

ACTIVE AND SELF-CONTROLLED WEB BASED EDUCATION IN GIS-TECHNOLOGY AND CARTOGRAPHY: THE 'GITTA' PROJECT

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ABSTRACT

A constantly growing global interest in spatial information and its presentation asks for qualified personnel to cope with GIST [Geographic Information Systems & Technology] in order to form an overall pleasing and profitable final GIS product, especially in economically challenging times of competition. This reason were decisive to establish the distance learning course naming 'GITTA' [Geographic Information Technology Training Alliance], in which the Institute of Cartography is responsible for the 'Data Presentation' content.

Aesthetically rendered high-end maps are in demand, which ask on one hand for skills in geo-information science and on the other hand for skills in geo-media design. GITTA tries to take charge of filling the noticeable gap between those two fields of science by establishing a study course that embeds both aspects. It further focuses on supplying an interactively programmed and IT-based, multilingual environment, to cope with increasing numbers of students for all levels and types of academic curricula. Studies with GITTA are no longer static-, reactive- or text-based learning but a multimedia-enriched course while sticking to a consistent educational structure with large emphasis on flexibility and self-exploration.

INTRODUCTION

Utilising the advantages of the opportunities currently available through new information and communication technology is the main goal of the 'Swiss Virtual Campus'. The SVC is a program of the Swiss Confederation initiated in 1999 for a 3 year period of time, which started in 2000. Out of this initiative, easily accessible teaching modules for basic and specialised study programmes, that are available via the internet, should be created. In our field of activity, the diffusion of GIST into a wide range of disciplines, dealing with spatially related problems, has created a steadily growing demand for broader access to educational material in this sector. GITTA, the ambassador for a newly reconceived concept teaching GIST and geo-media design combined in one study course, is responding to those needs.

Its consortium is made up of 11 partners spread throughout Switzerland, covering various types of higher education institutions. Their common motivation lays in exploiting synergies, increasing the teaching capacity as well as improving the quality by redesigning the course on a modular basis to offer high flexibility. That means: flexibility in time and content to be chosen, individually adapted to the students needs. The project's structure is divided into a common 'Basic Module' and an 'Intermediate Module'. Depending on the development progression, an 'Advanced Module' is planned, covering special and outstanding topics. Integrating and accompanying those 3 levels, in-between this interactive programmed learning environment, real world 'Case Studies' build an extra module to directly transfer theory into practice.

According to teaching content about presentation of geographic issues, GITTA offers all-embracing content, dealing with 'Data Presentation'. A consistent educational structure, in accordance with classic didactics, still provides clear orientation possibilities beneath virtual mobility that enables every student to play an active role in the learning process. Adapted to those needs is the syllabus structure – held modular, with concluding units.

The 'Data Presentation' Module tackles issues like: What are the reasons for presentation and visualisation needs? How to present cartographic data in a pleasing way? What are the required layout design settings and their graphical semiology? How to analyse statistical data for thematic cartographic needs? and e.g. How does the import of GIS data-sets into a cartographic environment function? For the planned 'Advanced Module' the following question would be answered: What are the technical possibilities for presenting an interactive map on the web?

Nowadays the emphasis must lay on an outstanding production to be profitable. That means a concentration on quality and professionalism in organising an effective and efficient line of production. Cartographers not only create maps but their operational area has been extended to: Enrichment of magazine features by information graphics, 3-D visualisations or simulations, software-development and web-design. With the background of GIST handling and an overall understanding of aesthetic presentation in our visually oriented world, we want to prepare the student to be successful in this wide field.

In this paper, we first deal with the organisational aspects of GITTA and the integration of the 'Data Presentation' module into the GITTA course curriculum. In the second part we will point out the didactical mode of operation in its structure and its technical implementation. Finally we will introduce the actual product accompanied by examples, its handling and involvement into the curriculum.

1 THE ROLE OF CARTOGRAPHY IN GITTA

Since the possibility of working with new web technologies exists, there were attempts of involving them in university education. Firstly, this new method of educating frees up valuable time for coaching and tutoring while creating substitutes for ex-cathedra teaching. Secondly, the benefit to reach the students via an additional channel opens another opportunity of motivation. In some cases it is better to offer web-based prepared content, depending on the individual way of thinking and learning, to bring forward drawing consequences between parts of information (1, page 70).

Cartography taught using classic didactic concepts often has some disadvantages listed as following:

- Theory is often separated from practical experiences
- The time span between content discussed in one lesson and the next is sometimes stretched over a week which creates a loss in orientation and link between the content
- The different depth of content preparation offers inhomogeneous and often redundant course substance
- An isolated view on cartographic aspects does not consider the demand for an overlapping knowledge that is compulsory nowadays for profitable work
- Offering appropriate material, e.g. maps, charts, good and bad examples and explications, etc., at the same time is often very difficult
- Visual explanations cannot be made while working on a higher level of abstraction

1.1 The Structure of GITTA and The 'Data Presentation'-Module

The GITTA project aims to design a modular course structure which is based on the following elements: An adapted instructional design leads into the course environment, divided into 3 major levels, 'Basic'-, 'Intermediate'- and 'Advanced'-level. Each of these levels is populated by 'Modules'. The 'Modules' are educational components which bound a specific field of knowledge and leads to well-defined expertise and skills. The whole project is subdivided into 6 'Modules' that are built upon each other as you can see in figure 1. Each 'Module' touches a number of methods and techniques as well as their applications. In the 'Basic Module', foundations and basic methods in each technical domain, as shown in figure 1, are introduced.

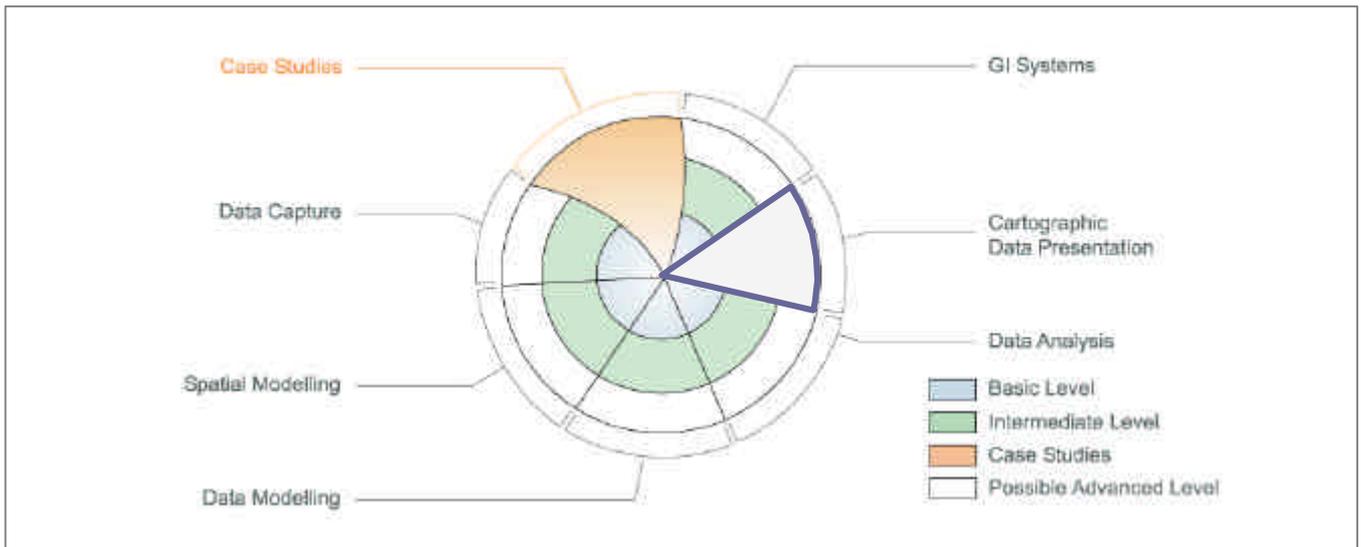


Fig 1: The GITTA Shell Model

In the 'Intermediate'-level, the knowledge of these techniques is further developed. The level of abstraction is higher. The tackled techniques move from a general point of discussion down to a specialised level. Finally, units of the 'Advanced'-level can concentrate on more specific issues and provide in-depth information on selected items. Accompanying the learning units, real-world 'Case-Studies' are an essential part of every level of learning; focussing on solidifying the theoretical knowledge in a case-based and trans-disciplinary form of studying GIS. Conceptual formulations are aligned so that students can prepare their individual work based on knowledge of the level they have completed. An introduction into the 'Case-Studies' is made visually by an explained illustration (figure 2) showing its cycle. Communication should firstly take place between students via e-mail, chat and whiteboard discussion before official help is requested.

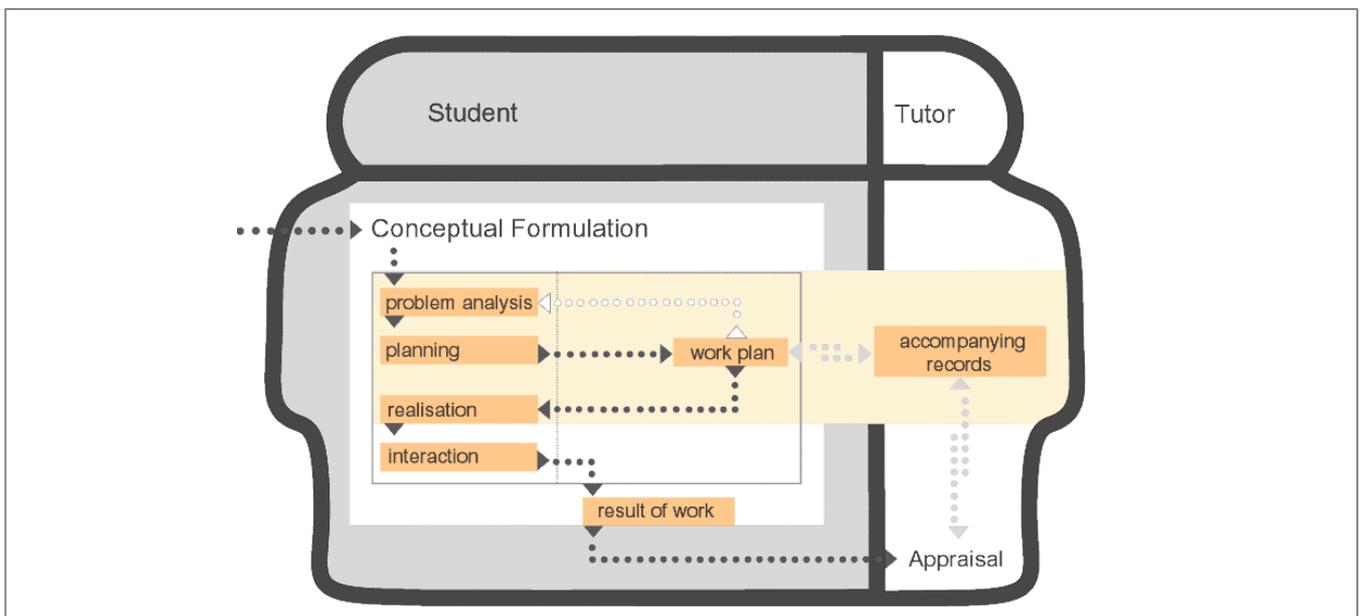


Fig 2: 'Case Study'-Structure

The next smaller entity among 'Modules' is the 'Lesson', which combines the lore about a special field of the 'Module'. The entire course organisation is modular down to this 'Lesson'-level, what means that the choice of content to be integrated at any time can be made on this level. This guarantees in-depth information in small learning units that can be successfully completed step-by-step, as well as guaranteeing high flexibility whereby a clear learning target is defined to the student. The smallest building block is the 'Unit'. They are an amount of coursework that cover in-depth content about a

specific topic. The overall lesson-counting-system is done in ‘Credit Units’ corresponding to the ‘European Credit Transfer System’, which will be counted on ‘Lesson’-level. The overall workload is set to 4 credit units per level (1 CU = 30 hours) .

Especially for the cartographic ‘Data Presentation’ Module, the curriculum is covered by the content shown in table 1:

	Basic 'Data Presentation' content	Intermediate 'Data Presentation' content
<i>Lesson 1</i>	<p><i>Presentation and Visualisation Needs</i></p> <ul style="list-style-type: none"> Demand for Maps Specially Ordered Maps Legal Order Maps Visualisation of Spatial Data Map Types 	<p><i>Statistics for Thematic Cartography</i></p> <ul style="list-style-type: none"> Statistical Diagramming Classification Rules for Diagrams and Charts
<i>Lesson 2</i>	<p><i>Layout Design Settings / Graphical Semiology</i></p> <ul style="list-style-type: none"> Map Size and Scale Definition and Organisation of Map Elements Typographic Design Colour Design Readability Rules 	<p><i>Thematic Data Presentation</i></p> <ul style="list-style-type: none"> Data Presentation with Diagrams Colour Schemes Symbolisation of Map Elements Standardisation and Classification
<i>Lesson 3</i>	<p><i>Cartographic Data Representation</i></p> <ul style="list-style-type: none"> Map Conception Map User Needs 	<p><i>Instruments of Digital Cartography</i></p> <ul style="list-style-type: none"> Systems Software Essentials Range of Functions
<i>Lesson 4</i>	<p><i>Generalisation of Map Data</i></p> <ul style="list-style-type: none"> Generalisation Concepts Generalisation Procedures Generalisation Methods 	<p><i>Handling of GIS Datasets</i></p> <ul style="list-style-type: none"> Data Transfer Data Treatment Data Output
<i>Lesson 5</i>	<p><i>Topographic Cartography</i></p> <ul style="list-style-type: none"> Notion and Intentions Content of Topographic Maps 	<p><i>Map Output</i></p> <ul style="list-style-type: none"> Needs for High Quality Output Map Media Output Devices

Table 1: Content of the ‘Data Presentation’-Module

For the scheduled ‘Data Presentation - Advanced Module’, content covering Multimedia and Internet GIS is designated. The goal lays on understanding and applying methods of multimedia cartography for online-, offline- and 3D-applications, which include: authoring tools, basic knowledge mediation of Java, SVG, HTML and XML as well as other web standards useful for realising attractive maps via new communication techniques.

1.2 Positive Aspects of Teaching with GITTA

Proposing a new structure for the GIST curriculum, the GITTA project fills the gap previously mentioned by strong convincing reasons:

- The proposed structure provides a large field to cartographic data presentation represented by 2 CU out of a total of 8 CU for the whole course ('Basic'- and 'Intermediate'-level).
- Small learning blocks, i.e., 'Units', guarantee efficient learning, since the project is laid out to demand short but steady phases of concentration from the student.
- The new structure brings consistency between the modules in order to globally enhance the quality of the overall curriculum and provides a clear view of the links between its modules.
- Learning happens in the same environment as the job of a cartographer is placed nowadays – mainly computer-based.
- The course gives the opportunity to assist the student in means of time and organisation flexibility if using the course on its own. In addition to ex-cathedra teaching, an extra learning opportunity is offered to the learner by using online education not as an isolated tool, but as an adjunct to the overall education process. The general description for this type of learning is called 'blended learning' (1), we will come back to, in the next section.

2 GITTA DIDACTICS - CONCEPT AND TECHNIQUE

Since we are living in the new era of a knowledge society we have to cope with very modified practices in contact with managing information. Since we use the computer more and more as a tool for gathering information, it becomes easier to also accept learning via this tool. Mostly we have to solve a problem like this example: creating an interactive map with connection to a database that can give us information about actual events for an exhibition, that the users might be able to consult via web or on location for better orientation, showing the services and attractions offered. For those cases, it is best to bring along competence in solving such tasks.

GITTA is especially designed for educating learners able to cope with such difficulties. GITTA tries to utilise available possibilities of the network plus classic didactical learning methods into an integrated learning concept. On one hand it offers learning, communication possibilities, information and an exchange of knowledge without binding to the time-factor. On the other hand, social contact and further discussions of the learned tasks, as well as possibilities for additional help can be met by a traditional classroom meeting. A necessary pre-condition therefor is a highly modular content database where the elements (text, illustration, animation, video, etc.) are saved separately. Each institution of the GITTA partners has its own experts looking after the current content and its composition. Depending which user group the course should reach, the lessons can be arranged to the individual needs.

To transfer the learning process in accordance with classic didactics, into an e-learning version, a consistent educational structure is most important not only for orientation but also for a positive result in course completion. On one hand the aim lies on its modular structure to ensure flexibility, personal obligingness, virtual and real mobility to each student, and on the other hand the aim is to ensure the compliance of traditional teaching elements that provide:

- student support – on social side and techniques,
- co-ordination of the course,
- feedback on immediately occurring questions,
- individual empathy for each different character of a student to hold the motivation on a high level,
- communication exchange between the learners and
- a pleasant learning environment that does not generate frustration.

2.1 The Didactical Approach – The 'ECLASSSS'-Structure

The question arises: How can such a synergy be organised? Out of the named aspects, GITTA adopts the ECLASSSS-structure beneath the traditional classroom meetings. The ECLASSSS-structure, originally designed by M. Gerson (2) and adapted to the needs of GITTA is the acronym for:

E = Explain **C** = Clarify **L** = Look **A** = Act **S** = Share **S** = Self-Assessment **S** = Summary

- The 'E' equals to the introductory statements made before each single lecture unit in a class. An example for an entry could be: What is to be discussed and in which context does the assignment fit that gives an explanation why this topic is being introduced and its historical perspective?

- The 'C' represents the core of what is being taught in a unit and its key concept. In this section the reading of facts is inevitable. GIST concepts are conveyed, depending on the module. In our case, 'Data Presentation', a short example is shown to make the problem visual for the students.
- The 'L' allows the students to review examples or samples that model what should be taught. It defines the main point, through illustrations, animations, videos, whiteboard activities and e.g., student presentations which clarify the named topic.
- The 'A' is to encourage the student to practice what has just been taught. It equals the classical lab exercises and hands-on workshops. It should be an important integrative part of the on-line learning course, as it actively engages the students. Into this category fall actions such as solving and experiencing online interactivity or simply setting a date for the next meeting in the institution's computer-laboratory.
- The first 'S' stands for interactive and virtual classroom meetings with the aim of discussing a theme that is given along with strict rules. This might happen via e-mail, chat-rooms or discussion listservers as well as drawing an illustration in whiteboard-group-discussions.
- The second 'S' should give students the opportunity to test for themselves, what they have learned. Important here is the feedback that needs to be given on each finished test to involve the learner and show him, compared to a traditional teacher, what has been good or bad – a constructive description is postulated, prepared in advance!
- The third 'S' is a new point added to M.Gerson's (2) structure. It should round a unit and find a conclusion to point out the main facts shown in this unit, what was learned and possibly also further expectations.

This structure once used, forms a unit surrounded by keywords that point out the main facts and clarifies the expectations concerning the user. Within the unit, special terms might be marked and be linked to a glossary – including overall definitions. With the manner GITTA addresses the students, situated learning should be promoted. For the first time, the opportunity to learn parts of the cartography course in everyone's own speed is given. Depending on the individual privilege they might start with elements they are most interested in. Regarding to studies (3), students will be most efficient where they do have their biggest deficit.

2.2 The Technical Implementation

Keeping the theoretically planned flexibility also adaptable in practice, an equivalent implementation strategy could be found using XML (eXtensible Markup Language) that was designed to describe data and what data is. GITTA makes use of this cross-platform, software and hardware independent tool for transmitting information because content and presentation can be separated to allow various adaptations in the future (see Figure 3).

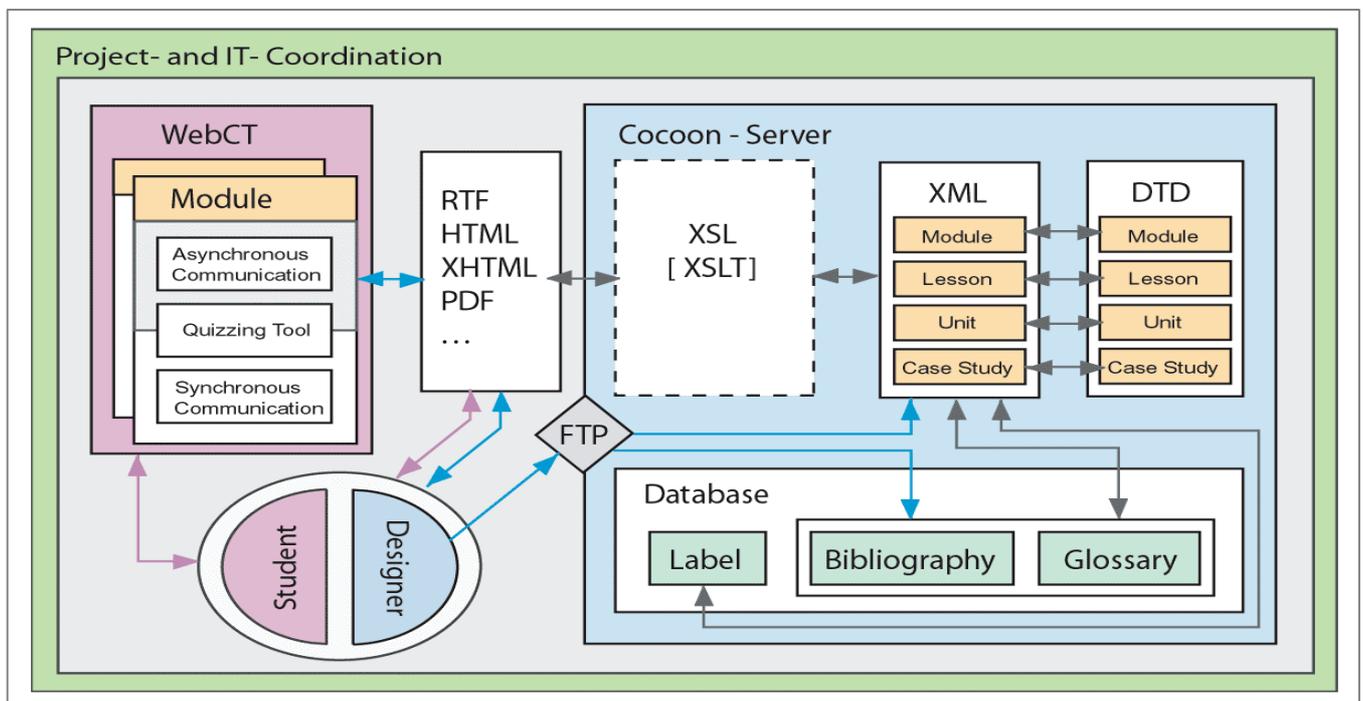


Fig. 3: The Technical Background and Realisation of GITTA

With help of meta-information, each and every information unit can be directly addressed and updated what speaks in favour for easy continuation. XML gives the opportunity to structure the content in a standardised form by using a DTD (Document Type Definition). GITTA converted the pedagogical ECLASS-model into a DTD-specification which fixed the syntax of valid element types and their structure, thus allowing data exchange between the GITTA authors.

XSL (Extensible Stylesheet Language) translates the content files – including text, illustration, animation, video, etc.- via XSLT (Extensible Stylesheet Language Transformation) into e.g. XHTML (Extensible HyperText Markup Language) to define patterns and format the layout of the final document-view. Beneath these server-side procedures, the actual access to GITTA from student-side happens pending further notice via ‘WebCT’ – as GITTA is flexible enough not to be fixed on a specific commercial product. WebCT is a course management system with a complete set of easy-to-use teaching and learning tools for course development, course delivery and course administration to serve broader student populations (4). GITTA only executes the display of its content, stored in GITTA’s server-side database, via WebCT. Additionally, GITTA makes use of the quizzing tool within this management system as well as using the interaction tools for performing the ‘Share’-part via such media as whiteboard discussion.

The newest browser versions fully support the official W3C XSL recommendations that generate correct display and function (at the time of testing in mid 2003 Internet Explorer version 6 or Netscape 6.2 respectively Mozilla 1.0 were currently available). In future, new versions of these browsers will also support the W3C XSL. One concern of GITTA is to be independent of a certain product and giving everyone his freedom in choosing their preferred tool .

3 CARTOGRAPHY-COURSE CYCLE WITHIN GITTA

The traditional lectures in Cartography at the Institute of Cartography are attended by different students coming from various departments, such as Geography, Geomatics, Geology or Environmental Sciences, etc.. Accompanying to lectures, practical exercises are offered on different levels and with numerous themes. The complete program may be extracted from the following web-side: <http://www.karto.ethz.ch/teaching/teaching.html>. GITTA will be integrated into the syllabus accompanying to lectures, either preliminary or during a lecture and for intensive preparation before exams. The content conveyed via the ‘Data Presentation’ online course is compulsory and will be part of the final cartographic exams.

3.1 Introducing the Course to the Students

Before starting with the cartographic course within GITTA, a brief introduction into the newly added learning environment is obligatory. Great value, thereby, is set on personally involving students and establishing a positive relationship to the previously unknown electronic medium. The handling of the course management system, as well as the introduction of the contact personnel is one main task. Another emphasis is introducing GITTA itself to the learners, that includes familiarising the specific symbolisation and navigation. At the same stage, the course’s structure is presented. Figure 4 for instance, shows the appearance of the first lesson out of the ‘Basic Data Presentation Module’. With the beginning of the ex-cathedra lectures, the online course-modules will be activated. Depending on the period of time a course is held, lessons can be hidden or activated for the student-view. While students work with GITTA, the tutor may either track the student’s activities during their work with WebCT or may do a course tracking. Tracking the student has the advantage to see how long a person stays on one course-page and shows which pages are visited. A review on all participants after the online-phase shows if the content has been easy understandable or if changes due to over-ambiguous course creation need to be done. The quizzes in the end of a unit or lesson are involved into the tracking-procedure to show the tutor the deficits each individual student group may have. In such cases, in depth considerations during the cartography course attendance at the University can be done or the online-version be adapted. Feedback from student-side or tutor-side is another valuable function to keep track of the students activities and the tutors impression, if considered from the other side.

3.2 Requirements

Optionally for the students is the enrolment into one of the named traditional study courses. The necessary electronic kit to attend the online cartography course at the University is provided by the individual institute, in this case the Institute of Cartography. If the students want to access the course from their home work-station, they would need the following equipment: a computer with internet connection plus the browser versions as listed in section 2.2.. Additionally, the Adobe Flash plug-in, an SVG viewer, QuickTime VR viewer and the Adobe AcrobatReader are advisable for optimal functionality.

PATH / basic / BPR / PresenVisual

Geographic Information Technology Training Atlas

Presentation and Visualisation Needs

Wherever we look, we are faced to maps. In daily newspapers and weekly news magazines, in books, on television, on the internet, on the train, at kiosks and even on table place mats. There is also a great variety in map types. Some are highly detailed and look like engineering drawings, others appear like hand made sketches or simple "way-finding" maps. Some of them show the whole world, others an area not larger than your backyard. The objective of this lesson is to demonstrate the importance of map and cartography in our pseudo-modern world, and giving an explanation to you why there are so many maps and why they do have such different aspects.

- » Demand for Maps
- » Specially Ordered Maps
- » Legal Ordered Maps
- » Visualisation of Spatial Data
- » Map Types

Map Critics

Throughout this first lesson we saw that each map has a specific communication objectives. Therefore, maps can be so different from each other because they serve specific purposes and have particular applications.

Keywords

Glossary

Cartography:
Unit: DemandMaps, LO: Maps and Cartography

map:
Unit: DemandMaps, LO: Maps and Cartography

Figure 4: Excerpt of the 'Basic Data Presentation Module' showing the 'Lesson level'. From here students have access to the following units: 'Demand for Maps', 'Specially Ordered Maps', 'Legal Ordered Maps', 'Visualisation of Spatial Data' and 'Map Types'.

3.3 Examples

Figure 5 displays an example of a unit-view based on the link in Figure 4, where content concerning ‘Map Types’ is shown. The chapter starts with a ‘clarifying’ part, followed by a ‘look’ part. Both sections are identified by symbols GITTA uses for encoding a certain meaning. As far as possible they are self-explanatory to ease the handling. To make it visual for the students, an animation in form of a slideshow covers several typical map examples in the look part.

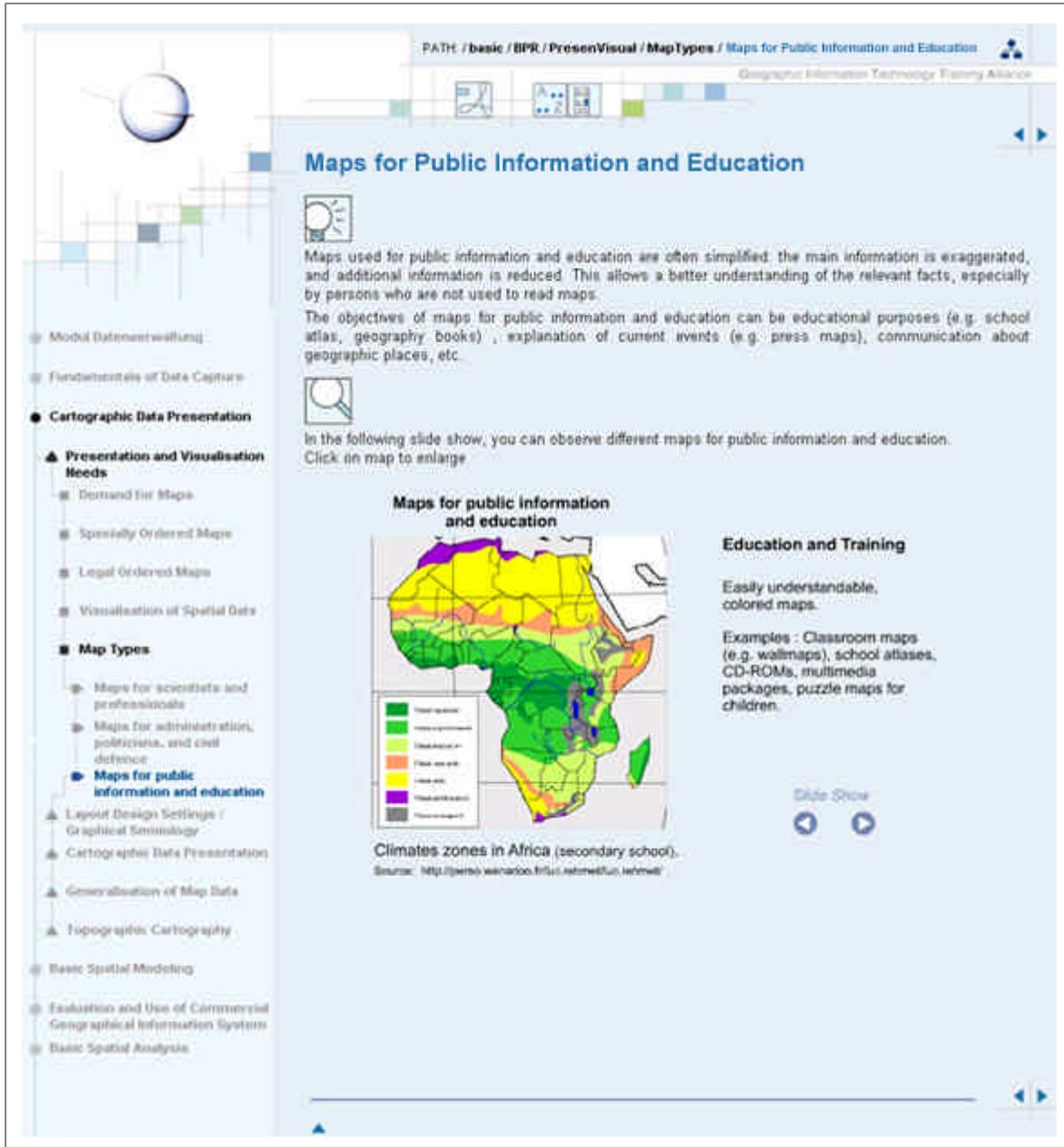


Fig. 5: GITTA Module:..... ‘Cartographic Data Presentation’
 Lesson: ‘Presentation and Visualisation Needs’
 Unit: ‘Map Types’
 Learning Objective: ‘Maps for Public Information and Education’

The innovation that is offered by GITTA are the numerous animations and interactive possibilities. Figures 6 and 7 are two examples pointing out the difference of learning Cartography with GITTA by attracting the learner to involve himself into the active and self-controlled web-based education.

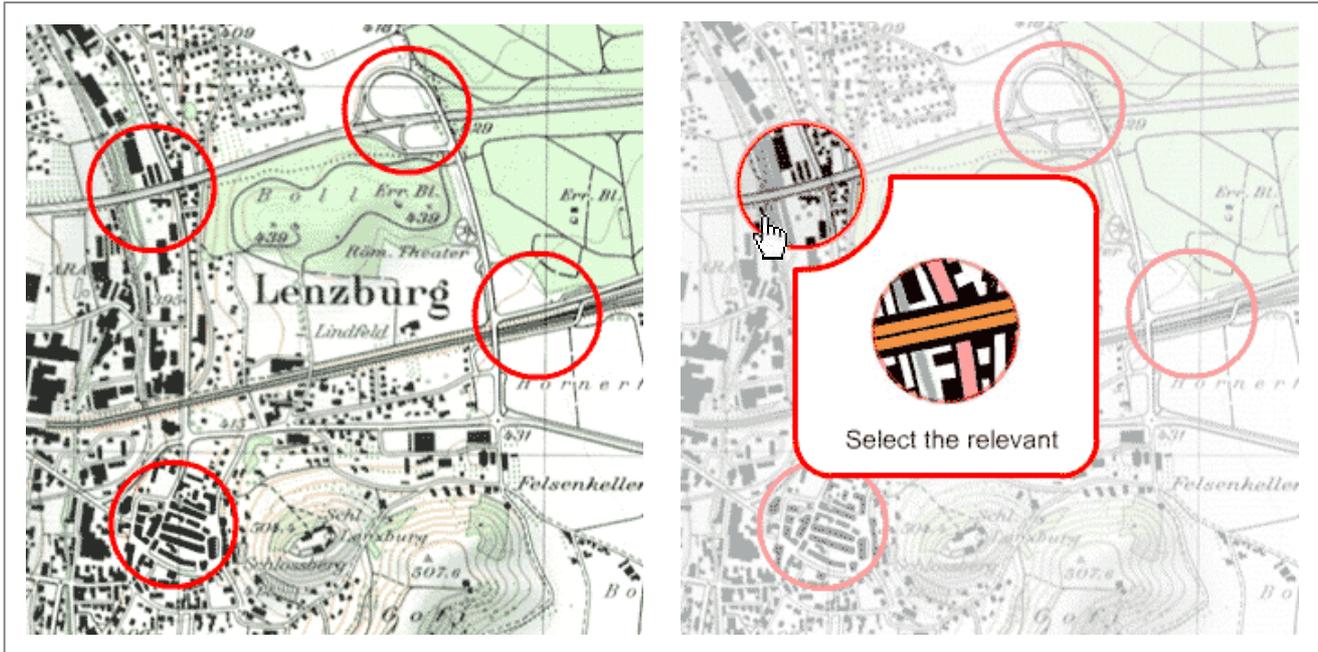


Fig. 6: This excerpt of an animation is taken from the unit 'Generalisation of Map Data'. The map-example with the red circles on the left hand side shows the animation in its initial state. After the mouse has been moved over one of the marked circles, an explanation is indicated beneath.

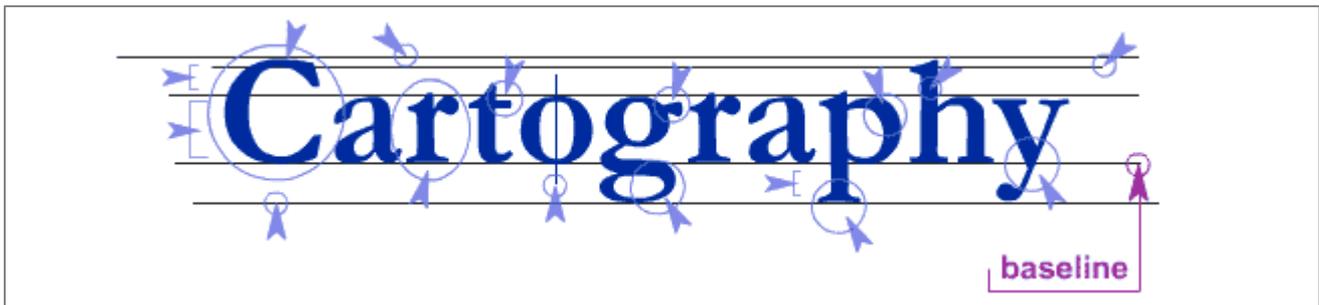


Fig. 7: This example of a mouse-over-animation is taken from the unit 'Typographic Design'. Moving the mouse over one of the hinting blue arrows presents a term of the necessary vocabulary about type, a cartographer should be aware of.

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