Marcus Conolly HICSS01], that the lack of socially responsive developments can be caused by isolated use of tools. These results require revisiting of methods and concepts with respect to the role of annotations, and identifying concrete design requirements. Unfortunately, up to now, (hypermedia-) individualization environments for personalized learning have not incorporated conceptual and empirical findings to an extent that teachers and learners could have experienced an added value when using these technologies.

4. Methodical and Conceptual Design

The following section details annotation- and the profile concept of ScholionWB+ (als FUßNOTE a web-based learning environment, implemented at the department of Business Information Systems – Communications Engineering at Johannes Kepler University of Linz) and the corresponding features with respect to individualization, collaboration and linking content and communication. Individualization of the content means enabling customization of the learning material to learner’s needs with respect to the users’ mental maps, networked thinking and information linking [8,9,28]. The enabling feature, implemented in the ScholionWB+ learning environment is based on the annotations concept. The ScholionWB+ developments emphasize the intertwining of hypermedia and collaboration-individualization technology in a distributed educational setting. Thus, it should overcome the limitations of existing approaches of individualization of content through the provision of the following features within the context of annotation:

(1) webbased, supporting browsing and navigation through the material by the way of using conventional internet browsers
(2) homogeneously defined annotations, supporting different categories of remarks
(3) requirements of performance and usability
(4) provide situation- and context-sensitive interaction
between learners and teachers
(5) to be open to present learning standards and existing data formats

Starting point of the design phase of the ScholionWB+ project has been the specification of a process model. The entire organization of a course has been captured through specifying user roles, organizational constraints, data, activities including their temporal relationships to complete certain tasks. The second major activity in the design phase was the development of several concepts, explained later. As ScholionWB+ targets towards a non-profit use, additional constraints had to be met with respect to the last mile: low-bandwidth PC-connections should suffice for communication and learning.

Annotation Concepts
To improve computer supported webbased annotations, learning environments subsit the proposition of pretending a disposal variety of interaction possibilities. In the context of ScholionWB+ following important annotation concepts were defined [28]:

(i) **Markings:** The learners are allowed to highlight or underline important text passages. They also can change the styles of the text such as making text bold, italic, big, small or stroken (In).
(ii) **Textual annotations:** The learners are allowed to add shown or hidden textual annotations, which can be inserted directly to the content or laid over the content as layer annotations (In).
(iii) **Multimedia annotations:** All multimedia files can be annotated at the content for adapting the hypermedia courseware to personal needs (In).
(iv) **Link annotations:** Links to internal (to targets inside the course material) or external resources (e.g. www-URLs) can be inserted into the content or laid over existing content (In).
(v) **Library annotations:** The learners are allowed to set links to library entries such as literature for reflection provided by the teacher (In).
(vi) **Discussion and Chat annotations:** Learners are allowed to insert links into the content, which point to discussion contributions or chat logs (In), (Coll), (ConCom).
(vii) **Knowledge Atoms annotations:** Learners are allowed to search knowledge atoms from the semantic network and annotate it to the content. The content can be individualized and completed by knowledge resources from proven standard textbooks, which are chosen by the teacher (In), (ConCom).

It turned out, that further following criteria have been met successfully:

(viii) **Web-based application of annotation functionality:** Due the possibilities of web-based, platform independent content management there should be an important aim to offer also annotation functionality in context of world wide web.
(ix) **Standard software compatibility**: Within the requirement of supporting arbitrary browsing and navigation systems, standard software compatibility should be a further target to be achieved by a comprehensively web-based annotation system.

(x) **E-learning specification compatibility**: Modern e-learning systems should be based on (respectively be compatible to) most common learning technology specifications and standards (e.g. IMS, SCORM [IMS SCORM]) referring to course materials and organization of courses.

**Views Concepts**

Annotation concepts, identified above are stored in user-specific views. A view can be explained best through a metaphor. It can be compared to a transparency that is laid over a course material. All annotations are part of the transparency. Users might also use empty ones and start a new series of annotations. They always have to choose a view when they open a course material. They might also remove it, give it to a public directory (to all users or to a group of users) or copy a public one for private use and append own annotations. The principles of cascaded profiling are described in figure 1.

![Figure 1: Cascaded Viewing](image)

**Cascaded viewing** is considered to be the key concept to support collaboration. Views can be set public in order that public views are available for each user: A user can open a material applying views (annotations, considerations) of another user. Thus, users might learn from each other. If a user selects a public view, he/she can copy it to the private ones and append individual annotations can be linked to content items in a context-sensitive way. The views concept is also crucial for achieving acceptable performance. It reduces the amount of data to be transferred in the course of learning and collaborating. When opening a course material, the user selects the corresponding, currently preferred view.

**Database Concepts**

One of the goals of software development is to create platform-independent software – especially through the rising popularity of Java. Unfortunately, database applications are often tied to a specific Relational Database Management System (RDBMS) even if it is written in Java using the Java Database Connectivity specification (JDBC). To overcome this deficiency Scholion’s database management system is based on the requirement to be independent to specific necessities. Therefore, a universal meta-layer based on the MVC (model, view, controller) paradigm to provide software independency as well as hardware independency. Among other motives ([17], [18], [19]) to implement database independent software solutions, the economic aspect through the possibility to use open source database management software is very punchy.

**Technology Concepts**

Increasingly, web-based projects are based on strict departure of presentation, business logic and data management ([18]) by the use of XML and XSLT. Unlike the HTML-based architecture which suffers from increased maintenance impacts as the web site grows in size and complexity, an XML-based architecture actually levels off. There is a limited impact on maintenance, as the documents get more complex. The ease in managing the content comes from the basic property of XML that provides a total separation of content (source) and style (output). The content or data resides in a single XML document and different XSL stylesheets presenting that data in different ways. This departure can be accomplished by combining Java servlets and XSL style sheets. In association with graphical user interface editors, model view controller frameworks seem to be a precondition for high productivity by separating a 3-tier architecture. As already mentioned, the ScholionWB+ technology concept contains a further meta-layer, providing database management system independency. MVC separation allows multiple views to share the same enterprise data model, which makes supporting multiple clients easier to implement, test, and maintain.

Most common browser technologies are supported by Scholion’s annotation feature, as Microsoft Internet Explorer 5.0 or Mozilla compatible browsers as Mozilla 1.2 or Netscape 6.0. Unique precondition is (full) support of DOM 1.0 and CSS 2.0, otherwise learners can browse through the course material but not even utilize annotation features. Performing annotation features in Microsoft Internet Explorer (MS IE) seems comparatively simple due concepts of DOM 1.0 have been implemented, even increased yet. Accordingly, MS IE supports various possibilities altering (X)HTML content based web pages. Textual content can be manipulated easily by approaching selected parts within the course material. For example, a part of a course material could be marked, by selecting appropriating words an changing it’s textual representation with Microsoft’s DOM implementation.

In contrast to Microsoft’s Internet Explorer, Mozilla compatible web-browsers do not support manipulating web content in any way. However, annotation concepts can be implemented by pre-annotating the course material page. Therefore course material has to be complemented through (X)HTML elements (meta tags) to grant indirect approachability and consequently realization of all annotation concepts.
The pre-annotation process (inserting of meta-tags) can be defined as follows: By way of a recursive client-side algorithm the course material (respectively DOM / (X)HTML document) has to be disassembled to smaller junks (e.g. words), whereby in front of and after every junk an active acting start and close element is placed. These elements observe user interactions (e.g. selecting textual parts of courseware) by saving temporary meta data of interacted junks. By means of that every user interaction is followed by the pre-annotated DOM / (X)HTML document, according to possibilities, similar to MS IE.

Learning standards
ScholionWB+ course material is based on (compatible to) most common e-learning specifications and standards (e.g. LOM, IMS, SCORM [LIT]), whereby these specifications have been enlarged in specific areas (e.g. annotations, mobile course material).

5. Implementation
Transfer concepts presented in section (4) have been implemented in the ScholionWB+ advanced distributed knowledge transfer environment. The transfer concepts also were objectives for development. Following section denotes their relationship to the technical concepts and features through assigning their abbreviation.

As concerned, the technical architecture is based on 3 tiers, providing database management system independency for distinction of datamanagement, presentation and business logic (model, view and controller). On the local instance of ScholionWB+ at the Johannes Kepler University of Linz (http://scholion.ce.jku.at) we use a Oracle 9i database capturing all data (including all media files and slides stored in BLOBs) and Tomcat 4.12. The application’s servlet technologie is based on Java 1.4 and generates a XML meta language, similar to HTML, but independent from web-browser specific characteristics, that is rendered to XHTML 1.0, DOM 1.0 and CSS 2.0. Scholion’s architecture enables individualization of the graphical user interface as well as annotation and profile concepts.

Courseware Schema
In Scholion the concept of a Learning Unit (LU) describes that unit, which is typically learned by students at once and treats a well-defined theme representing a natural unit that can be reused by authors of lectures. To ensure these qualities the material scope of a LU should not exceed a customization time limited to about 15-20 minutes. However, also a minimum size is required, which in ScholionWB+ was defined as 10 minutes. What’s more, the concept of undivided reception of LUs is also supported by the possibility to invoke different degrees of specification (in note form, conventional learning content, enlarged literature references, which are not relevant for exams) of the material presentation. Moreover, LUs are those organization units, which should be assigned to meta-data. In the conceptional structure model sketched in the following, the LU gets connected with its higher and secondary organization units.

![Figure 2: Coursematerial Structure](image)

LUs are - maybe ambiguously - assigned to single moduls, which are the next higher organization unit of the materials, similar to a lecture of one hour a week for a term. Courses are learning programs, that are based on different modules. On the next lower level of aggregation a learning object is split up in Presentation Units, which are linked together sequentially. These Presentation Units represent the material on a certain level of detail (levelOfDetail) which can be chosen by the user, where three levels of detail exist:

(i) Level 1: Short presentation of the materials in a telegraphic way, which is also suitable for a presentation in lectures, etc.
(ii) Level 2: Detailed presentation following a lecture script and suiting the requirements of the on-line-consumption.
(iii) Level 3: background-information, examples, interactive elements, references to more detailed literature, etc.

The three levels are synchronized, that means there is a connected presentation unit (or maybe more) in the higher levels to the one in level 1. This vertical relation is shown in the illustration by associating with the endings sub and super.
Several presentation units are structured in typified parts or blocks, which guaranty the possibility of white-box reuse. Furthermore, this structure enables learning requirements to offer filtering, rendering and awareness functionality, but also comes towards individual learning habits of users. Several types of parts are modelled in the illustration by specializations of the type Block exemplarily. The courseware is classified within attributes of a specific type, that are not shown in the graphics. Blocks are connected sequentially within a presentation unit. Moreover it is possible to adjust the presentation units to the quality category matching the actual technical learning context by choosing appropriate blocks from a quantity of semantically equivalent blocks of the corresponding level (renderingLevel). Because of this, the course material can be adjusted to mobile tools like PDAs and phones, too.

**Technical Architecture of ScholionWB+**

Based on the model view controller paradigm, Scholion’s architecture establishes strict departure of presentation, business logic and datamanagement by the use of XML and XSLT. The goal of MVC design is to separate the application object from the way it is represented to the user from the way in which the user controls it.

![Technical Architecture ScholionWB+](image)

**Figure 3: technical architecture ScholionWB+**

Scholion’s MVC architecture grants following benefits:

(i) Re-use of model components: The separation of model and view allows multiple views using the same model.
(ii) Increased design complexity
(iii) Easier support for new types of clients
(iv) Clarity of design
(v) Efficient modularity

**Annotations in the context of individualization**

In order to illustrate the interactive and integrated use of addressed annotation features, figure 4 shows a browser-window with different kinds of annotations available in ScholionWB+ such as markings (in this case highlighting), textual layer annotations and hidden textual annotations, links to discussions (as discussion annotations), multimedia and library annotations, link annotations and the corresponding menus for manipulating the annotations.
Linking Content and Communication

Communication can be considered to be most important for constructivist learning procedures. Communication can be realized in advanced distance learning tools in various ways. ScholionWB+ supports predominant synchronous and asynchronous communication features.

In difference to conventional communication elements, following possibilities of linking content and communication, which are realized in the SCHOLION WB+ system, are most important:

(i) Annotations in the course material content which link to discussion contributions or chat logs.
(ii) Links to course materials from the chat forum, the discussion board or the infoboard
(iii) Links to library entries or to multimedia files in chat contributions, discussion contributions or infoboard entries
(iv) Inserting of Knowledge Atoms from the semantic network into discussion contributions
(v) Cascaded viewing

6. Evaluation and User Experiences

ScholionWB+ was evaluated in the course of a university lecture of subject Communications Engineering at Johannes Kepler University of Linz (Austria) in winter term 2002/03. Therefore a testing group with 73 students and a control group with 72 students was set up. For matters of evaluation, materials were drawn up with the ScholionWB+ web-editor. Special attention was paid to a structured representation of the learning materials. At the beginning and at the end of the test a standardized questionnaire was used to evaluate the motivation of the students and simultaneously a test about the contents of the course was set up, which was applied at the beginning and the end of the course. During the course a questionnaire was used, too; it mentioned Time-on-Task regarding communication among students and between students and teachers and the work with the features and likewise about the importance and usability of the tools. At the end

---

1 Instruments and results of the tests can be seen on [http://scholion.ce.jku.at](http://scholion.ce.jku.at)
of the lecture, there were interviews with some of the students, too. The activities of the group participants were listed up in the database. Referring to the individualisation the first evaluation shows the following:

**Individualisation:** The results concerning adjustment of learning materials to individual needs are very interesting, because they clearly show the influences of the student’s habits. So the annotation tool, which realises the possibility to link content and communication, was judged very positive. However, the habits of the students to learn with traditional learning materials in contrast to use hypermedia-based materials hindered the use of the annotations tool to a greater extent. One of the test persons described the problem clearly by declaring “paper rules”. For many students working only with course materials on the screen is not imaginable yet. There are problems of acceptance especially for users of modems and wearers of contact lenses. So some made statements like: “I can’t imagine learning in front of my screen the whole day.” Therefore it is important to accentuate the added value of online materials and the relevance of the annotation tool. Additional value was stated through the possibility to use multimedia functions combined with hypertext based documents. A student wished “references to additional information (definitions, background knowledge) in the text – illustrative examples for an explanation in multimedia like little animations, flash films, etc… There must be an additional profit, otherwise it isn’t sensible.” The advantages can be hypermedial materials of high quality as well as functionalities like ScholionWB+: “The annotation tool definitely is of high quality and easy to use.” Looking forward to increase the use of content in contrast to non-digital documents the annotation of digital material is one of the prior conditions for the acceptance of web-based knowledge transfer application. Deeper information about methods and results of the evaluation can be found at [29].

7. **Conclusion**

Becoming aware of essential features of distributed learning environments requires to check the Quality of Service in terms of provision of integrated features for learners and students. This paper reflected critically on individualisation and annotation support. Both have been provided by existing virtual learning systems. However, a sound integration has been lacking by traditional systems up to now. The ScholionWB+ learning environment has been developed to bridge the gap between individualisation and collaboration features, thus, enabling both, individual design of and access to learning material, and collaborative and highly interactive learning in a context-sensitive way. The gap has been bridged through the views concept, since the integration should not result in loss of performance (e.g., caused by permanent data transfer of material to provide proper context), and to supporting direct feedback between learners and teachers for the sake of continuous quality management. The features this paper detailed are particular annotations (e.g., text comments, questions, media files), individual link management, adapting, sharing and cascading of views required for individual as well as group task accomplishment. Scholion’s future activities will focus on (i) further individualization requirements, (ii) integrating annotation functionalities into mobile learning devices (e.g. PDA and Phone) and monitoring features to ease web-based e-learning.

8. **REFERENCES**

Nicola Henze and Wolfgang Nejdl and Martin Wolpers: Modeling Constructivist Teaching Functionality and Structure in the KBS Hyperbook System. Institut für Rechnergestützte Wissensverarbeitung, University of Hannover, 1999


CrossDB Bridging the Gaps: http://www.crossdb.com/, 2003


