PROJECT GITTA: BUILDING A VIRTUAL CAMPUS FOR HIGHER EDUCATION IN GEOGRAPHIC INFORMATION TECHNOLOGY

Robert Weibel and Eric J. Lorup
Department of Geography
University of Zurich
Winterthurerstrasse 190
8057 Zurich (Switzerland)
Tel. +41-1-635 5190
Fax +41-1-635 6848
{weibel,elorup}@geo.unizh.ch

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ABSTRACT
This paper presents an overview of GITTA (Geographic Information Technology Training Alliance). GITTA brings together 11 departments in 7 Swiss higher education (HE) institutions in an effort to develop a virtual campus in Geographic Information Science and Technology in Switzerland. The project is funded by several Swiss federal HE funding agencies as well as by the participating universities and has a duration of 3 years (07/2001 – 06/2004). Rather than being restricted to a single course the contents of GITTA is aimed to cover a comprehensive GIS curriculum at the basic and intermediate levels, with additional case studies that can be used for case-based, practical exercises. The web-based teaching materials developed in this project will be integrated into the curricula of the various participating institutions in a blended teaching mode, that is, they will replace ex-cathedra teaching where possible, freeing up space and time for enhanced forms of face-to-face teaching, such as coaching and tutoring. Contents implementation is based on XML and related technologies (e.g., XSLT). XML DTDs have been created to directly match the pedagogical design and alleviate contents development by authors. For dynamic contents, Macromedia Flash is used. The overall system architecture relies on the e-learning platform WebCT as well as on a Cocoon server. WebCT is used for authentification/authorization and tracking of students as well as for quizzing and asynchronous communication between teachers and students. The actual contents is not stored in WebCT (since WebCT does presently not support XML contents) but in a Cocoon server that is accessed through WebCT and that converts the XML contents to XHTML and/or PDF documents in real-time using specific style sheets and serves them to the web client (i.e., student).

1 INTRODUCTION

This paper reports on GITTA (Geographic Information Technology Training Alliance), a large-scale project aiming to develop e-learning contents for higher education (HE) in Geographic Information Science and Technology in Switzerland. GITTA is one of 50 projects of the "Swiss Virtual Campus" (SVC, http://www.virtualcampus.ch), a program that is funded by several Swiss federal agencies involved in higher education. The GITTA project brings together 11 departments from 7 Swiss HE institutions, making it one of the largest projects of the SVC. The project consortium includes the University of Zurich (lead institution) and the University of Fribourg; the two Federal Institutes of Technology of Zurich and of Lausanne (ETHZ, EPFL); as well as the three Universities of Applied Sciences of Basel (FHBB), of Rapperswil (HSR) and of Southern Switzerland (SUPSI). Jointly, the consortium covers more than 75% of the seat capacity in HE in Switzerland.

The departments involved in GITTA span a variety of fields (e.g., geography, geomatics, forest engineering, environmental science) as well as three language regions (German, French, Italian), plus English for international versions.

2 PROJECT OBJECTIVES

From the above it is quite obvious that GITTA is an ambitious project that emphasizes on networking to a large degree. The overall objectives are as follows (GITTA Consortium 2000):

- build a truly nationwide virtual campus for HE in GI Science and Technology;
- cover a comprehensive curriculum in GI Science and Technology (rather than just a single course);
- exploit synergies between the associated departments (e.g., one Introduction to GIS course rather than many courses at the introductory level);
- improve the quality of teaching material (e.g., have the database specialists develop contents that can then be used by non-specialists in their courses);
- integrate the contents of GITTA into the standard curricula of the participating departments;
- complement traditional forms of teaching (blended teaching)
- replace ex-cathedra teaching where possible; use capacity of teachers for coaching rather than ex-cathedra teaching; and
- foster independent learning among students (including case-based teaching and self-assessment).

3 PEDAGOGICAL DESIGN

Due to the interdisciplinary composition of the consortium, as well as the different school types and curricula involved, a modular structure was chosen for the design of the course contents, enabling the re-combination and specialization of contents for specific curricula.

Figure 1 shows the overall course structure of GITTA, explained hereafter. Two types of teaching resources are available: 1) the so-called *modules* which are intended to replace or complement traditional lectures; and 2) the so-called *case studies* which may be used as practicals (or lab exercises) and which focus on developing the problem solving skills of the student. Both, modules and case studies, are developed at two *levels*, the *Basic Level* (roughly corresponding to an "Introduction to GIS" course) and the *Intermediate Level* (corresponding to an intermediate course in GIS). At each level, there are a series of modules, each covering a particular theme of GI science and technology: *Data Capture*, *Spatial Modeling*, *Data Management*, *Spatial Analysis*, *Cartographic Data Presentation,* and *GI Systems*. Both, the Basic Level and the Intermediate Level courses consist of a total of 4 credits (measured in ECTS units). The associated case studies make up a total of 3 ECTS units per level; an individual case study ranges between 0.5 and 2 ECTS units. In principle, a third, Advanced Level could be added later to the GITTA course structure, as indicated in Figure 1. Advanced courses would typically focus on narrow, specialized topics and provide in-depth information. Whether this is a feasible option, however, would have to be decided based on a detailed requirements analysis.

Figure 2, then, shows the hierarchical organization of levels and modules into smaller sub-units. Modules such as 'Basic Spatial Analysis' are subdivided into *lessons* (e.g., 'Terrain Analysis'), and those again into *units* (e.g., 'Geomorphometry'). Each of these hierarchical elements takes a different role. While the modules serve to group together various lessons of one of the main themes (which, in some cases, might even make up a special course, such as one on spatial analysis), lessons are devoted to a topic that would typically be covered in roughly one week of traditional lec-

turing. Lessons also define components that can be combined to build a specific, 'localized' course. Hence, for instance, an 'Introduction to GIS' course at the University of Fribourg will consist of a different selection and sequence of lessons than an introductory course at ETHZ, owing to the differences of the curriculum and the priorities of the disciplines involved (geography in Fribourg, geomatics at ETHZ). Finally, units form the smallest self-contained component and serve to teach a narrow topic of roughly half an hour length. Units all follow the same pedagogical structure in a series of steps called the ECLASS scheme (adapted from Gerson 2000): **E**ntry, **C**larify, **L**ook, **A**ct, **S**hare, **S**elf-Assess (plus an additional Summary to wrap up the contents of the unit). Using elements of explanation (in the Entry and Clarify parts), illustration (in the Look part), interaction with the e-learning software (in the Act part), interaction with other students and the teacher (in the Share part), and self-evaluation (in the Self-Assess part), the ECLASS scheme should ensure that the learning objectives are met and that the student can evaluate by him/herself whether that is indeed the case. The sequence Clarify-Look-Act may be used multiple times in one unit and is called a *learning object*.

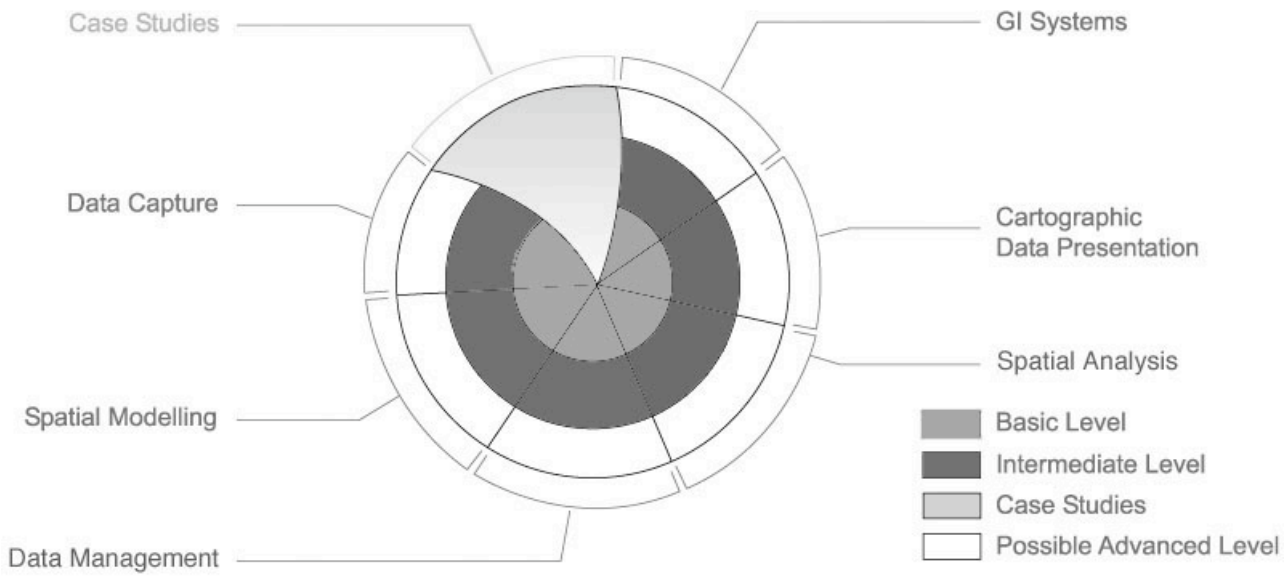

Figure 1: Level and Module structure of GITTA

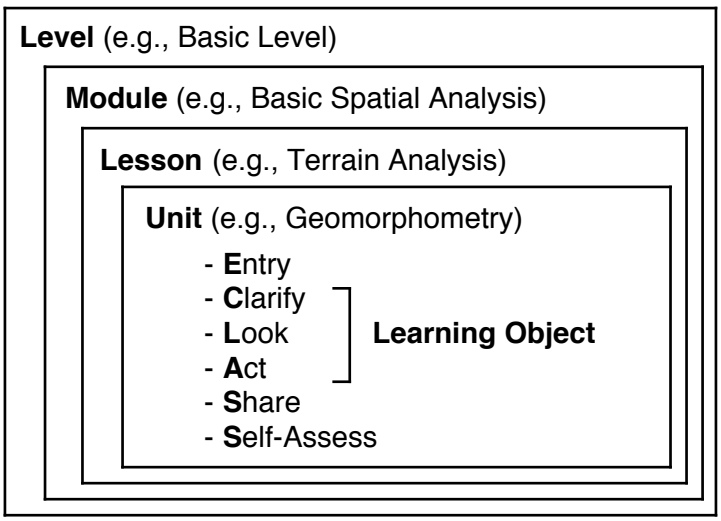

Figure 2: Hierarchical structure of teaching objects

As mentioned above, the Case Studies should complement the Modules by practical work, much like practicals (or lab exercises) complement face-to-face lectures in a traditional teaching setting. Since Case Studies focus on practical work and on the development of problem solving skills, they need a different pedagogical design than the Modules, as illustrated in Figure 3. The student is given the assignment and can download the necessary background information, readings, and data from a case study webpage. For a suitability analysis for potential animal habitats, for instance, this consists of the habitat requirements of specific animal species, associated background readings (e.g., wildlife literature), as well as relevant data for the given study area. The student then analyses the given problem and develops a work plan which can be discussed with a tutor (typically via electronic communication, such as discussion boards). Subsequently, the student develops a practical solution to the assignment using GIS software. During the entire process, which also includes a presentation of the results ('interaction' in Fig. 3), the student may communicate with the tutor or instructor by electronic means, allowing the tutor to keep a record of the interactions with the student.

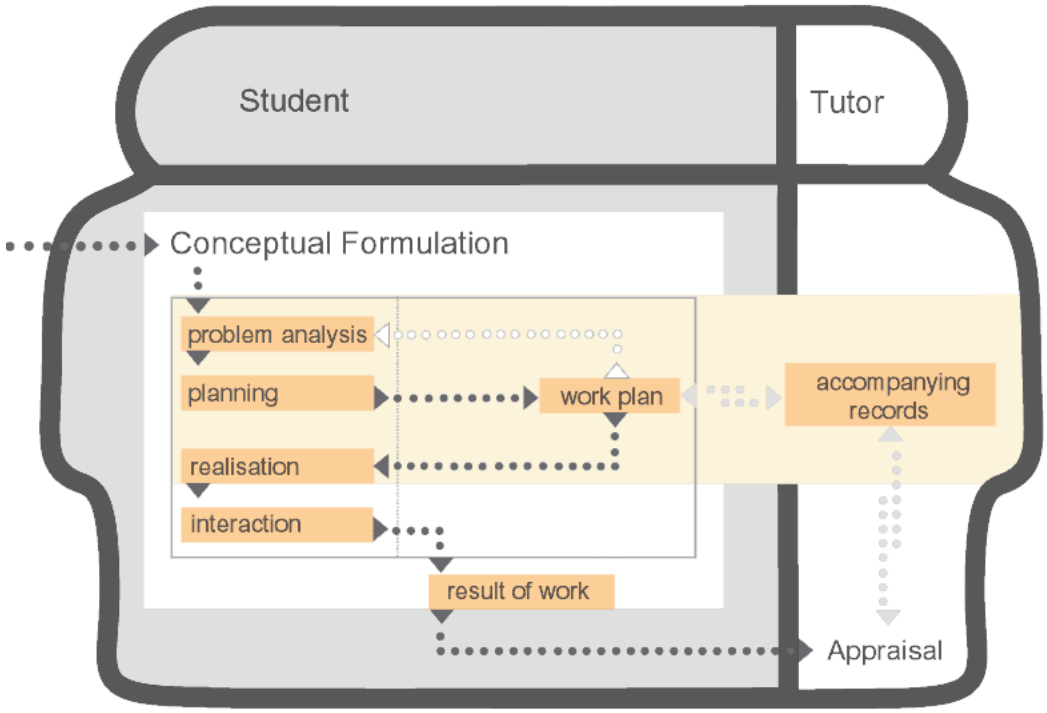

Figure 3: Structure of Case Studies

4 TECHNICAL DESIGN AND IMPLEMENTATION

Great care was taken to map the pedagogical design directly (i.e., 1:1) to a technical design and infrastructure. For reasons of platform independence, but even more importantly for reasons of sustainability and future maintainability XML and associated technologies such as DTD and XSLT are being used for the main part of the teaching materials developed. For animations, Macromedia Flash is being used. The use of XML allowed direct translation of the elements of the pedagogical design into the structure of XML documents. Through DTDs, the elements of the ECLASS scheme can directly be translated into XML tags. A sample DTD structure for the Unit object is shown in Figure 4, reflecting the ECLASS scheme. Due to the separation of contents and style that XML offers, it is also easy to generate different forms of output (e.g., XHTML, PDF) by means of different style sheets.

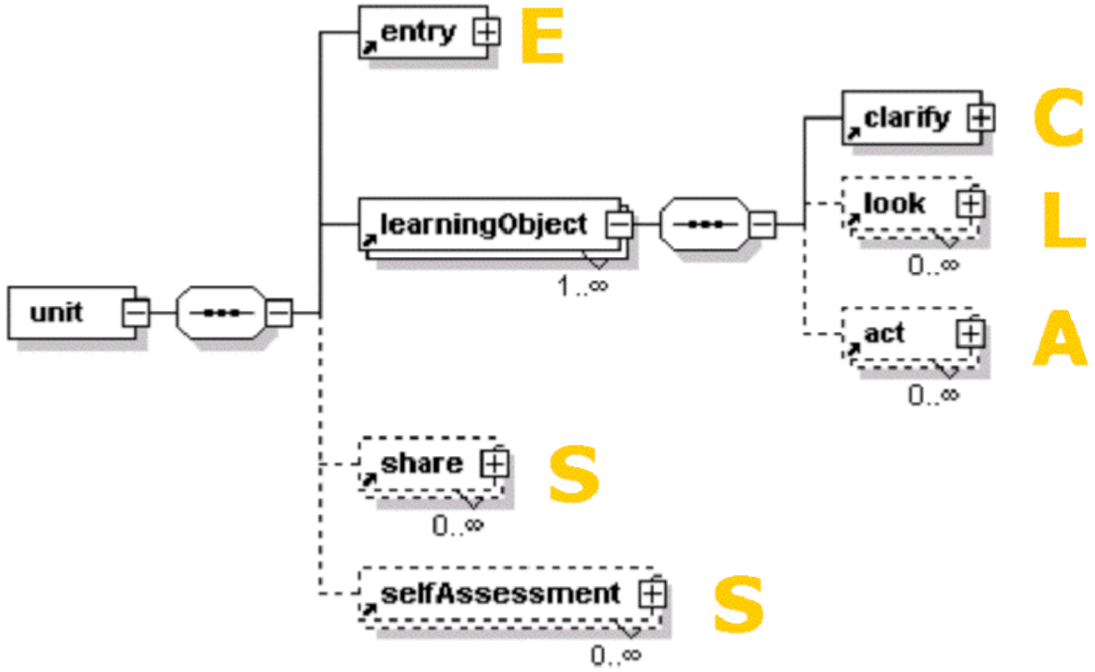

Figure 4: DTD structure for the Unit object matching the ECLASS scheme of the pedagogical design

Since XML is perhaps not easily accessible to many authors who do not 'think' directly in XML code, a variety of simple tools was developed to assist in the authoring process. For instance, the authors use a kind of 'coding form' that is made available as a Word document and that contains the ECLASS structure. Once these Word documents have been filled, they can be simply copied and pasted to generate XML code through an XML editor such as XMetaL.

Figure 5 illustrates the overall system architecture of GITTA. For course management the e-learning platform WebCT (http://www.webct.com) is used. However, we are exploiting WebCT in perhaps a somewhat non-standard way. Due to certain constraints that WebCT would have imposed we chose to store the actual contents on a Cocoon server (http://cocoon.apache.org/). WebCT, then, is used to maintain and manage the links to the contents contained on the Cocoon server. Drawing from the common contents stored on the Cocoon server, specific 'localized' courses can be compiled for each partner institution managing a specific set and sequence of links to lessons through WebCT. WebCT, furthermore, is used for course administration (student registration, access control, and progress monitoring), for asynchronous forms of communication among students and teachers (email, discussion boards), synchronous communication (chat), as well as for quizzing, where WebCT provides functionality to develop quizzes and also evaluate the results and performance of students.

Originally, one simple reason for using Cocoon was the fact the WebCT (in the version used so far) does not support XML directly. Hence, despite the various advantages of an e-learning platform such as WebCT, we had to develop a solution that could convert XML in real-time to formats supported by WebCT and standard Web browsers, most importantly HTML and PDF. However, we sound found that Cocoon has many other advantages as well. Not only does it convert XML code in *real-time* to other formats (XHTML, PDF etc.) using XSLT, hence removing the problem of maintaining separate versions of HTML and PDF code and alleviating the maintenance problem and increasing sustainability of the GITTA contents. It also provides caching mechanisms, making sure that the format conversion is only re-calculated when needed. And it connects easily to RDBMS such as Oracle, which we use to maintain information such as bibliographic references and the glossary.

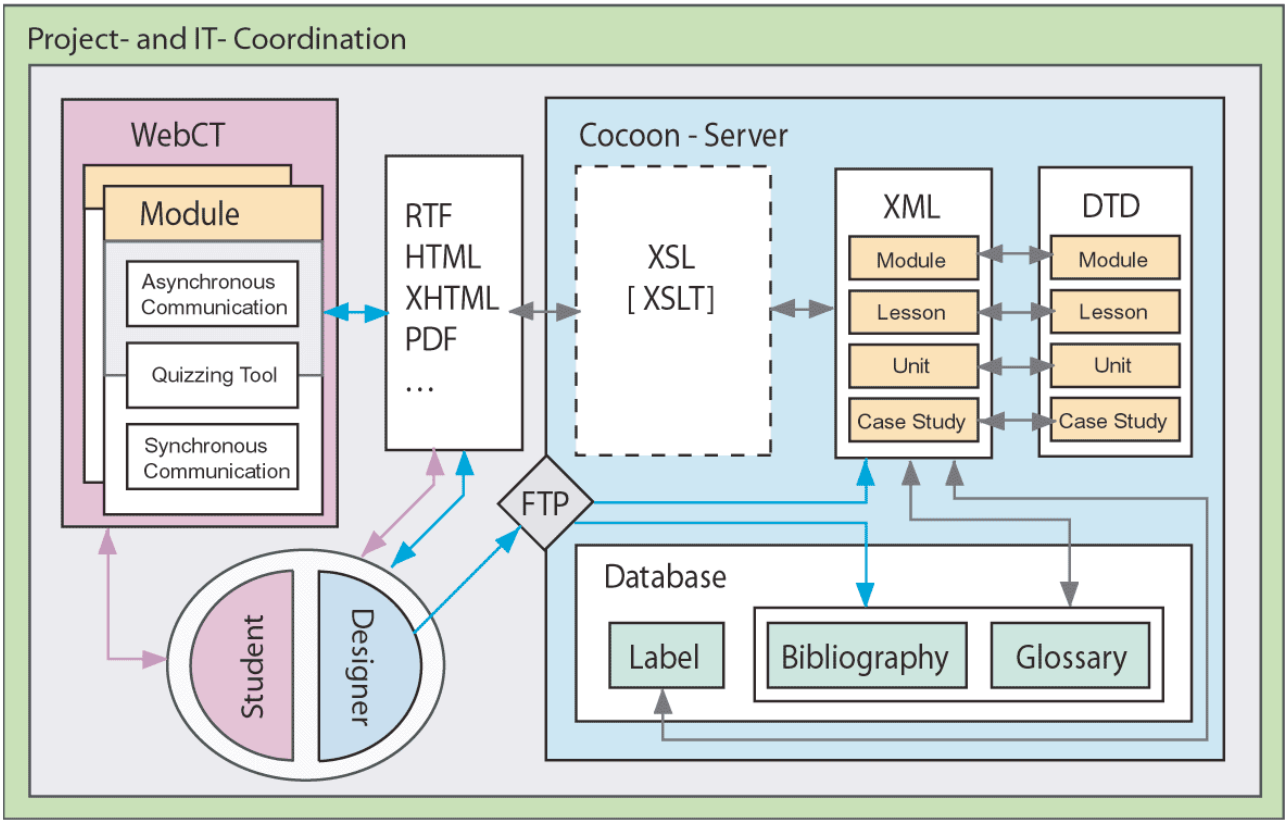

Figure 5: Overall system architecture

Figure 6 shows a sample page that has been converted for use by a standard web browser. The navigation aids show the hierarchical structure of the contents (lessons symbolized by a circle, units by triangles, and learning objects by squares). The graphics, in this case, consist of an interactive Flash animation that is used for a self-assessment of the student. On each page, a PDF button is available that allows the student to download a PDF version of the lesson (generated in real-time by Cocoon). Likewise, buttons for the glossary entries and bibliographic references of the lesson are available (top middle)

5 INTEGRATION INTO CURRICULA

Apart from the technical issues discussed above concerning the compilation of a specific course (such as 'GIS I' for the Department of Geography, University of Zurich) that builds on the overall contents stored on our contents server, pedagogical and logistic considerations must be taken into account (Horton 2000). Different partners will be exploiting the GITTA contents differently in their teaching. While some expect to *replace* entire courses or at least entire course segments by e-learning, others only wish to use GITTA materials as a *complement* to traditional forms of teaching. However, as so many others who are exploring e-learning as a new way of teaching and learning in higher education we are still very much on a learning curve in terms of finding the appropriate mix of e-learning and traditional teaching. Hence, the introduction of GITTA lessons into courses of the standard curriculum are accompanied by in-depth testing to establish what makes e-learning work in actual teaching situations and what doesn't. In June 2003, a study was conducted in collaboration with the Department of Pedagogics of the University of Berne. Within the course 'GIS I' at the Department of Geography, University of Zurich GITTA material of the module Basic Spatial Analysis was used during 5 weeks. The 110 students participating in the course were assigned to three different groups, each of which received a different form of accompanying tutoring, including face-to-face tutoring as well as two forms of electronic tutoring (using different communication modes). In

order to evaluate the learning success with respect to the three tutoring forms, the students had to take a standardized test following the e-learning period. The expectation is that the accompanying tutoring forms would have an effect on the take-up of the e-learning material and hence on the success in the final test. As this study has only just been concluded, the analysis of the test results is still outstanding. In any case, we expect to the be using the results of the study to better direct the integration of GITTA lessons into actual courses of the standard curriculum.

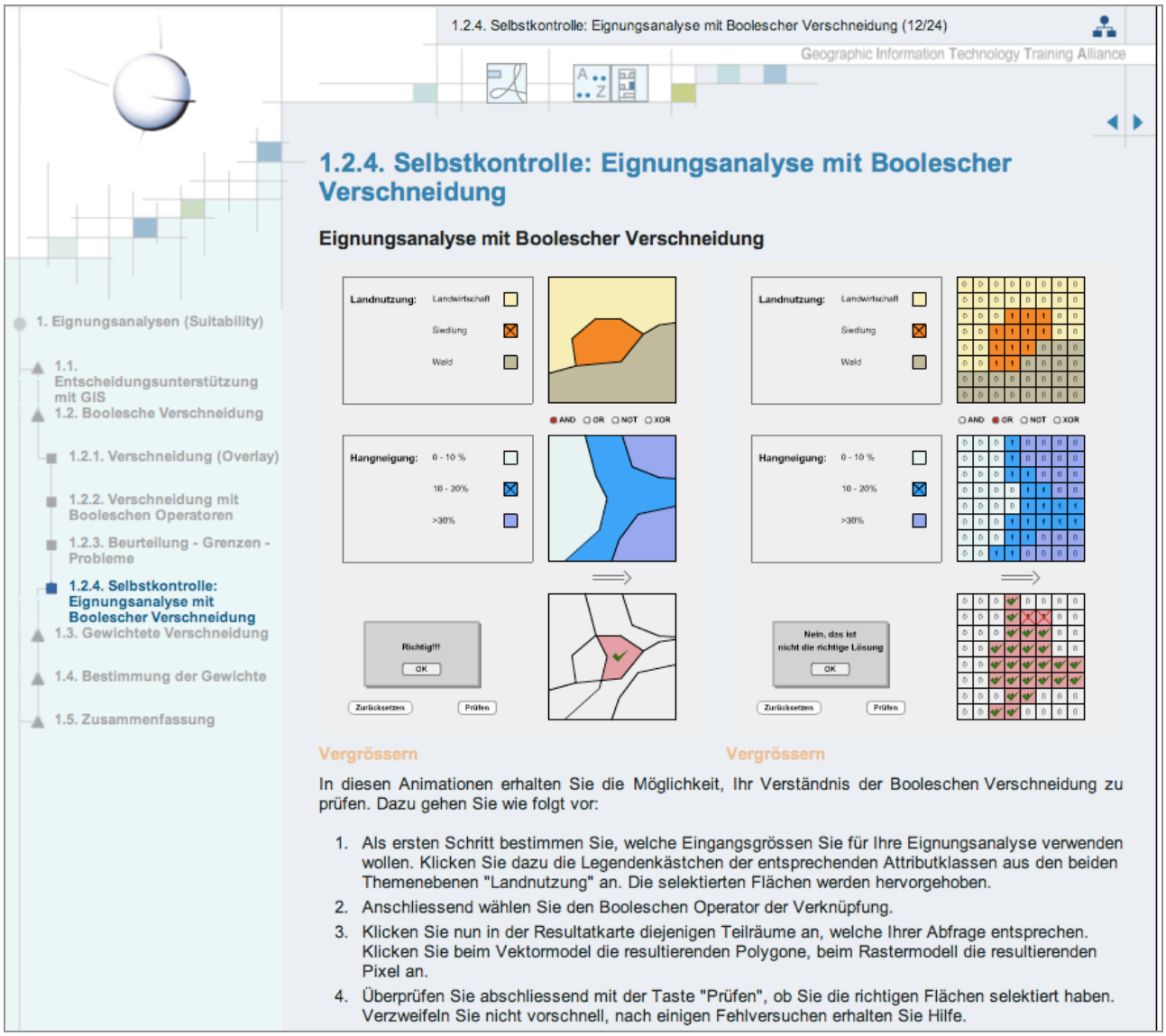

Figure 5: Sample screenshot of GITTA contents (from the German version of lesson ‘Suitability’ in module ‘Basic Spatial Analysis’). Self-Assessment of the principle of Boolean Overlay.

6 CONCLUSIONS AND FUTURE DEVELOPMENT

Development of the Basic Level modules and associated case studies is completed; the development of the Intermediate Level modules is now under way and should be completed by the end of this year. The modules of the Basic Level undergone an internal peer review within the GITTA consortium. Some of the Basic Level modules have already been used in field tests within standard curriculum courses. The students have largely reacted positively to this new form of teaching as well as to the contents of the material offered. However, we believe it is still premature to draw any conclu-

sions at this point, given that the field tests conducted so far have been of limited number and duration. However, the field tests have provided valuable information that will allow us to further improve the logistics and design of curriculum integration, and enhance some of the pedagogical design elements for the Intermediate Level. Also, we now have 'good' and 'bad' examples of contents that was well received by the field test students or criticized, respectively.

A challenge still largely ahead of us is the translation of the contents to different languages, owing to the multilingual nature of the consortium. The plan is to make available (most of) the modules and case studies of the Basic Level in the three main native languages of Switzerland (German, French, Italian), plus English; the Intermediate Level contents will be exclusively in English, to avoid cross-translation effort. So far, the Basic Level modules and case studies have been developed in the native languages of the authors. They still have to be translated to the other languages of the Basic Level. While an English version will be generated for all Basic Level modules translation to the other languages will be on-demand only (i.e., only when needed); it will start this year and last until the end of the project (June 2004).

Both translation and consolidation/maintenance will be key challenges for the time to come and the time beyond the end of the project. As far as maintenance is concerned, we trust that we have developed a technical infrastructure that should at least minimize the technical maintenance hazards associated with 'old style' technologies such as HTML or JavaScript. However, maintenance also needs authors. While these are presently funded through the project, we will have to revert to using regular staff after funding for the project runs out, if further funding through a follow-on project cannot be secured. Finally, perhaps related to maintenance issues, we also hope to collaborating and networking with other, similar projects on the international level.

7 ACKNOWLEDGEMENTS

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Web Resources

GITTA public homepage: http://www.gitta.info (login to course contents is password protected)
Swiss Virtual Campus program: http://www.virtualcampus.ch
GITTA project description: http://www.virtualcampus.ch/display.php?lang=1&name=200128pres