"Wissensraum Architektur" –
A Constructivist Model of Learning for Architectural Education at Anhalt University of Applied Sciences

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1 Idea and Conception

The study of architecture is by nature highly interdisciplinary. Design, structure, technology, ecology and economics must all be considered in the process of planning and building. Therefore it is important to encourage an integrated approach in terms of education and to create an interdisciplinary network of learning contents. Wissensraum Architektur is a contribution to this idea.

Wissensraum Architektur is an internet-based system for teaching and learning at the Department of Architecture and Civil Engineering at Anhalt University of Applied Sciences in Dessau. The basis of Wissensraum is a pool of media elements and multimedia-based components to which authors from different fields contribute. The authoring system allows instructors to create, by simple means, digital learning modules. Due to the modular structure, modular elements and sequences in varying relations and by different authors can be reused and restructured. A knowledge map visualizes relationships among the different learning content. In this way, a virtual campus in Dessau is created step by step.

The didactical concept of Wissensraum supports Constructivist models of learning. Users can use the database for research and can create their own way of learning concerning particular themes. The availability via Internet makes it possible to work from any location at any time.

2 Structural Design of Wissensraum Architektur

The structural concept of Wissensraum Architektur is orientated on the SCORM model. There are three levels of presentation which differ in complexity of content: media elements, learning cards, and learning units.

Media Elements

are the smallest components of Wissensraum, e.g. text, images, interactive applications (Flash-, Java-based), video or audio files. For input, there is an entry-mask containing the necessary options for metadata. Data is stored in high resolution, according to the principle of multi-channel-publishing. All versions that are needed for different presentation

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1 Sharable Content Object Reference Model
requirements, e.g. screen-display in different sizes (thumbnails/enlargements), printouts, etc., are automatically generated from the original file by the (software) system.

**Learning Cards**

Texts, images and animations are composed by an author into learning cards. They are the smallest instructional elements of the system and deal with the topic described in the title. Learning cards can, through „associated media elements“ (images, plans, animation, etc.), which are displayed on the bottom of the card, be further expanded to illustrate the concerned theme.

Learning cards consist of a heading with the name of the author, and a toolbar, an info-frame and a content-frame. The info-frame shows the specific field and category of the contents that the card belongs to. It also shows all the learning modules containing this card. The history-function makes it possible to easily return to the cards visited before.

The entirety of the learning cards makes up a multimedia-based „Architektur LehrLexikon“ which is meant to be an encyclopedia for teaching architecture. An extensive search function can be used for enquiries. Contents can be stored in a personal folder. The thematic environment of the displayed learning content and its relations to other learning cards are visualized in a knowledge map.

![Fig. 1: Learning card „Bogentragwerke“ (arch structure) with associated media elements](image)

The content of the different learning cards can be exported to Learning Management Systems (learning platforms) in order to create courses. The course administration and management are provided by the learning platform.
Learning Units

To present extensive topics or to give explanations in greater depth, learning cards can be organized into learning units. The learning units consist of an introductory page which describes the content and intent of the unit, and about 5-10 pages of content. While in many cases simply ordering the cards one after another is inadequate and too general to create a learning unit, the cards are supplemented by related texts through means of the authoring tool which acts as the common thread throughout all relevant texts. Authors have the opportunity to use the essential elements of the cards to bring in what they see as necessary in relation to the topic they want to teach. As there is a fixed general layout, format mismatch among the cards of different authors is avoided. Learners are guided by a navigation bar, which is automatically created by the authoring system.

To create learning units, the authoring system provides an editor. The sequence of the cards can be changed at any time, and it is easy to take out or add cards.

Knowledge Map

Correlations between the related learning cards stored in the database are visualized in a knowledge map. Different icons symbolize general learning content, buildings and persons. In this network, the title of the cards is displayed. The graphic presentation is more descriptive as a textual display and clarifies the relation between content objects. It is possible to select certain aspects of the network by using filters.

Fig. 2: Knowledge Map
The knowledge map is dynamic and navigable. The current item is displayed in the center of the screen. By selecting another term, which can also be entered by the search function, the center of the network moves. A double click on the title opens the contents of the learning card.

3 Technical Realization

System Architecture

Technically, Wissensraum Architektur is based on a modified content management system which is divided into an editorial server and a publishing server. The CMS uses open-source software and technologies. The content is drawn up in XML/XHTML and stored in a MySQL-database. The browser-based construction of the system makes it possible to carry out editorial work at any internet-PC without installing special software.

![System architecture of KT-CMS](Source: Klute-Thiemann Informationstechnologie, Dortmund)

When the creation of learning cards and learning units is finished, they have to be published. Data is transferred to the publication server and then provided as html-files.

Authoring System

The creation of content occurs online. Editorial work can be done via internet independent from place and time. The user interface of the authoring system is aligned to common design of software interfaces, and so is intuitively operable by the user.

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2 ConMan CMS – Klute-Thiemann Informationstechnologie, Dortmund
For the layout of content, various templates are available. Stylesheets are used for formatting, so that there is a strict partition between content and form. For media elements or learning cards, authors can work with their own material or use data from the database. A file structure or a search function is used to find and select these elements.

Abb. 4: User-interface of KT-CMS authoring-system, entry-mask for learning cards

The visualisation of the knowledge map is realized by using thinkmap SDK, a java-based software tool. Correlations between learning cards are determined by an editor.

4 Didactical Concept

Wissensraum Architektur is part of a Constructivist learning model in architectural education. Constructivist learning theory assumes that there is no objective reality. It is rather the learner him/herself, who creates his/her individual construct of reality and thereby generates cognition. The learner is part of the learning process. Especially in the design of a building, this becomes clear: the design process is not linear, but multi-level iterativ. The role of the teacher is to be a coach and tutor who shows the way to solve a problem and not an instructor, who asks for answers. Methods of an internet-based design-
process by means of a „Digital Sketchbook“ have been developed and evaluated in the IMLAB\(^4\) research project at Anhalt University of Applied Sciences in recent years.

The self-determined approach of learning improves creativity and can be applied to other fields of architectural education. Constructivist learning environments should offer freedom to the user to create his/her own way of learning.

The hypertext structure of learning cards and the contribution of different authors makes it possible to develop a differentiated view and to find a personal way of learning. The dynamic structure of the knowledge map stimulates the spirit of discovery and awakens curiosity. Wissensraum Architektur supports an explorative way of learning.

5 Target Group and Applications

Wissensraum Architektur purpose is not only meant to pursue technological goals, but is intended to contribute to sustainable appliance of new media in architectural education. First of all, the project is addressed to the teachers. Local data should be continuously integrated into a central repository of media elements, which can be used by all participating authors. The authoring environment makes it possible to easily create digital learning units. They can be published within Wissensraum Architektur or can be exported to learning platforms in order to create a course.

Those learning in Wissenraum can work with the available learning units independent of time constrictons and location. In accordance with the Constructivist approach, they can also use the data base for their own research and self-determined learning.

Presently, the project is addressed to teachers and students of the Department of Architecture and Civil Engineering at Anhalt University of Applied Sciences in Dessau. After finishing the test phase, is can be transferred to other departments and schools. Depending on the supplied content, the Wissensraum model can be used for undergraduate education as well as for graduate and post-graduate. Beyond this, the digital content is an important basis for a broad spectrum of e-learning possibilities such as virtual courses or blended-learning arrangements.

The website for Wissensraum Architektur is:  www.wissensraum-architektur.de

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4 IMLAB - Interdisziplinäres modulares Lehrelement für Architektur und Bauwesen, gefördert vom BmB+F im Programm „Neue Medien in der Bildung“, 2001-2003
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1 Introduction

In response to a high demand for continuing education in the area of building construction and architecture, a post-graduate master course for building restoration was initiated at the University of Karlsruhe in 1997. Restoring old buildings is one of the major tasks in architecture practice. It is a long-term social necessity, not least since a huge amount of valuable resources and energy are wasted by knocking down old buildings and setting up new structures (see MAI, 2004). About two-thirds of all construction activities in Germany concern the conservation or restoration of existing buildings. Merely one-third of all building concerns constructing new structures. In response (and to some degree anticipation) to this phenomenon, a special research department (315, Maintenance of Historically Important Buildings) was previously initiated at the University of Karlsruhe in 1985 and has been operating for 15 years.

Since the program seeks highly qualified students and practicing architects with a first degree, a pilot study was set up to meet the needs of practicing architects who often cannot afford to leave their offices for two full terms. The goal of the reformed study program is to allow students to reduce the face-to-face studies on campus to four months. Alongside a short description of the didactic concept of the study program, the focus of this paper is on two targets: The virtual study case based on an intelligent tutoring system and the communication and collaborative learning environment that shall support open-ended learning processes.

2 Concept of the Study Program

One major didactic concept of the master program is to build upon a truly blended learning scenario, using eLearning not just as a supplement to a normal face-to-face study program. Rather, it replies to the needs of the students, which have finished a first degree already and need to work at least part-time in order to finance a post-graduate degree. The following metaphor is intended to help clarify the different aspects of the program.

2.1 The blended learning matrix

On the one hand, a matrix is a rectangular array of elements set out by rows and columns. Today there are new ways of presenting those correlations graphically, which are oriented on how the human brain works. Examples include mind maps, concept maps, etc. For our master program, a matrix is being developed showing the organization of contents or

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1 The German term for the master program is Master of “Altbauinstandsetzung”. Altbauinstandsetzung is neither the same as building restoration, nor just building renovation. It includes cleaning, maintenance, and repair.
curriculum, time or sequence of modules and courses, and space-like on-campus studies, field trips and excursions and distance learning.

To get back to the term matrix, another meaning used in the field of biology is relevant. Here "matrix" means the ground substance on which something can be raised or an enclosure within which something originates or develops like the womb. The latter is the main focus of our matrix, lead by a didactic design generating a ground substance and space - virtual or real - on and in which the study program, the students as well as teachers can grow. Matrix, as it is understood in biology, is also the substance of the body; in our case the construction of knowledge and education of our students. This type of matrix is flexible enough to take off more substance by learners and teachers and allow new ways of exchange.

As the conception of the new structure of the Master Program took place, the restructuring of the content and correlation of the program (as well as didactic standards) became very important. Additionally, communication among the teachers or authors makes the program much more transparent. This allows a reorganisation, which in turn enables the program to become much more efficient with increased quality. Even before the new program had started, the matrix had already given a good ground substance on which to base the program. While restructuring the program, the goal is to develop a student-centred learning environment for presence as well as distance learning and to continuously increase the quality and efficiency of the program.

2.2 Program structure in time and space

Until now the program was structured as two consecutive semesters of on-campus study plus a twelve-week final master’s thesis. Since the program is very intense and time consuming in this configuration, it is not possible for students and practitioners to work during the semester. The advantage of the restructured program is achieved through its extension to 17 months. A 19-hour workload per week during the distance-learning phase enables students to remain employed full-time. Recently, the program started a two-month on-campus study phase. During this intense on-campus study phase, students will visit building sites in order to get to know the genius loci of a particular project and to use all their senses in gathering impressions of the site and the design problem. They also gain experience with field-specific methods and enjoy first-hand experiences, which can still not easily be transformed or transposed into virtual environments. Lectures and workshops give a broad insight into the fields of building restoration and offer a condensed form of abstract knowledge in this field. Students can take the chance to truly come to know teachers and other students and their different attitudes towards design and restoration issues. Learning in the same physical space particularly fosters a sense of co-education and enables the students to learn from one another and allows the formation of effective collaborative groups. The common workspace at the university allows spontaneous and more casual conversation and collaboration, which has always been typical for creative atelier environments. Indeed, the modern architectural education is modelled on this type of design education (see NOTHHELFER, 2003).

On-campus studies are then followed by a nine-month distance-learning phase interspersed with a few on-campus meetings for consultation, examination and events. During the distance-learning phase, natural science subjects such as building physics or construction planning can be examined via case studies. Creative design work and socio-cultural studies are also part of the second study phase and are performed in cooperative groups.
Since the program is scheduled in modules according to the European Credit Transfer System, students of other programs can likewise sign in to single modules and receive credit points accordingly. The structure and content of modules with its particular focus and expertise is also attractive to practitioners, who may just want to take part in single courses or modules. The modular structure will thus allow flexible life-long learning for young practitioners as well as for established architects and construction engineers.

2.3. Didactic aims

Didactic aims for this program are derived from lessons learned from over five years of net-based collaborative design studies at the University of Karlsruhe (see: KOCH & RUSSELL, 2000) as well as other collaborative computer-based projects (see particularly NOTHHELFER, 2003, and MANDL, 2004). According to MANDL (2004) problem-oriented teaching and learning should maintain a balance between knowledge construction by the learner and instruction by the teacher. Constructivists argue that “the construction that takes place in the head often happens especially felicitously when it is supported by construction of a more public sort in the world” (PAPERT, 1993). Neurology shows that “First a learner has to internalize what is outside, then he can externalize what is outside” (PAPERT 1990). Brain research is providing this basis for the theoretical underpinnings of constructivism (see. MATURANA, 1998, S. 22, EDELMAN 1992, FREEMAN, 1995). PHILLIPS (1995) and also Piaget explain, that knowledge is created individually by people and influenced by their values and culture, as they experience reality during physical and social activity. VYGOTSKY (1978) posits that knowledge is co-constructed through social and cultural contexts, rendering reality non-objective. Knowledge socially constructed as reality is created during physical and social activity. The teacher's role is to be a collaborator who participates with the students in constructing reality by engaging in open-ended inquiry that elicits and addresses student (mis-)conceptions. Still it is not always sure that learners are mature enough to learn and construct fully self-directed. Students might be expected to do too much. Due to this, some support and instruction is required of the tutors or teachers.

These principles led to the following main didactic goals that shall be supported by the learning environment, case examples and the tutoring process:

1. Promote **collaborative knowledge construction and a social context** (see learning paradigm constructivism above)
2. Provide **authentic context** with multimedia. According to NEWMANN and WEHLAGE (1995), authentic pedagogy boosts student achievement. A learning situation is authentic if students engage in higher-order thinking, develop a deep understanding of subject matter, participate in discourse to build shared understanding, and apply academic learning to important, realistic problems and personal experience.
3. Endow with **multiple contexts** – providing not just exemplary cases, but a large number of examples, allowing students to generalize abstract knowledge.
4. Supply quick **access to further information**, content resources and include hyperlinks to other resources to solve problems and design proposals. Learners should detect knowledge gaps and explore resources mentioned above as well as libraries to gain media competence and a critical reflection.
5. **Provide feedback and guidance** where needed.

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2 Those goals were likewise presented by MANDEL at the Learntech 2004 in February 2004.
The following chapters explain some of those basic goals more explicitly and put them into the context of our learning environment.

3 Communication and Collaboration

As mentioned above, the didactic aim of the distance-learning phase is to support collaborative knowledge construction to improve students’ skills to plan and perform projects. Interacting with other students offers the opportunity to gain different perspectives on a problem, to discuss different solutions and different problem solving strategies, to get important hints, to argue about difficulties and support each other with feedback and other forms of help (SALMON and PERCINS, 1998). Another reason to promote collaboration among students is that the sharpening of communicative and collaborative skills are important requirements for professional practice (see ASAP, 2003). Whereas intelligent tutoring systems only allow for communication indirectly with a teacher within a set frame, the introduction of specific communication media also enables flexible and open-ended exchanges with other teachers and students. Particularly for creative design processes, communication is essential for tutoring and for learning from each other. As well, it allows the training of communication and collaboration skills with new media, which is needed in current office practice. Particularly in times of economic crises, the networking of small architecture and landscape architecture offices is common, using flexible and effective variants of joint work.

Therefore, important aspects of design-based learning environments are tools which enable students and teachers to collaborate in design work via the Internet. Another important issue in the open-ended approach of learning-by-design is the need to provide students with skills to regulate their learning activities effectively (see DEWEY, 1938). Within collaborative design studios, it is essential to find a balance between self-directed activities and coordinated work with others. The addition of administration tools will enable all participants to share projects efficiently, arrange schedules, etc. Further, students need to have similar rights as teachers in the learning environment, allowing all to truly collaborate in open-ended project work. Still, most of the common learning environments give students restricted rights. Even though they contain complex content management systems and a variety of communication tools, they often forbid administrators to really adopt the system to specific needs of the learner, the teacher and the subject. Open source platforms, such as the flexible platform “Netzentwurf”, developed at the University of Karlsruhe, and communication tools designed at the RWTH Aachen, provide a robust basis for further development. These platforms can provide a structure to support collaborative knowledge construction via a series of distinct communication tools, quick access to case studies, as well as resources and effective variants of joint work.

A flexible handling of user rights allows different roles of teachers and students within the learning process. Since Master programs are to educate leaders, students must also be able to take this role in specific group work. The tutors’ and experts’ task is more to give advice concerning the learning or design processes and reflect students’ work instead of dictating the right answers (also see SCHOEN, 1983). Students in this program have a professional background and provide guidance to other professionals in their offices. Thus they can support each other and give meaningful feedback to teachers as well. Indeed, they can reflect upon the theoretical knowledge, use scientific methods and build upon knowledge

\footnote{In the Institute for Industrial Building Production (ifib), Faculty of Architecture}
gained during lectures. This allows the academic material to be synthesised with the valuable findings of professional practice.

As an empirical study showed, design students prefer synchronous communication tools, like video conferencing and shared desktops for distance teamwork, presentations as well as desk crits (NOTHHELFER 2003, S. 242f). For group work they also point out the necessity of a shared virtual space to exchange data and information asynchronously (ibid.). Different distinct synchronous and asynchronous communication tools are being developed in cooperation with RWTH Aachen as a backbone for collaborative work and tutoring.

4 Problem-Oriented Learning Within Authentic Situations

In addition to project work, a series of online case-based studies enhance students’ skills to diagnose and solve complex problems. One aim is to give an authentic frame using a series of case studies involving demolished or damaged buildings. Other case studies use buildings that do not represent the state-of-the-art in energy technology, etc. Specific problems in the field of building physics, structural engineering, sustainability, etc. are combined with tasks of usability, economy, design and the like.

Whereas lectures during the face-to-face studies primarily present abstract knowledge and some examples of good practice, case-based studies foster a problem-oriented application of abstract knowledge in complex cases. Students have to actively solve problems and master the process of analytic reasoning themselves. The case studies thus provide a vital constructivist learning environment. Students come to know a wide range of real-world problems, typical methods of investigation, documentation and problem solving within the learning context of different disciplines. The case-based studies explicitly give attention to the solution and metacognitive reflections on the solving process.

Learners are encouraged to first actively request information by wisely choosing sensitive examination methods to gather the necessary information. They need to choose appropriate steps to first find out where particular problems derive from, e.g. if damp and mouldy walls are spoiled due to moisture, damaged roofs, leakages, etc. Often a whole range of information needs to be gathered to exclude many possible reasons and finally the student to find the best solutions for the defined problem. Based on these examinations, students can proceed to choose a variety of different hypotheses to work out what the main problem could be. Based on what they examined previously, students receive feedback on whether their hypotheses are right or wrong, and to what degree. If they did not get enough evidence, they are advised to go back once again to uncover more information about the case. Once students find the right hypothesis, they can proceed to develop solutions for the defined problem.

This path of examination, hypothesis and measurement, which focuses on smaller problems (and usually on ones involving a reduced number of aspects), is very common in practical building restoration. It is an important method needed in professional advisory consultation. In addition, more complex projects that include the whole range of aspects are part of the first semester project and also the thesis work.
Since different authors include their perspectives and personal estimations in these case studies, the students receive different viewpoints from that field. Authors can give their personal note to these cases. Case studies are far from fully-automated computer-generated cases. Still, once the cases are filled out by the author with a variety of facts, material, hypotheses, solutions and a sampling of relations between those entities, the intelligent tutoring system fully automates the feedback. Complex algorithms in this student-centred learning environment allow adaptation and feedback to student activity and answers according to what has been previously inspected in a specific case. According to the learner's prerequisites and skills, the flexible architecture of the system even allows different levels of guidance.

5 Technical Realization of the Learning Environments and its Components

The learning environment as a whole will be combined out of the communication and administration tools, the case-based studies and a complex database. The latter provides space for further material, student contributions and a range of tools that have been specifically developed for building physical problems. These tools and the database have been developed by another research team at the University Karlsruhe (the FBTA), called “Lernnetz Bauphysik”. All components will be integrated in a user interface, which provides access to all components, even though they are physically spread over different servers and interfaces as well. A central LDAP server allows the student to login only once (single sign on) and then virtually and directly access all components. As the main focus of this paper is the collaborative and case-based learning, the structure of the two related platforms will be explained in more detail.

5.1 The communication and administration tools

An aspect often overlooked by other "virtual education" projects, is the administrative outlay needed to coordinate and run the schools and programs. To this end, the project has set out from the start, to allow the administrators as well as the tutors to organise the courses within the same platform. The often mundane task of compiling student lists, recording progress or issuing grades can involve a large amount of paperwork and time. The goal of the administration module is to streamline these processes and to increase the transparency of the course status to the tutors and administrators.

Key to the system is a unique login for each member, be he or she administration, tutors, students or guests. The LDAP authentication allocates resources (or modules) according to the profile and role of each member.

The students are able to choose courses they would like to undertake. These are given a priority by the student (first choice, second choice, etc.). After a certain date, the system allocates places in the courses according to the availability of space, the student's priority choice, and, if applicable, a weighting according to the student's seniority. In larger applications of this process, allocating 600 Students to 40 Courses can take three people 3 days time and result in 20% of the students receiving no placement. The system has allowed this process to take about one hour with approximately only 2% fallout.
This is only the start of the process. From the placement module, class lists are automatically drawn up. This allows, for example, tutors to automatically email all participants. Other modules allow tutors to offer times for criticism and students can book these periods with the click of the mouse. These lists, which are generated from the database on-the-fly, are then used to record progress as well as final marks. The student can then see the progress and a list of their marks at any time.

The communication modules involve basically synchronous and asynchronous communication. Most spectacularly, the platform offers embedded videoconferencing. The Flash Communication Server enables the Flash plug-in (which is shipped with most every modern Web-Browser) to access the video and audio inputs of the user's computer. This is advantageous in many ways. Firstly, the members do not need to install additional software on their computer. Secondly, the communication is platform independent: Flash works with Web Browsers under Linux, Windows and Apple Macintosh. Thirdly, because the video and audio is in a website window, all packets use the standard HTTP port (normally :80). This means that firewalls, which are increasingly common, do not pose a hurdle to communication.

For the users, the most important aspect is the "Who's Online" part of the interface. This is a small part of the window, which displays visually, who is currently online. This transforms the webpage from a piece of information to being a "place". Students are then not alone with their information and can initiate informal communication with other members currently online.

Other modules allow the students to pass simple text messages via a pop-up window or to enter a forum where queries can lie dormant awaiting an answer. An implementation of a web-based, communal sketching environment is not yet ready for prime time.

5.2 The intelligent process model for case studies

An intelligent tutoring process model allows steering and controlling the flow and adoption of the training case hand-in-hand with the learner model, which continuously maintains a protocol of the learner’s process (see MARTENS, 2003). The system is implemented in Java and uses XML as an exchange format. The focus of our system is on building restoration, but the flexible architecture allows the system to deal with other domains as well\(^4\).

\(^4\) The system is derived from the so-called “docs ‘n drugs” model by the University of Ulm.
Fig. 1 The authoring and learner system for case-based studies

The system actually consists of three basic models: The expert knowledge model with common knowledge of the discipline, the case data model with the case-based knowledge and the pedagogical learner model steering the flow of information, refining different modes of guidance and navigation. All models are fed via a range of authoring tools. Experts can define the most important terms and methods via a hierarchy editor. Authors can use these terms as a guideline and use them for their particular case studies. Authors feed the system with important facts needed to solve specific case studies in the fact editor. To combine different hypotheses with important facts, they use a rule editor. Spatial location of information can be placed on maps using the map editor. After finishing the content and relations in the case data model, authors can regulate the navigation through contents and a kind of “screen play” with which they can control how to present situations, results of examinations, or feedback of questions raised before. From the perspective of the learner, these are then displayed on a set of pages. Actions and relations refined by the author define a more or less open navigation and denote steps in the process of the survey.

Contents and actions contain preconditions and effects. Contents as well as the amount of actions available in each step are adapted to the information in the learner model. Every time the learner selects an action, the system protocols it. The tutoring process
automatically than adapts the contents of the next display based on the protocol (see MARTENS, 2003).

Classical checkpoints can be included to have students reflect specific topics. These kinds of questions and feedback are independent from the learner’s protocol. Multiple choice questions are used to make sure that the learner has the right background knowledge; however, the different hypotheses cannot always be based on simple linear reasoning. Often a multitude of solutions is possible. The system therefore allows the students to be shown the consequences of their steps via differential feedback based on what has been examined before (see ibid).

The system allows teachers to choose different modes of guidance: from fully-lead to completely-free navigation through the cases. As explained before, it is important to keep a balance between control, to help students to focus their work and not lose orientation in the learning process, without losing control of their own learning process. This can be achieved by restricting the amount of actions at particular steps, e.g. allowing the student to proceed only after answering some reflective questions.

While the case studies can be worked through independently, they are still integrated into the wider learning environment with communication tools and other devices. Particularly at the stage of discussing hypotheses and measurements, virtual meetings are to be timed to put the discussion in a wider context. Theses are vital to review the process and allow space for discussion of alternative solutions, problems of implementation and points of views.

6 Conclusions & Outlook

The aim of the blended learning matrix in building restoration is to provide a robust and yet adequately flexible concept and platform that includes interactive case studies and a variety of communication and administration tools that support the balanced didactic concept of effectively moderated but self-guided learning and teaching. They allow the participants to share a common real and virtual workspace, learn from one another, receive distance and presence desk criticism, and to stay in contact with leading researchers and practitioners inside and outside of the University. The master courses that take place from the winter semester of 2004 onward show how well the matrix fosters the growth of the project.

7 References


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