WiBA-Net: A Web-Based Learning Platform for Civil Engineers and Architects

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Abstract: We present the final state of a web-based e-learning system geared for non-computer scientists. The system incorporates a set of interesting learner-centered components, such as the SAP Learning Solution. We also describe our experiences with a modular approach in a multi-partner project – the requirements, advantages and possible risks.

Introduction

In this paper, we present the final version of the WiBA-Net project [Rößling et al., 2002], a German e-learning project for architects and civil engineering. WiBaNet is a multi disciplinary multi-site project involving six Universities in Germany, headed by the domain expert group of Prof. Grübl (Civil Engineering Dept., Darmstadt University of Technology). Using a web front-end, WiBA-Net aims to support learners, educators, and graduates, and to raise interest in studying architecture or civil engineering in pupils.

In the paper, we concentrate on authoring-technology related aspects for which we were responsible in the project. We describe the key components, especially the web portal, the learning management system used, and the testing environment. We believe that this overview can highlight interesting features and show that ambitious goals can be met – even if most participants are not from fields close to computer science.

The WiBA-Net Portal

The WiBA-Net portal is the web-based project interface for both students and educators. It contains a small number of mostly independent components. A different project partner was responsible for each component. Therefore, one of the main tasks of the project was to customize existing components and to establish a fully functional system from those components.

The main gateway into the system is MTS (Management Training System) developed by the Fraunhofer Institute in Darmstadt, Germany (Rößling et al., 2002). MTS provides personal access for both students and educators. After entering the system, the user can choose from the main menu as shown in Figure 1. Users can access full-fledged Courses or test their knowledge in the Exercise Pool using self tests, examples of exams, or a virtual laboratory. The university-specific Lecture Hall contains lecture notes.

Information between users can be exchanged with the Communication tools including a forum, white board, chat, and sending e-mail to tutors. The Knowledge Network is a repository of the information stored in WiBA-Net in the form of texts, pictures, animations, simulations, and audio or video sequences. The portal can be personalized in MyWiBA. External Information such as international or national standards can also be accessed in a special section. Finally, educators can use the Administration section to add or modify the home page and the latest news.

Most commonly used items are also placed in the navigation bar under the main heading, including administrative tasks such as changing the Password and accessing usage Statistics. The latter is restricted to educators. A Search tool in the upper right corner provides access to all elements in the repository, and is often very helpful for both educators and students. A Glossary provides a quick definition of many terms used within the WiBA-Net contents. To support content reuse, the contents can be shared by educators. For this regard, the use of the built-in extensive metadata is important. At least key information, such as title, author, description and keywords, should be filled in for each resource to facilitate easy location and retrieval by other users.

1 The research in this project was financed by the German Ministry of Education and Research and supported by SAP AG, which has provided for the project components of SAP Learning Solution.
The courses themselves are developed and delivered by the SAP LSO\(^2\) (SAP Learning Solution, 2004), which has been developed by SAP AG and for the project maintained and extended by Telecooperation Research Group of TU Darmstadt (Germany). Each course uses the assets, which are stored in the Knowledge Network. Some of the assets are using also glossary, which is available for WiBA-Net project as Learning Object Repository (LORe) from Technical University in Stuttgart (Germany), one of the partners of the project. Courses may contain also tests, which are developed with Perception from Questionmark (Questionmark, 2004).

Students of TU Darmstadt are also invited to Digital Lecture Hall (Mühlhäuser, Trompler, 2002), which has been developed by Telecooperation Research Group of TU Darmstadt (Germany) and adopted for this project by Institute of civil engineering of TU Darmstadt (Germany) as Elsbeth. This system allows teachers to combine in the lecture explanation with slides prepared, performance of calculations or examples (writing, drawing, combining of electronic materials) and interaction with students (through their mobile devices, PDAs and notebooks – questions, small queries and feedback). All the information are displayed on the virtual multi board (holding threads of slides from history) in order to facilitate students following of the lecture. Additionally is each lecture recorded by digital cameras and available online (together with the electronic materials performed during the lecture).

**Learning environment**

Central module of each learning platform is learning environment. In WiBA-Net project we have chosen a shrink-wrapped version of the authoring module within SAP Learning Solution (SAP LSO). Main reasons for this decision were following:

- SAP LSO addresses different styles of learning.
- SAP LSO adapts the learning path by taking into account didactical classification of the material and relations between learning units.
- SAP LSO stores metadata according to the International standard SCORM (SCORM, 2004).

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\(^{2}\) In the past has been used the name L\(^3\) – Life Long Learning.
• SAP LSO has very clear, automatically generated, navigation system.
• Reusability (in SAP LSO only the structure of the course is created, not content)
  - of educational materials itself,
  - of created learning networks.
• Repository of SAP LSO allows versioning and sharing materials very comfortably.
• SAP LSO keeps track on the progress of each student.

SAP LSO is the learning environment with very strong pedagogical background. Basic components of the
system are instructional elements and tests, which are carrying the content itself (respectively the URL of content).
SAP LSO allows storing different metadata about each component, from which is the most important pedagogical
classification. For each instruction element must be defined knowledge type – Orientation, Explanation, Action or
Reference/Source (including few subcategories for each type). Tests can be classified as Pre test, Exercise, Self test
or Post test. The authors can additionally establish relationships among the components, which can be characterized
as Hierarchical, Refers to, Belongs to, Precedes or Prerequisite of. Based on this information and micro-strategy
chosen by student, the order of instructional elements and tests is automatically generated. There are currently five
main micro-strategies: Only orientation, Orientation first, Action oriented, Explanation oriented and Example
oriented. Each of them influences the order of elements according to the knowledge type (e.g., in example oriented
micro-strategy examples precede other types of components), taking into account their relationship with other
elements (e.g., if exists an element, which is a prerequisite of some example, this comes in order first).

Sets of instructional elements and tests can be organized into the learning object. Learning objects, together
with instructional elements and tests can be organized into learning network, which already has to contain an
overview. Learning network may also contain another learning network. Order of learning networks and learning
objects within the course is determined by macro-strategy. Student can choose from Deductive (Top - Bottom) or
Inductive (Bottom - Up) macro-strategy. Alas, our project partners felt uncomfortable with a resorting of their
content pages. Therefore, the micro- and macro-strategy for each learner was fixed to preset values.

At the beginning of learning session learner choose micro- and macro-strategy (eventually are taken from
learner’s personal preferences). Based on this choice and pedagogical metadata set by author, the recommended
order of learning elements is suggested. This can be simply followed by clicking on the navigation button Forward,
or it is possible to display a navigation path in the bottom part of the window and simply click on the desired
element. Navigation path also gives an orientation about visited and recommended elements as it is shown in Figure 2.

Figure 2: Example of navigation path generated by SAP LSO

Figure 3 shows the basic scheme of communication between the modules of WiBA-Net learning network
during a learning session. We had to connect SAP LSO with MTS – to establish a basic access to the courses. All
the materials are stored in the knowledge network, SAP LSO contains only the files defining the structure of courses
(SAP LSO-specific files).
Authoring environment of SAP LSO is a stand alone application, what allows the authors to design their courses independently on the connection to Internet. SAP LSO is typically providing also connection from authoring environment directly to the global repository at the server – upload and download, and thus to support reusability of existing learning networks. Despite of that, we have implemented our own administration of courses from few reasons. We wanted the WiBA-Net portal to be an only one and fully functional gate to all the materials (including a metadata about the courses). This was an important step to make the searching function really efficient. At this moment, the authors can edit a course locally on their computer and use the packaging tool to create a package with the course (*.lnp file). This file can be uploaded to WiBA-Net portal and accessed immediately. In the background is the file downloaded, unpacked and installed on the SAP LSO Server and feedback about the whole process together with URL of the course is sent back to MTS, which is running WiBA-Net portal. As the next step the author should enter also the metadata for the uploaded course (metadata editor is the part of WiBA-Net portal). Analogically is possible to replace remove an older version of each course.

Since Pedagogical Department of TU Darmstadt (Germany) has been one of the project partners, we had been receiving first feedback right from the beginning of the WiBA-Net project. Continuous evaluation during the whole duration of the project has made an important contribution to the project and we were able to adjust the SAP LSO dynamically according to the results of evaluation. First suggestion came up from the students, which were missing an overview of visited materials and materials which still need to be seen. Actually this information was available
from the content overview (button Content in the course navigation bar) but this has been shown to be not sufficient. Students want to have an overview of their progress continuously, without a necessity to click on any button. Therefore we have implemented displaying a number of the visited pages and all the pages together (Figure 4). For this we had to take into account that the number of the pages displayed is not identical with the amount of the instruction elements and test, but we have to count into it the overview pages of learning networks as well.

Another improvement developed during the project helps to provide a better aimed feedback. This requirement came from teachers, which were willing to receive a feedback on content from learners. In order to achieve a comment on a particular content page, the WiBA-Net ID number (from database of knowledge network) must be provided. Thus we had to extract the ID number from URL of the sources and display it in the course interface (Figure 4).

Testing

During the project we also had to choose a tool for tests. This is not an easy task since an ideal tool does not exist and each of testing environments has pros and contras. Besides of test editors integrated in various learning platforms, there exist also stand-alone solutions in this field. For a long time they were using different formats to store the structure of test. Therefore was nearly impossible to change it. Recently, IMS-Consortium has developed standardized specifications for data structure. Tests and exercises can be described by XML data according to IMS QTI Specification (IMS QTI Specification, 2004), what makes them compatible with different learning platforms.

In WiBA-Net project we have decided to integrate „Perception“, a product from Questionmark (Questionmark, 2004). Our decision was based on these advantages:

- Supports more kinds of tests, which are described in IMS QTI specification.
- Possibility to integrate multimedia elements (picture, sound, animation).
- Supports reusability of test questions (common repository for test questions).
- Tests are available as HTML pages, no special plug-in is needed.
- Possibility to integrate templates.
- Possibility to evaluate access and progress of learners.
- Support of block-tests.
- Feedback can be provided after each answer or at the end of the whole test.
- The order of the questions and answers offered can be shuffled.

Main components of the system are: Question Manager – to develop questions and to create a question-database, Assessment Manager - to create an assessment from the questions chosen from a question-database, Browser Based Authoring – interface of the server accessible via Internet, Administration System - to administrate authors and students and Reporting - the reports about results (available in access-format and thus accessible also from specialized statistic programs). Authors can access reports about users, groups of users, tests and particular questions. The content of report can be adjusted according to the author’s needs.

Since WiBA-Net is not meant to evaluate learners, tests have only motivational function. They can help learner estimate how did he/she mastered particular topic, how is the state of his/her knowledge and if it is deep-seated. According to the evaluation most of the students really appreciate (and even require) possibility to test and prove so themselves their own progress. In WiBA-Net project have been integrated following test forms:

- **Pre-tests** at the beginning of a course: to test how much is chosen course relevant for the student. In case the results of pre-test shows he/she has mastered the topic, student could skip the course.
- **Middle-tests** in the middle of the course: they are offered as a ‘small break’ for students.
- **Post-tests** at the end of the course: to prove that student has mastered content of the whole course.

Each test contains feedback and well-founded solution, which refers on additional source of information or possible source of mistake. The tests are presented as a block test: all the questions and tasks are visible at the same time and can be processed by learner. Therefore the evaluation of the answers follows only after answering all the questions.
Evaluation & Results

Since one of the project partners was Institute for general education and vocational education (TU Darmstadt), the learning environment and courses have been developed under their supervision and with respect to pedagogical requirements. Besides of that, they did also evaluation of the project and learning environment. This was accomplished through observation of users, questioning, problem-centered interviews and online questionnaires.

Evaluation of teachers (14 respondents) showed that 63% use WiBA-Net during the lectures, 50% to prepare their lectures and 37% for online consultations. 64% of teachers are using WIBA-Net during the normal working hours. On the other hand, only 19% of students are accessing WiBA-Net during this time – online consultations would be more suitable for students in the evening. Generally dominated positive feedback (variety of materials, multimedia forms, teaching by composed content) over negative (the amount of materials available is not sufficient yet, technical difficulties, partially design). Teachers believe that WiBA-Net brings an excess value for them and for students as well, it supports systematic development of educational materials, searching possibilities and repository of digital materials.

The evaluation of students (43 respondents) showed that most of them are using WiBA-Net in order to prepare for tests or exams (53%), to pre-/rework lectures (13%) or for both (16%). 58% of students were connecting from home, 26% from university, 3% from both, 13% not at all. Most of the students are using the system after finishing their lectures and seminars (66%). As a desired way of communication was pointed online consultations (62%), forum (16%), chat (16%) and tutoring (6%). Students were also asking for possibility to download and print materials, content pages in pdf-format, completeness and links to other universities.

Summary and Future Work

We managed to achieve nearly all goals for the WiBA-Net project. The portal has a very attractive front-end (see http://www.wiba-net.de), and also offers a large selection of interesting content.

As the project combines different modules, our first task was to establish a communication between the various parts of the system. The system is based on international standards to ensure interoperability, including HTML, SCORM (SCORM, 2004) and IMS QTI (IMS QTI, 2004). However, modularization allowed us to choose the best solution (from those available and affordable) for each task in the project. Most of the existing learning platforms have both strong sides and drawbacks. Our approach combines those most suitable for the purposes of the WiBA-Net project. Since we were able to access the source code for most of the modules (apart from Perception), we could even adjust the tools according to the special needs of the project and according to the results of the pedagogical evaluation during the project. Our only major regret is that our project partners refused to accept courses that dynamically adapt to individual learners and their learning style.

Although the project financing is now finished, the work still continues. Apart from transforming the strategies into SCORM, we are working on an improved test editor. Finally, we plan to improve the pedagogical concepts built into SAP LSO. This especially includes a set of “course templates” that shall make generating courses for specific content types far easier.

Literature


