DOCUMENT RESUME

ED 477 086 IR 021 814

AUTHOR Roessling, Guido; Trnkova, Jana; Langendorf, Uwe; Tillack, Karin; Muhlhauser, Max

TITLE Learner-Centric Online Teaching for Non-Computer Science Students.

PUB DATE 2002-06-00

NOTE 7p.; In: ED-MEDIA 2002 World Conference on Educational Multimedia, Hypermedia & Telecommunications. Proceedings (14th, Denver, Colorado, June 24-29, 2002); see IR 021 687. Figures contain illegible type.

AVAILABLE FROM Association for the Advancement of Computing in Education (AACE), P.O. Box 3728, Norfolk, VA 23514. Tel: 757-623-7588; e-mail: info@aace.org; Web site: http://www.aace.org/DL/.

PUB TYPE Reports - Descriptive (141) -- Speeches/Meeting Papers (150)

EDRS PRICE EDRS Price MF01/PC01 Plus Postage.

DESCRIPTORS Civil Engineering; Course Content; *Distance Education; Foreign Countries; Higher Education; *Instructional Design; *Instructional Effectiveness; *Learner Controlled Instruction; Online Systems; Teaching Methods

IDENTIFIERS Europe

ABSTRACT

This paper reports on two key elements of successful online teaching: learner-centric design and harmonization of content and facilities. The paper shows how these two crucial requirements could be fulfilled with great success in a project that involves a non-computing related subject matter (civil engineering) and 31 educators from five European countries. The context of the project, called WiBA-Net, is explained, and the L3 system chosen for providing content access and navigation is introduced. The paper also outlines key decisions in designing and building WiBA-Net, emphasizing the two crucial aspects mentioned above. This outline can serve as a guideline for projects in other subject matters and context, and is thus regarded as valuable for a general audience. (Contains 14 references and 4 figures.) (Author/AEF)

Learner-Centric Online Teaching for Non-Computer Science Students

Guido Rößling, Jana Trnková, Uwe Langendorf, Karin Tillack, Max Mühlhäuser
Department of Computer Science, FG Telecooperation
Darmstadt University of Technology
Alexanderstr. 6
D-64283 Darmstadt, Germany
{guido, jana, uwe, tillack, max}@tk.informatik.tu-darmstadt.de

Abstract: This paper reports on two key elements of successful online teaching: learner-centric design and harmonization of content and facilities. We show how these two crucial requirements could be fulfilled with great success in a project that involves a non-computing related subject matter (civil engineering) and thirty-one educators from five European countries. We explain the context of the project, called WiBA-Net, and introduce the L^3 system chosen for providing content access and navigation. We also outline key decisions in designing and building WiBA-Net, emphasizing the two crucial aspects mentioned above. This outline can serve as a guideline for projects in other subject matters and context, and is thus regarded as valuable for a general audience.

Introduction

Many online learning materials suffer from two common drawbacks: the lack of learner-centric design and display disparities in content by different authors. The first drawback especially touches the offered learning path which often comes in either of two extremes: statically fixed or nearly absent. Fixed learning paths are encountered for example in lecture slides which are placed in a certain order and may be restricted to forward and backward navigation. Mostly unstructured HTML documents with cross-references, on the other hand, do not provide any clear path by giving too much leeway to the user.

Neither approach is helpful for the student. As has been shown in various research projects, not all learners are the same! Providing a single type of access for all students is therefore unlikely to result in optimum learning and retention. Learner-centric navigation requires guiding the learner to a learning path tailored to his or her individual preferences and learning style. However, the learning path should not be enforced. Thus, both extremes are ill suited for learner-centric teaching.

Within our ongoing research project, we are looking for a middle way solution. To be usable outside computer science, the system must not place high expectation of computing familiarity on users or authors. Finally, standard content as commonly found on Web pages should be embeddable, for example QuickTime or MPEG movies that illustrate special subtopics.

Our research is part of the WiBA-Net project funded by the German Ministry of Education and Research. The project shall provide a common platform for online teaching. Our current topic focus is on civil engineering. The finished system shall be embedded into the teaching at the various participating universities, to the benefit of both learners and educators.

In this paper, we present the chosen approach for supporting learner-centric online teaching. The paper is organized as follows. We first provide a short overview of related online teaching systems, focusing on their support for individual students. We then give a short overview of the L^3 system used for content modeling, followed by the technical implementation. Finally we summarize the paper and outline areas of future research.

Related Work

Although e-learning has become very popular lately, there is still no "ideal environment" which attracts masses of learners and fulfills all their needs. Many "traditional" educators are therefore skeptic about massive use of the Internet as a medium for learning processes. Virtual School or University is still more "vision" than reality. However, most universities are trying to implement an online form for at least some courses. At the moment probably the best individual access is given in WebCT (WebCT 2002), which allows the tutor to distribute the learning materials and assessments to each student separately – we could say "manual individualization of study". Element K KnowledgeHub™ (Element K 2002) also offers this feature. Macromedia Authorware 6.0 (Macromedia 2002) can be considered as the most flexible environment in which a high level of interactivity can be reached. For course and test building, it provides an iconographical language with decision step elements so the author can in fact "program" some individualization for the students. However, this is relatively difficult for authors without programming experience.

Teachers are of course aware that really effective learning requires more than the individualization in the above-mentioned meaning. It is only logical that we recently observe a boom of many different projects, mainly at universities, focused on building learning environments, which would provide epistemological pluralism and hence a better transfer to the learner. Following the learner way of thinking has been shown to increase the efficiency of education (training) and retention. In these environments intelligent tutoring and adaptability to learner needs are present at different levels and are also interpreted differently. A brief overview with a short characteristic of the most important projects follows.

TANGOW (Carro et al. 2001) (*T*ask-based *A*daptive Lear*n*er *G*uidance *o*n the *WWW*) lets students choose their learning strategy, for example placing theory before exercises. Suggestions for changing the current strategy can be made by the system if the student does not obtain good results with a given strategy.

ELM-ART II (ELM-Art 2002) is an intelligent interactive textbook for programming in LISP. Adaptability is implemented by selecting the next best step in the curriculum on demand. Links are annotated according to a traffic lights metaphor, indicating if a section is ready to be learned, ready but not recommended or not ready yet. The annotation is updated after a learning unit is finished, reviewing all prerequisite concepts to the current unit (Carro et al. 2001). *ELM-ART II* enables direct interactivity by providing live examples and intelligent diagnoses of problem solutions. All function call examples can be evaluated. When the learner clicks on a live example link, an evaluator window shows the evaluation of the function call. Users can type solutions to a programming problem into an editable window and then send them to the server (Weber et al. 2002).

SKILLS (Neumann et al. 2002) (scalable Internet-based teaching and learning system) organizes the course material according to its prerequisites. Adaptability is implemented by taking the student's previous knowledge of the subject into account (Carro et al. 2001). The teacher prepares a default configuration for every course. Concepts addressed by the system are marked in the user's profile. If the user is familiar with some concepts from external sources, control questions are given from the tutoring component. If these questions are answered, the known concepts are removed (hidden) from the course. If the student does not want to answer the control questions, the concepts to be removed are marked until the student solves the exercises at a later time (Neumann et al. 2002). Annotations, notes and additional files can be stored or published to other students.

WINDS (*W*eb-based *In*telligent *D*esign and Tutoring *S*ystem) (WINDS 2002) produces individualized courseware for the students according to their current state of knowledge, their preferences and learning styles. Each learning element has a didactical goal. Authors can create new content using a set of predefined paragraph templates. Examples paragraphs are *Cover Story*, *Simple Explanation* or *Picture Compare*. *Complex Paragraphs* combine several elements ("content blocks") with different pedagogical functions to fulfill a pedagogical goal, for example *introduction*, *definition* or *example*. Each such chunk of information has a predefined order, pedagogical role and other metadata. Based on the user model and the metadata, the system can adapt the content sequence according to the chosen learning strategy. For instance, a concrete example can precede or complement an abstract statement if needed. To prevent or at least reduce cognitive overload, the pedagogical roles of the learning elements as well as those of the content blocks can also be expressed graphically, for example by different background colors (Specht et al. 2001).

The L^3 Learning Environment

L^3 (Leidig 2001) ("*l*ife-*l*ong *l*earning") is a learning environment by SAP CEC at Karlsruhe, Germany. L^3 structures course materials into four different types of containers. *Learning networks* (LN) are the topmost element of the hierarchy and may contain a set of *LN, learning objects* (LO) *and instructional elements* (IE). The actual content is represented by *instructional elements* (IE), each covering roughly one page of paper. The different types of IE include example, action, introductions or resource links. Learning objects combine a set of IEs addressing a common topic. Additionally, the relation between given elements can have different types, specified by the classification of the edge connecting the elements, as shown in (Fig. 1).

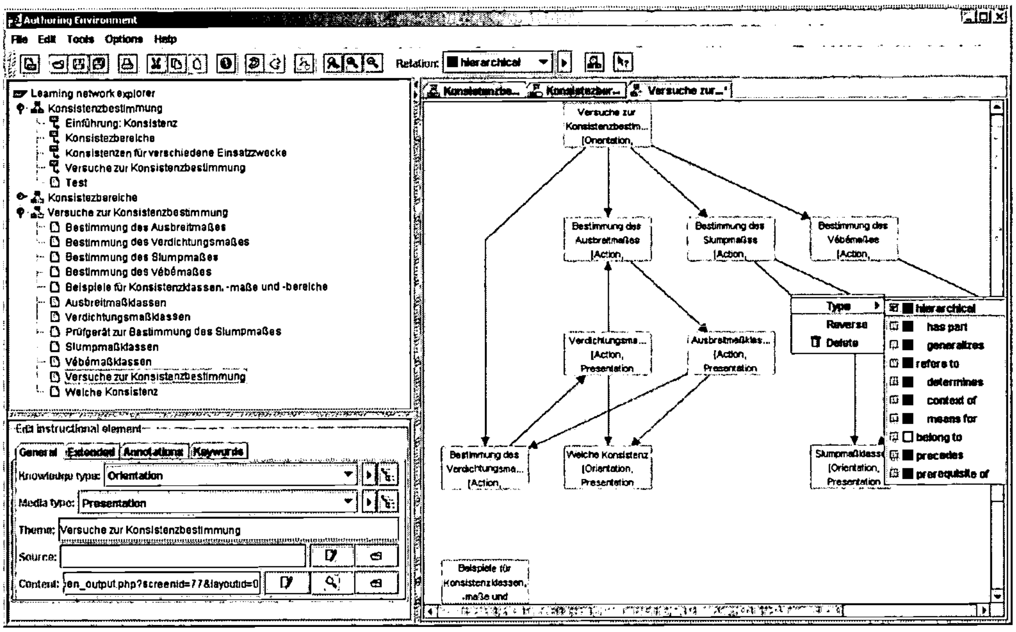

Figure 1: L^3 course editor, showing the course structure, metadata and connection types

Each element has a title, an author and a set of metadata. This metadata includes the knowledge and media type, approximate time required for finishing the unit, the types of competencies that can be achieved by working on the unit and a classification of the content according to an underlying taxonomy.
The learning path is generated based on the relations between the elements and the content type of IEs. The user can choose a learning strategy on two different levels. The *macro-strategy* covers the order of the higher-level elements such as LNs and LOs. The following macro-strategies are offered: table of contents, deductive and inductive, as well as one linear version each of these strategies. The ordering of the IEs within a given learning object is controlled by a *micro-strategy*. Currently available are orientation only, orientation first, explanation oriented, action oriented and example oriented microstrategies. The learning material can also encode temporal or causal dependencies between IEs as prerequisites, if they cannot be avoided.
The learner may submit offered tests at any time. Failed tests may influence the course process, for example by asking the learner to review parts of the course. Any SCORM-compatible test (SCORM 2002) can be used, for example generated using Authorware (Macromedia 2002). Additional techniques that may be integrated into page content are beyond the scope of this paper. Basically, all content types acceptable in HTML 4.0 can be integrated easily, for example Flash, MPEG, RealMedia or QuickTime media.
L^3 courses are executed on a standard Apache Web server with an Enhydra Application Server (Enhydra 2002). Enhydra performs the rendering of the L^3 content. The end-user requires only a current web browser. Additional plug-ins may be required for special embedded content, such as MPEG or QuickTime video material.

The WiBA-Net Approach

WiBA-Net is a course network that contains learning units for civil engineers and architects. The content is a central part of civil engineering studies. We have to address the following user groups, each with its own unique interest in the system:

- Undergraduate students use the network to prepare for the mandatory exam at the end of the course,
- Graduate students use WiBA-Net to access the basics of their study and additional courses,
- Professionals in related fields use the network for research and learning more about covered materials,
- High school students can experiment with WiBA-Net to gain or increase their interest in the topic area and possibly induce a desire for studying in this field.

The target audience also contains the educators who can use the WiBA-Net for publishing content for lectures and sharing it with other educators. Currently, 31 educators have agreed on a content memorandum for WiBA-Net, coming from universities in Germany, Austria, Switzerland, Denmark and Hungary.

We have to consider not only different needs of user but also a different (moreover non-computer science) backgrounds of the authors. Therefore, our system has to respect the learner's individual needs and be easy to use. At the same time, it must also be comfortable for authors who want to share their materials and combine them in different way to course contents. We have decided to adopt L^3 as the tool for managing and displaying the content for WiBA-Net due to the features offered. Key aspects in the decision werethe following:

1. learner-centric approach - for example, the "orientation only" micro-strategy fits high school students,
2. a user-friendly interface which can be used intuitively,
3. metadata support should allow authors to provide essential information about materials for efficient sharing of resources, even among different universities,
4. online courses require high interactivity and lots of multimedia materials. Therefore, we need good support for tests and multimedia files.

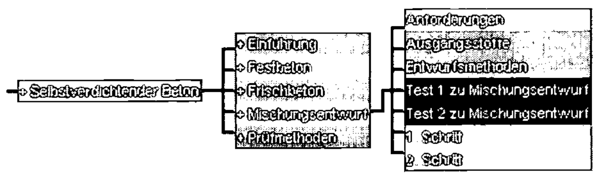

Figure 2: Example learning path in L^3

As shown in (Fig. 2), the course elements on the learning path are marked with different colors according to their degree of recommendation, including not recommended, recommended and visited elements, as well as the current element and test entities. The elements in the right row from top to bottom contain the current element, two recommended elements followed by two tests and two elements which are not yet recommended. The second element in the middle row is a finished learning object.

The educator specifying the course contents does not directly define the learning path. Rather, the path is assembled dynamically from the learner's chosen strategy. Thus, WiBA-Net offers a very good compromise between cognitive and constructive learning, both for educators and students. The learner can also pursue a different path than the offered learning path by clicking on the element in the navigation structure at any time.

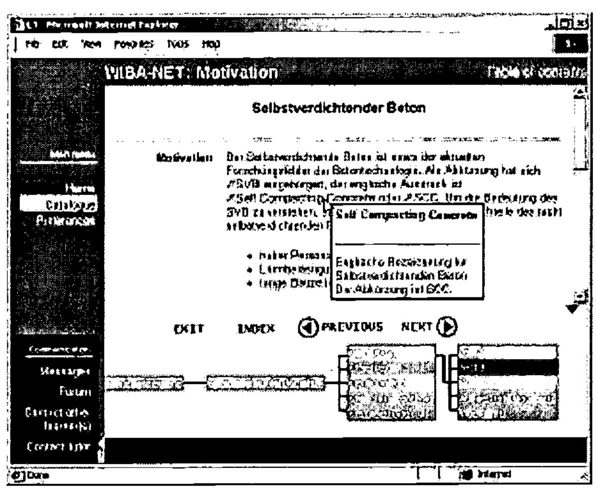

Figure 3: Example content as shown in WiBA-Net

An example content provided by WiBA-Net is shown in (Fig. 3). The left frame contains elements for customizing the environment, selecting a course, and entering communication via mail, forums or direct contact. The actual content of the page is shown in the center of the window. The standard navigation elements for leaving the current course or accessing the index, as well as stepping forward and backwards, are placed below the content area. The bottom of the page shows the current leaning path.

Similar to the common navigational elements provided by L^3, the course con tents are formatted using a common underlying style sheet, providing a corporate identity for the whole set of courses. By assuming the same underlying layout, we achieve a harmonization of both the content and the facilities, making the finished product "smoother" to both look at and use.

A key concern within the project is that learners shall not be restricted by the tight focus of the single course they currently are in. For this end, our project partners have coined the concept of *knowledge clusters.* A cluster contains a set of pages addressing a common topic in a well-structured manner. They can be referenced from any course as "related topics", offering a more in-depth treatment for the selected topic than would be possible within a given course. The page order of clusters may also adapt dynamically based on the strategies.

Since the project shall create a platform for online learning at the field of civil engineering for the whole German academic community, metadata are one of the key points. The metadata must provide sufficient reusability of the learning materials, as well as a basis for an effective searching function for the authors and for the students. L^3 itself supports the definition of various LOM-based metadata (LOM 2002), as illustrated in (Fig. 4). For the reasons mentioned above we have decided to adapt this model as follows:

- all the metadata are fully SCORM compatible (SCORM 2002),
- those optional data in SCORM model which are relevant to the project; most of them will actually be mandatory for the authors within the project.
- as much as possible is generated automatically by the system (e.g. metadata scheme, size of the file,...),
- many categories have already predefined content but authors are allowed to change it anytime (e.g. intended end user role, copyrights,...).

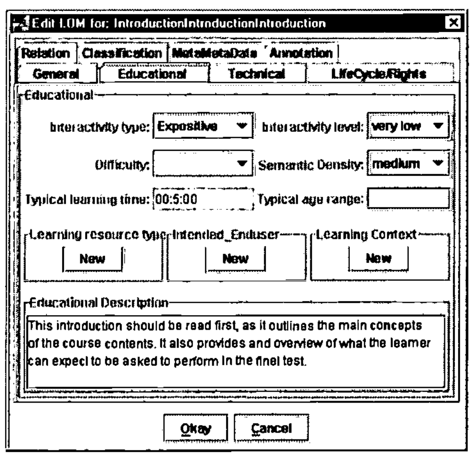

Figure 4: Example screen shot of the LOM -based Metadata editor

We are working on realizing automatic links to the appropriate knowledge clusters for the current content. This requires both a thorough classification of the content with metadata and a clever server component that can automatically deduce "related" entities. Additionally, a precise taxonomy is needed for building a meaningful set of terms for classifying the contents.

Conclusions and Further Research

Effective Web-based learning requires two key features: learner-centric design and a harmonization of both content and facilities. The former point mainly touches upon the degree of guidance given to learners for navigating the content.

The WiBA-Net project builds a prototypical system for learner-centric online teaching that incorporates the SCORM (SCORM 2002) standard. WiBA-Net has to address different target user groups and accommodate a

large set of educators from different countries. The main focus of our prototype system thus lies in learner-centric navigation support and the harmonization of both content and facilities.
The content is presented within the L^3 environment. L^3 accepts standard HTML-conformant input for its components and thus supports many different input types. We employ a default style sheets that provides a common look and feel that is not restricted to a single course. The large amounts of participating parties that provide content necessitate such measures to keep the system's harmonious look.
The project presents several challenging aspects for all project partners, including different views of software solutions and slight but important differences in the usage of key terms. More seriously, some key definitions needed for the software solution are currently lacking. This is especially the case for the support of related elements to be linked to the currently displayed content, termed "knowledge clusters" within the project.

References

Carro, R.M, & Pulido, E., & Rodriguez, P. (2001). TANGOW: A Model for Internet-based Learning. *Continuing Engineering Education and Lifelong Learning, 2001*, Vol. 11, Nos. 1/2, 25-34.

Element K KnowledgeHub™. Online: http://www.elementk.com/elearning_solution/htm/managing.asp (seen April 22, 2002)

ELM-ART project. Online: http://www.psychologie.uni-trier.de:8000/projects/ELM/elmart.html (seen April 22, 2002)

Enhydra Application Server Home Page. Online: http://www.enhydra.org/ (seen April 22, 2002)

L^3. Online: http://www.l-3.de (seen April 22, 2002)

Learning Object Metadata (LOM) Online: http://ltsc.ieee.org/doc/wg12/LOM-WD3.htm (seen April 22, 2002)

Leidig, T. (2001). L^3 – Towards an Open Learning Environment. *Journal of Educational Resources in Computing (JERIC)*, 1 (1), Article No. 7.

Macromedia Authorware. Online: http://www.macromedia.com/software/authorware/ (seen April 22, 2002)

Neumann, G., & Zirvas, J. (1998). SKILLS - A Scalable Internet-Based Teaching and Learning System. *Proceedings of the World Conference on WWW, Internet and Intranet (WebNet '98), 1998*, Orlando, Florida, 688-693.

SCORM definition and resources. Online: http://www.adlnet.org/scorm/downloads.cfm (seen April 22, 2002)

Specht, M., & Kravcik, M., & Pesin, L., & Klemke, R. (2001). Integrated Authoring Environment for Web Based Courses in WINDS. *Proceedings of the Interactive Computer Aided Learning Workshop (ICL2001), 2001*, Villach, Austria.

WebCT. Online: http://www.webct.com (seen April 22, 2002)

Weber, G., & Specht, M. (1997). User Modeling and Adaptive Navigation Support in WWW-based Tutoring Systems. *Proceedings of the Sixth International Conference for User Modeling (UM-97), 1997*, Vienna, New York: Springer Wien New York, 289-300.

WINDS project. Online: http://www.winds-university.org/ (seen April 22, 2002)

NOTICE

Reproduction Basis

X	This document is covered by a signed "Reproduction Release (Blanket)" form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.
	This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").