

WebPublishing—A Multimedia-Oriented Approach to WWW-based Learning*

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The quality of WWW-based learning depends on several critical success factors. Especially, the course material on the WWW should not represent a one-to-one transfer of written lecture notes. Added values like interaction and dialogue components, training modules, etc. should be provided. This paper introduces an approach of multimedia-oriented WWW-based teachware packages taking these demands into consideration. Applications are based on a series of reusable modules providing core functionalities and serving as a framework for developing WWW-based teachware packages with any type of content.

MOTIVATION

TECHNICAL DEVELOPMENTS in the fields of communication and new media are important pacemakers for the process of education re-engineering. The distribution of information—especially via the Internet/WWW—and the availability of powerful support systems (video-conferencing, groupware, authoring tools, etc.) provide the platform for innovative forms of teaching and learning. Media-based learning resources cover conventional computer-based training applications, electronic learning material (e.g. PowerPoint slides, single educational WWW pages), WWW-based courses, as well as various forms of synchronous and asynchronous tele-teaching/telelearning applications. Due to the penetration and growth of the Internet, especially WWW-based courses seem to be of special interest for future educational scenarios.

To fully utilize the conceivable potential of WWW-based learning, a set of critical success factors needs to be taken into consideration [1]. For instance, course material on the WWW should not represent a one-to-one transfer of written lecture notes. Added values like interaction and dialogue components, training modules, etc. should be provided. Also, WWW-based courses should not provide a ‘media overkill’ forcing time consuming data transfer in a networked environment. Multimedia elements should be integrated in the sense of ‘opti-media’. Furthermore, the learners must not be left to study by themselves, as in the classical CBT situation. Finally, WWW-based course modules and contents—like any other CBT material [2]—should be reusable. A course author has to be able to easily combine existing and newly created teaching material on the WWW into a course of any sort.

In the context of a teleteaching/telelearning project at the University of Erlangen-Nuremberg [3] a new approach to WWW-based learning is introduced. A major aim is to develop an open environment for teaching, learning and co-operation, which provides learners with multimedia-oriented WWW-based teachware packages on various subjects. These applications are based on reusable modules, which provide core functionalities and serve as a framework for WWW-based teachware packages with any type of content. The learner can make use of this framework through a control panel implemented in Java, where different buttons give direct access to the value-added functionalities. The following sections show the most important features.

REALIZATION APPROACH

Figure 1 shows the standard screen design. The subdivision of the browser window into separate frames is based on the layout suggested in [4]. The presentation of course material in the *information frame* (2) is managed through a control panel situated in the *control frame* (1). This panel—implemented in Java—provides various buttons which are dynamically enabled or disabled depending on the context of the information being displayed. The value-added functionalities (e.g. navigational and orientation guides, online manual and glossary, annotation pad, communication tools) can be activated by these buttons (see Fig. 2). The frame-based implementation guarantees that the control panel is always directly accessible. The problem of scrolling the navigation out of bounds, which often occurs in longer documents on the WWW with navigational areas at the top or bottom of the document, is hence avoided.

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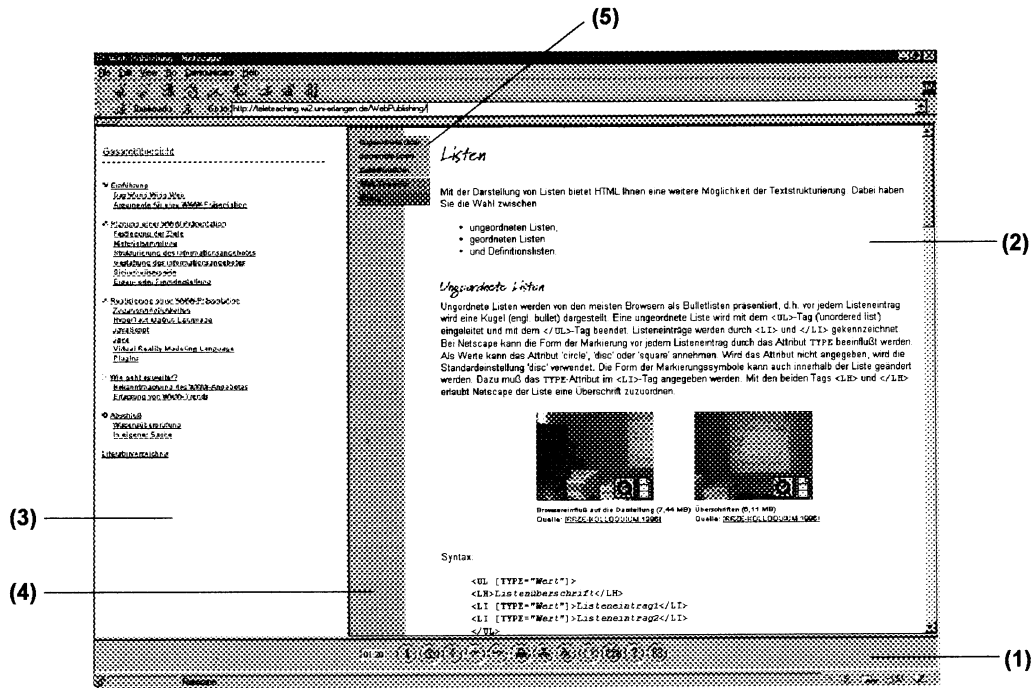


Fig. 1. Standard screen design.

Furthermore, dynamically updated *tables of contents* for the individual chapter and the whole course can be switched on and off in a separate frame (3) by using two corresponding buttons on the control panel. This approach enables the learner to always easily determine his or her exact position within the course without leaving the guided tour.

A *colour coding* of course modules simplifies the orientation within a teachware package. This concept is implemented through a vertical colour bar on the left border of each document (4). The main course chapters of a teachware package have a unique colour, so that the learner can use this guide to always determine which part of the course he or she is currently viewing. Longer course modules also provide *jump-spots* as an additional navigational aid. They are located in a side menu (5) and ensure fast access to individual sections of the course module. The colour of the jump-spots corresponds to the vertical colour bar of that particular module. In addition, there are other coloured jump-regions in the side menu, which

provide particular interaction options and are labelled as interaction-spots. Their colour coding is consistent throughout the tutorial, e.g. red for progression tests or blue for context oriented interaction components.

Figure 3 shows a set of multimedia elements which are frequently used. The key to Fig. 3:

- (1) Audio/video clips taken from recordings of lectures (QuickTime format)
- (2) Illustrations taken from multimedia presentations (e. g., PowerPoint slides converted into GIF format)
- (3) Text passages taken from course books (e. g., Word files converted into HTML)
- (4) Animations to explain difficult content (QuickTime format)

Basically, the framework of value-added functionalities can be filled with multimedia course material on any topic. This teaching material—at our university frequently produced within a synchronous teleteaching and telelearning context and reused for the asynchronous approach—

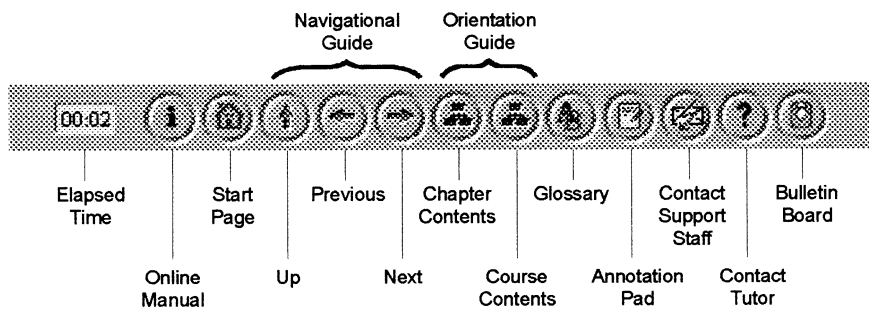


Fig. 2. Buttons in the control panel and their functionality.

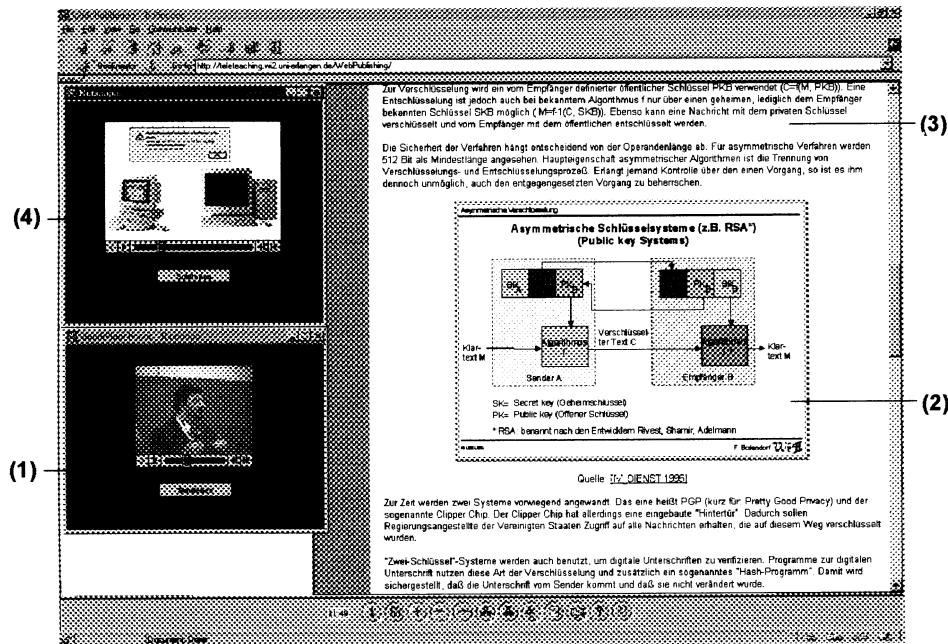


Fig. 3. Multimedia modules in a WWW-based teachware package.

consists of excerpts from video recordings of lectures, corresponding digitized snapshots of blackboard writings and overhead transparencies, as well as of contents from multimedia presentations, electronic lecture notes, elements from course textbooks, exercises, etc. In addition, computer animations, textual, visual and audio components are added and external supplementary WWW resources can be linked.

The WWW-based teachware packages are implemented entirely in HTML, Java, JavaScript and WWW-compatible media formats (e.g. graphics in GIF and JPEG format, audio/video clips and animations in QuickTime format), with no CGI processes taking place. This enables on-line use on

the Internet or Intranet but also allows for off-line use via CD-ROM.

VALUE-ADDED FUNCTIONALITIES

Navigational guides

A Java-applet is provided to *simplify the navigation* within the course material. In principle the course content may be experienced in two ways. First, through unstructured exploration (*user determined presentation*). Second, by following a predefined guided tour step by step (*system determined presentation*). If the user initially decides to use the system-determined presentation, but leaves

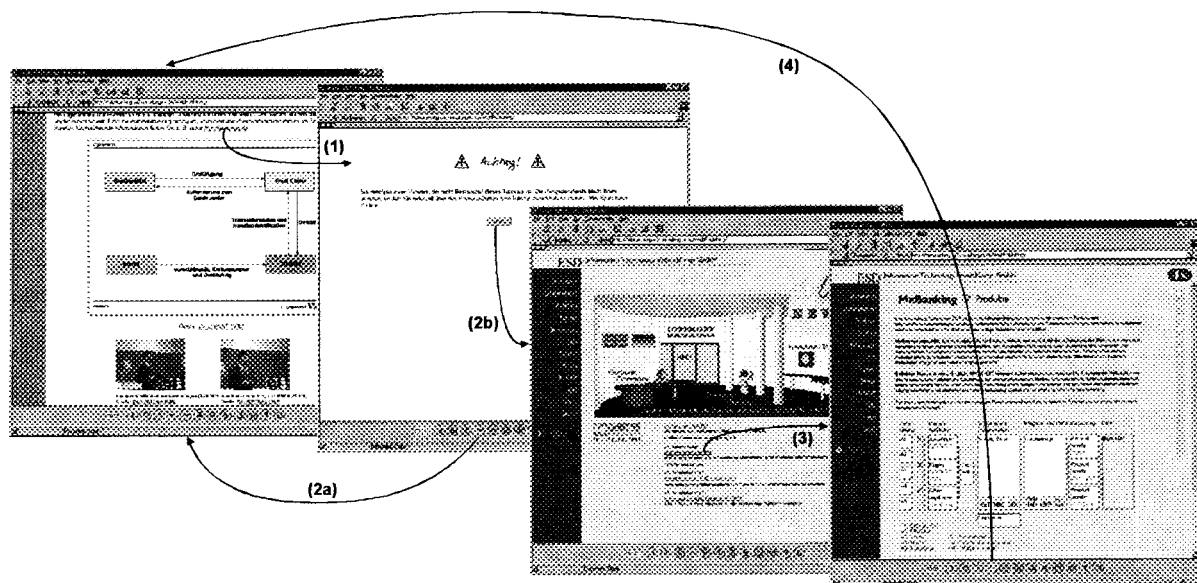


Fig. 4. Navigational guides.

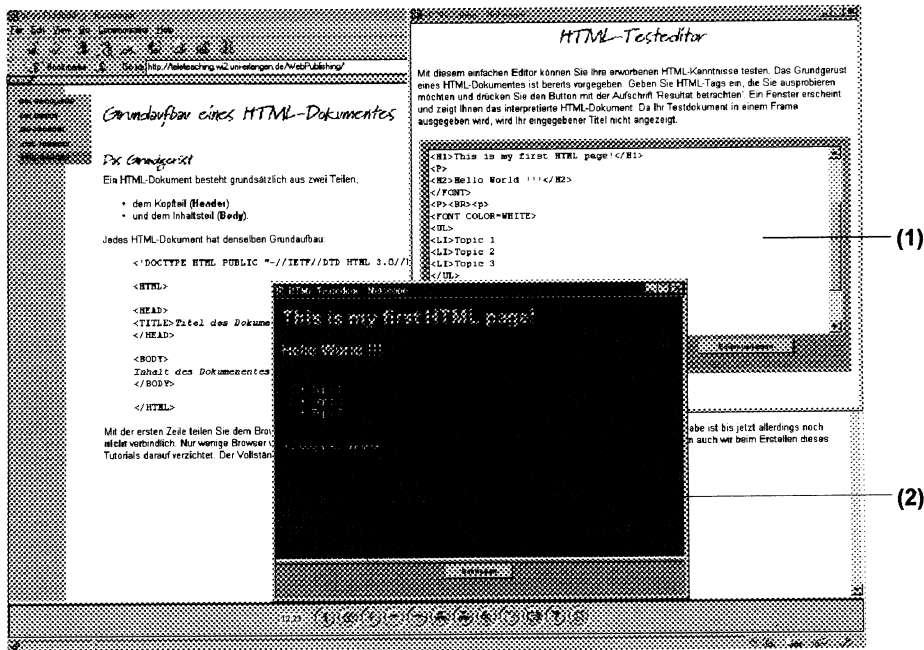


Fig. 5. Interaction components.

the predefined path, for instance to follow links and cross-references to supplementary external resources on the WWW (*composite-type presentation*), he or she can always directly return to the last viewed chapter of the on-line course by just one mouse click. Figure 4 shows a schematic representation of the *navigational guides* within a composite type presentation.

If the learner selects a link to an external source of information on the WWW, the system signals that he or she is about to leave the guided tour of the teachware package (1). At this point the user has the option to return to the guided tour by pressing the *previous* button (2a) or to follow the external link (2b), which is then loaded from the WWW into the information frame without relinquishing the functionality of the control panel. Within the WWW the user can follow any other links (3). By using the *previous* button he or she can always directly return to the last chapter within the guided tour (4), without having to use browser-specific aides like multiple clicks on the 'back' button.

The definition of a guided tour as the basis of navigational support within WWW-based teachware packages differs from related research work as described in [5–7]. In particular the complete absence of CGI techniques is a new approach, hence removing the need for any client-server interaction.

Interaction components

The educational concept is influenced by the constructivistic philosophy of learning, which defines learning as an active, self-motivated, context and situation-oriented social process [8]. While asynchronous on-demand forms of learning

inherently require active and self-motivated learning, the demand for context and situation-oriented learning is satisfied by providing appropriate interaction modules. They permit the interactive discussion of authentic problems within the individual learning context, and hence offer means for immediately applying the knowledge gained. For a HTML course for instance a Java-Script-based HTML test editor—shown in Fig. 5—was developed, which allows the interactive creation (1) and illustration (2) of HTML documents without having to use an additional application.

Progression tests

For standard *progression tests* a building block was developed in Java (see Fig. 6), which provides a simple definition of free-form and multiple-choice questions and answers that can be integrated into a WWW-based teachware package.

Annotation pad

An *annotation pad* gives the learner the opportunity to take individual notes on each chapter.

On-line glossary and manual

The *glossary* is always available to access definitions of unclear terms without having to go through any search procedures. An integrated *online manual* offers the learner assistance with the use of the teachware package, the functionalities of the core features introduced here, as well as with operating the communication tools to get in contact with the tutor, the technical support staff and other learners.

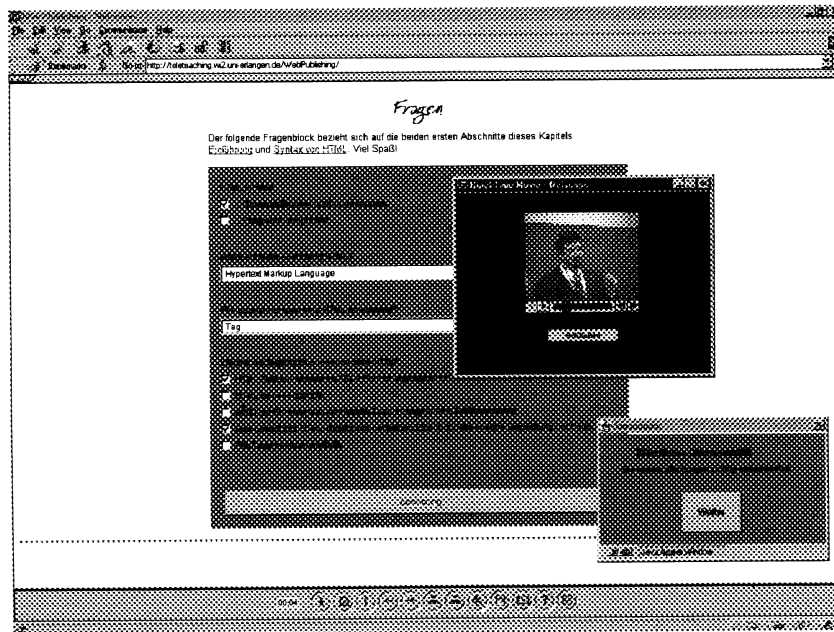


Fig. 6. Progression tests.

Learner/tutor communication

During the on-line use of a teachware package in a distributed teaching and learning environment the learner must always be able to *contact the tutor and supporting technical staff* through integrated media channels [9]. Some interfaces for this type of feedback and interaction can be activated by the control panel.

Learner/learner communication

Multilateral communication among distributed learners in an on-line course is realized. One of the tools provided is a multimedia WWW-based bulletin board system, accessible via a button in the control panel. In this forum for asynchronous discussion the tutor can create closed user groups, where learners can jointly solve problems without the feeling of being observed by a third party.

EVALUATION

WWW-based teachware packages have already been integrated into the curriculum of students at the Faculty of Economics and Social Sciences at the University of Erlangen-Nuremberg. A first evaluation of the introduced open environment of teaching, learning and co-operation took place during summer semester 1997. Within a three-week period 60 students had access to a teachware package being part of a business information systems seminar. The tutor and the development

team were always available for questions regarding content, technology and ergonomics. This tutoring service was provided via asynchronous e-mail communication and also via synchronous video-conferencing and groupware applications during certain office hours.

Some of the aspects mentioned by the students were: increased flexibility in terms of time and place; suitable approach to gain basic knowledge individually; variety of value-added functionalities compared with other WWW-based courses; suitable means to immediately apply the knowledge in the learning context.

The positive feedback to the prototype implementation 'WebPublishing' (available at <http://teleaching.wi2.uni-erlangen.de/WebPublishing/>)—award winning in 1997's software competition of the German Academic Software Co-operation (ASK)—encourages an extended evaluation beyond the boundaries of our university. An evaluation of the approach is planned at several German and Austrian universities and colleges, in the area of teacher training as well as in companies. Among others, Siemens, Lufthansa and Deutsche Telekom have stated their interest to evaluate the multimedia-oriented WWW-based teachware packages for their training purposes.

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