

E-LEARNING COURSES FOR GIS AND REMOTE SENSING IN GERMANY STATUS AND PERSPECTIVES

Gerhard Koenig^a, Jochen Schiewe^b

^a Institute for Geodesy and Geoinformation Science, Technical University of Berlin, Germany
gerhard.koenig@tu-berlin.de

^b Institute for Geoinformatics and Remote Sensing, University of Osnabrueck, Germany
jschiewe@igf.uni-osnabrueck.de

Commission VI, WG VI/2

KEY WORDS: Education, Online learning, E-learning, Training, Web based, Multimedia

ABSTRACT:

E-learning can play a vital role in providing suitable and effective learning environments to enhance the knowledge and skills of students. The paper will begin with an analysis of the recent e-learning activities of the German GIS and RS market. The main projects are introduced, benefits and problems are discussed.

In conclusion, one can see that a huge number of valuable e-learning materials has been developed, most of them in joint efforts which have led to fruitful and welcome cooperation among universities. However, also some problems can be identified which may be grouped into the aspects distribution, pedagogy and strategic organisation and will be outlined in this paper.

The question how to minimise problems and maximise e-learning's impact plays a major role. Several recommendations will be discussed which may help authors to provide stimulating and interactive learning environments which will be sustainably used in future.

1. INTRODUCTION

Education is getting into the focus of politics and the German society after the results of so called PISA studies (Programme for International Student Assessment), invoked by the OECD, were published. In these tests the performance of the educational systems of 41 participating states were compared by screening the skills of fifteen year-old school pupils in the areas of mathematics, reading and sciences. The results increased sensitivity that equality of educational opportunity has to be strengthened in all levels of education. Discussions led to the demand for a structural change also in the area of tertiary education. To meet the challenges in a continuously changing world especially in the technical disciplines and to compete in our globalised environment, modern educational flexible and easily updatable tools must be introduced in order to meet the increasing international requirements. Quality and competitiveness of universities will play an even more important role in near future. Also a wider variety of educational offers for lifelong learning have to be implemented to fit the customers' needs.

Moreover, German universities are faced with other great challenges in the near future. Predictions forecast a continuous increase of students, resulting in a rapidly growing demand for college places, training capacity and a broader variety of courses. Faced up to national and international competition and confronted with stagnating budget the university management has to find new ways to supply the demand, even improving quality and quantity of education. Promised benefits of e-learning, such as economic, organisational and pedagogical

advantages, have forced higher education institutes to test and implement some form of e-learning. Large sums of money have been spent by national and local governments, by university administration and by engaged institutes on the many aspects of designing, developing, facilitating and managing e-learning at a higher level. A major breakthrough was achieved in 2001 when the German Ministry for Education and Research (BMBF) and the European Union (EU) encouraged several project teams to develop advanced e-learning material. Their work resulted in a number of highly interactive e-learning modules that involve learners in topics within geoinformation science, remote sensing, cartography and surveying.

2. GIS AND RS E-LEARNING ACTIVITIES

The following section will give an exemplary overview on e-learning activities in the GIS and remote sensing domain, considering the fact that the list is not exhaustive.

2.1 eduGILA2

In July 2003 a network for GI Science Education - Latin-America was established. The partners come from Brasil, Mexico, Chile, Spain, Portugal and Germany (University Muenster). The network is supported by ALFA (América Latina - Formación Académica), a programme of cooperation amongst higher education institutions of the European Union and Latin America.

Main targets of the projects are an increased mobility of students (Masters and PhD levels), an exchange of teachers

(professors and research assistants), a harmonization of curricular contents and an enhanced research cooperation.

Within this network several e-learning courses were established (<http://www.edugi.net/eduGLA2>). In this context the University Muenster successfully organized a summer school course 'Introduction to Digital Cartography' (Figure 1).

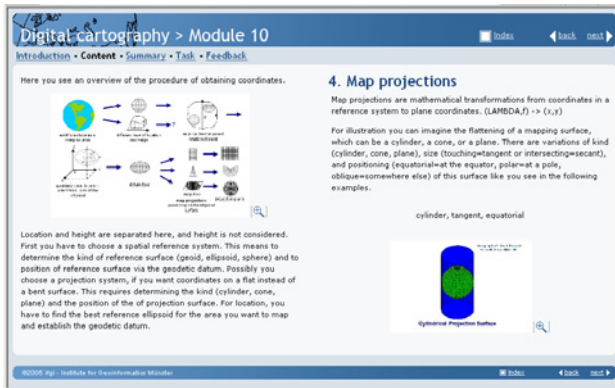


Figure 1: Digital Cartography – University Muenster

Students learn how to create thematic maps by using modern visualization techniques. The course explains how specific user requirements and demands on thematic maps can be fulfilled by a modern interpretation of classical cartographic theories.

Web-design and navigation is based on the development of geoinformation.net, which is described below.

Access to the teaching materials is limited to course participants.

2.2 ELAN - Virtual Landscape

The project 'Virtual Landscape' is part of the joint project "E-Learning-Academic Network" (ELAN), a network of e-learning courses covering different disciplines funded by the state of Lower Saxony, Germany. Access is also limited to course participants.

The idea of this project is to represent the landscape virtually in order to provide an intuitive entry point for studying the landscape, its genesis, the spatial processes occurring on it, but also models for describing and analysing it (Katterfeld 2005). The project consists of three main components: a virtual landscape, learning material related to it, as well as modules in terms of applications or scenarios.

Virtual Landscape follows the action-oriented and blended learning concept. For example, students can study the planning process necessary for routing a railway line. Lectures give detailed information and an introduction into the task. A map exercise is carried out within a hands-on seminar where students solve a complex task by running through the different stages of decision making: from analysing data according to their relevance for a planned project, discussing about alternatives unto forming the decision. The planning process will be exercised within the Virtual Landscape. For this the spatial base (maps etc. - Figure 2) and thematic data (e.g. different soil parameters, water protection areas, areas of biotope protection etc.) are provided. Tools for exploring and

analysing data are supplied in the web-based environment. For visualisation and analysis 2D and 3D-views are provided.

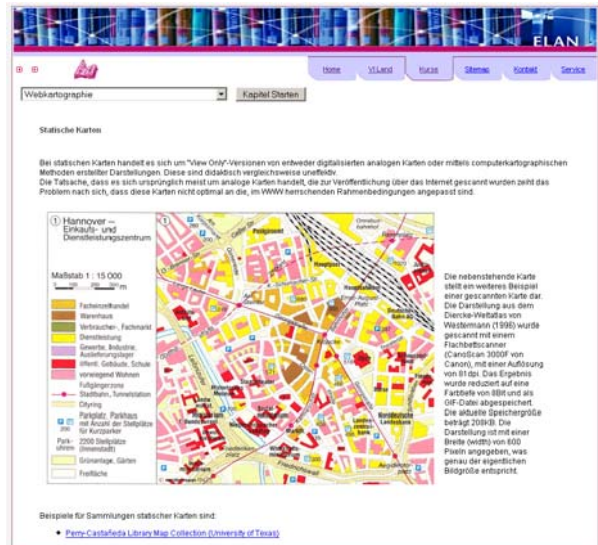


Figure 2: Virtual Landscape – University Hannover

The target group for using the developed e-learning-environment are students in Earth Sciences, such as geodesy, geoinformatics, geography, environmental studies, landscape planning as well as students of applied computer science.

2.3 ELITE@TUB

ELITE@TUB (E-Learning in Tertiary Education at Technical University Berlin) is based on developments initiated by members of the Department of Photogrammetry. It uses web-supplemented information for the lectures as well as additional input for exam preparations. Access to the complete set of materials is free.

Central idea of the tutorial is to offer students learning material dependent on individual pre-knowledge and skills (Koenig 2004). This is achieved by introducing a database concept. For each content and questions page a degree of difficulty is allocated and stored as metadata. On the other side, students' knowledge is measured during the learning phase continuously which allows adjustment of the tutorial to the students individually.

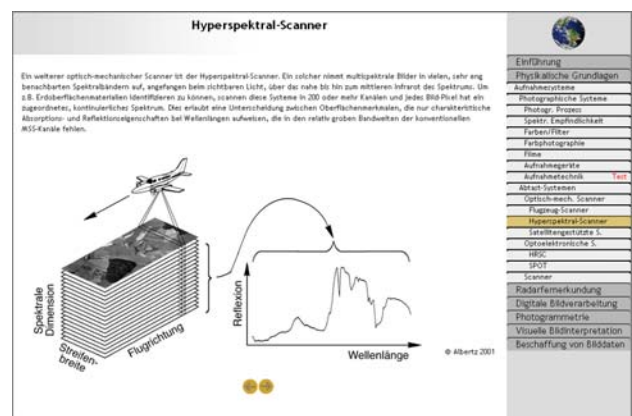


Figure 3: ELITE@TUB – Technical University Berlin

The training course splits into seven different modules, covering photogrammetric and remote sensing relevant topics. So far, the modules are addressed to German students only. With the introduction of the international Master's course 'Geodesy and Geoinformation Science' a redesign of the tutorial is in progress, based on the European Credit Transfer System (ECTS), translating the modules into English, which will allow future students to deal more extensively with remote sensing and GIS topics.

2.4 FerGI

The FerGI (Fernstudienmaterialien Geoinformatik) project started in October 2003. FerGI is a cooperative project of the center of excellence in geoinformatics in Lower Saxony (GiN) and the e-learning network VIA Online. The GiN partners – four institutes from the University Hanover, the University Osnabrueck and the University of Applied Sciences in Oldenburg are developing the contents whereas VIA Online, represented by the University Hildesheim gives didactic support (Krüger 2005). Usage of the materials is free.

The aim of the three years lasting project is to produce and evaluate 20 e-learning modules, mainly concentrating on special geomatics topics. The content is divided into small compact modules (with ECTS points from 0.5 to 3) guaranteeing a better content exchange and a greater acceptance amongst GI lecturers. The contents of the modules will be given in German and / or in English.

The FerGI modules impart knowledge on GIS base data acquisition, spatial data management, data analysis and presentation. Beyond more theoretical modules, building a solid basic education, also application-oriented modules are implemented, deepening learners' practical experience. The module "Laser Scanning Systems" (Figure 4) was introduced successfully in the CATCON competition during the ISPRS symposium in Istanbul.

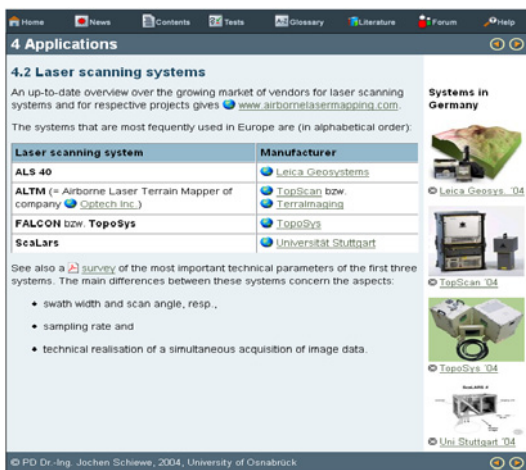


Figure 4: FerGI-online – University Osnabrueck

2.5 geoinformation.net

One of the most successful developments was sponsored by BMBF: *geoinformation.net*. *geoinformation.net* was developed in a consortium of nine university institutes from the areas of

geodesy, geography, computer science, spatial planning and pedagogy. It comprises 14 coordinated, but self-contained learning modules. Modules are designed to enhance face-to-face teaching, but can also be used by students for preparation and follow-up work (Dörschlag 2005). Access to the materials is free.

For each learning module two versions are available: one version is optimised for supporting lecturers in classes, the other version is for Internet use. This version complements and enhances content of course transparencies with additional text, points out correlations and interconnections and provides tests and exercises.

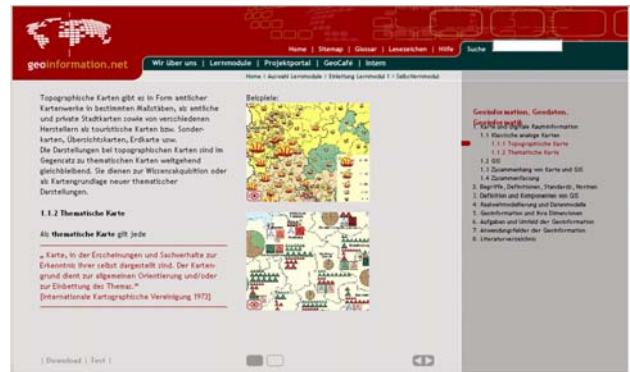


Figure 5: geoinformation.net – University Bonn

Designed for re-use, all transparencies are stored in a 'transparencies pool' as HTML-files. With the help of a so called 'Lecture Builder' lecturers have access to the pool and can adapt and group transparencies for their individual courses. Adding own transparencies is also supported.

In terms of didactics problem-based motivation and active forms of learning are mainly focused on. In addition, the 'GeoCafé' provides a geo-algorithm-IDE based on a geo-relevant, Java-like programming language. Algorithms and data structures can be visualised online (GeoJava). Works on GeoCafé are still in progress. Last but not least, the communication component 'GeoChat' facilitates learning in groups.

2.6 gimolus

During the BMBF-funded project phase, the gimolus group (partner: Universities Stuttgart, Wuerzburg, Duisburg and Oldenburg) developed learning modules for different disciplines in environmental science (Müller 2004). Usage is limited to members of the participating universities.

The gimolus learning portal is based on a combination of XML-data modules, XSL-transformations, WebGIS- and database usage as well as serverside interpreted PHP- and Java-elements. The 'virtual landscape' is the central concept for combining learning modules, based on real geodata covering the south-west region of Germany.

Dataset-geometries and attribute data are stored in a MS-SQLServer database, managed via ESRI's ArcSDE. This geodatabase holds different dataset levels, matching the needs of the different thematic topics of the gimolus participants. The data is used in exercises as basis for interactive model-calculations and visualisations via ESRI's Arc Internet

Mapserver (ArcIMS). Tasks range from simple exercises that can be easily worked on in 20 minutes up to complex problems demanding one or two hours of concentrated work depending on the individual approach. Modules feature different technologies and software from Flash and Excel, web-based geoinformation systems, to models based on Java, JavaScript, Visual Basic, Pascal or PHP (often directly linked up to geoinformation systems). The following subjects are dealt with:

- model evaluation
- hydrological modelling techniques
- models of population dynamics
- habitat modelling with logistic regression
- erosion modelling
- strategies of collecting samples
- evaluation models in landscape planning
- Finite-Difference methods
- network analyses
- geodetic methods of measurement
- basics of working with geoinformation systems

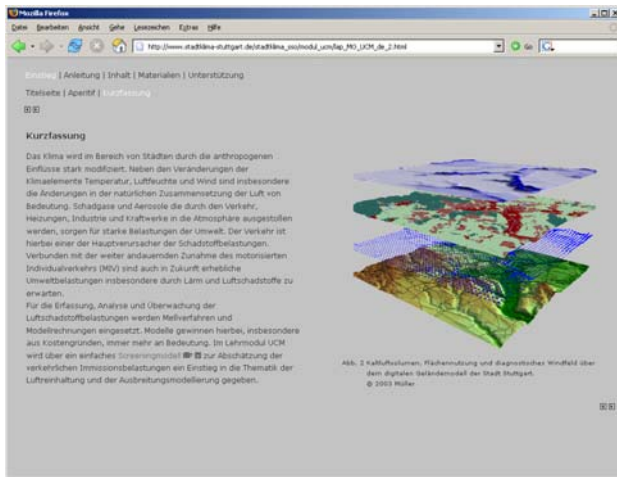


Figure 6: gimolus – University Stuttgart

Communication between students and lecturer via e-mail or module specific discussion-boards is also part of the system.

2.7 WEBGEO

WEBGEO combines multimedia-based, web-based teaching and learning modules. These modules impart basic knowledge of topics in physical geography, such as climatology,

geomorphology, pedology, vegetation and animal geography, and hydrology. Students who are interested in these topics have free access.

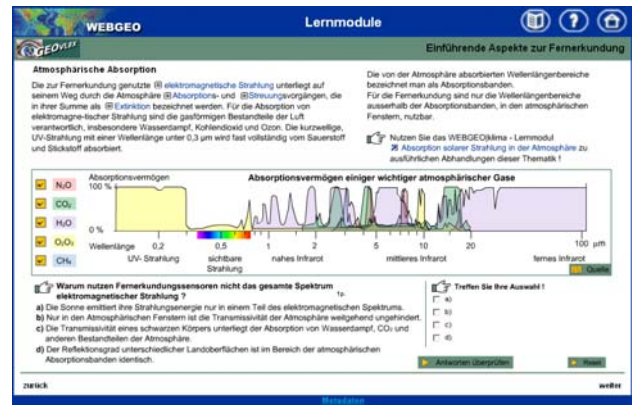


Figure 7: WEBGEO – University Halle

Modules allow for visualisation of typical geo-processes, preparations and interactive orientation in terms of virtual excursions and for model calculations of typical geographical processes depending on interactive user-defined parameters.

Learning modules in WEBGEO are created in line with the concept of networked, systemic learning. This allows acquisition of physical-geographical knowledge by employing knowledge strategies that aim at understanding and solving problems. This approach will lead away from acquiring isolated special knowledge towards developing ecological thinking and understanding instead. Special subject modules, methodical modules, tasks and characteristics of the information network are designed and linked to each other, guiding learners to solve a problem successfully.

Teaching and learning materials are presented in the form of networked basic learning modules, so called 'basic learning objects'. Modules can be easily maintained and updated as well as reused and adapted to different target groups and teaching contexts. Based on the smallest possible learning units, WEBGEO develops combined concepts of modularisation that are appropriate to present large and even cross-subject contents in a way conducive to learning.

Table 1 gives a recapitulating overview of e-learning modules features just now presented.

Synonym	Internet Address	Topics	Lang	Techniques	Partner
eduGLA2	www.edugi.net/eduGLA2	digital cartography	e	XML, PDF, PowerPoint	Münster
ELAN	portal.l3s.uni-hannover.de	web cartography	g	HTML, PHP	Hannover, Braunschweig
ELITE@TUB	www.igg.tu-berlin.de/elite	remote sensing, photogrammetry, (GIS)	g / (e)	HTML, PHP, Flash, Servlets	Berlin
FerGI	www.fergi-online.de	GIS, remote sensing, photogrammetry, cartography	g / e	HTML, Flash, PDF	Osnabrück, Hannover, Oldenburg, Hildesheim
geoinformation.net	www.geoinformation.net	GIS, cartography, remote sensing	g	XML, PDF, PowerPoint	Bonn, Karlsruhe, TU-München, LMU-München, Uni BW München, Münster, Potsdam
gimolus	www.gimolus.de	GIS, hydrology	g / e	XML, PDF, Flash, ArcIMS	Stuttgart, Würzburg, Duisburg, Oldenburg
WEBGEO	www.webgeo.de	physical geography, remote sensing	g	XML, HTML, Flash	Freiburg, Halle; Frankfurt/M, Trier, Heidelberg

Table 1: e-learning modules – overview, 9.4.2006 (g: German, e: English)

3. CHALLENGES

It can be concluded that a huge number of valuable e-Learning material has been developed, most of them in joint efforts which have led to fruitful and welcome cooperation among universities. However, also some problems can be identified which hinder the acceptance of the e-learning idea. These problems can be grouped into the aspects distribution, pedagogy and strategic organisation.

3.1 Distribution problems

Although e-learning is offered by most institutes, acceptance is still moderate. This may have several reasons and depends on the individual situation at the universities. But in general, e-learning is too often scattered within and across institutions and has limited visibility. Another reason is the content itself. In the eyes of lecturers courses seem only partly usable, because the own curriculum follows a broader or shorter, a more or less mathematical or application oriented approach. As a result the modules don't fit the individual needs. Of course problems with digital rights often hinder adoption, and also there may be discontent with the practical implementation as e-learning modules suffer from interoperability problems which prevent from using third party material.

3.2 Pedagogical aspects

Although in most projects pedagogues are involved in the process of course development and project evaluation, a general scepticism about the e-learning approach and the pedagogic value can be noticed. Indeed, there is no value added, if courses follow the tendency to imitate existing ways of learning rather than transforming and using content differently, applying accepted pedagogical approaches such as collaboration or constructivism. Up to now, e-learning mostly supplements rather than replaces classroom-based teaching. Face-to-face classroom teaching still remains central, and even the blended learning approach is insufficiently adopted.

On the other hand, collaboration techniques are not attractive to students in small institutes. Direct access to lectures is preferred over forums or chat rooms. These techniques are only suitable for distance learning or in the post education market supporting life long learning.

3.3 Strategic organisational challenges

Project support often caused overlapping development of proprietary management systems to fit assumed needs. Meanwhile, commercial learning management systems (LMS), which are found too dear or open source LMS (future, maintenance too insecure) are rarely used. Also, the fear to be dependant on a LMS which complicates a platform change and causes dispensable work is a major argument. But to the authors' opinion e-learning benefits from LMS because they handle administrative functions, provide tracking and reporting, offer assessments and report test scores, and measure learner competencies. Moreover LMS give e-learning modules an unique, area-wide visibility and corporate design.

The most severe constraint is that continuous operation and maintenance are still a major problem. The survival of projects depends on staffing after financial support by project initiators stopped. Today, most universities can not ensure the essential sustainability.

4. RECOMMENDATIONS

Several recommendations will be given in this section, which refer to various organisational levels. Starting from bottom-up, authors of future materials and systems should consider the following:

- Learning technologies are supposed to be designed to work within established open standards. Large pieces of content should split into smaller modules (learning objects) to facilitate and increase material re-use and sharing.
- New didactical and learner oriented approaches have to be applied. It is advisable to create constructivist learning spaces that include interactive and personalised student oriented features. To be successful with e-learning, experimental learning, project learning, action-oriented learning and experience based learning approaches should be considered during course development.
- As for the management of copyright of digital content (DRM), there is a need to develop a system which is simple enough for content creators to understand and use. At the same time, it must of course provide proper legal protection of digital content rights and be technically well designed and robust (European Commission 2005).

But even more important several actions on the respective university level have to be made:

- E-learning is successful only if a binding strategic concept for the whole university exists. University administration must propagate, support and bundle individual activities.
- In consequence, universities have to build centres for multimedia in education and research. They must be responsible for setting up and maintaining the e-learning infrastructure, consisting of servers, development environments, authoring tools, content management systems (CMS) and LMS.
- Well trained media competence is a must! Media-centres have to distribute their knowledge offering training courses to interested university employees, giving support in creating animations and producing complex visualisations but also giving pedagogical advice. Of course, computer scientists, software engineers, graphic artists, designers, and pedagogues have to be on the team to meet the demands.

Finally, a set of actions on an across-university level are recommended:

- Coordination of initiatives and projects bringing together people with different background will reinforce e-learning activities. Partnerships are a key characteristic of e-learning that could help institutes to share knowledge and good practice and will help to avoid duplication of work.
- E-learning modules have to be peer-reviewed or comply with a quality assurance process, which will provide confidence and strengthen the acceptance. For further education and training a certification should be aspired.
- A good marketing strategy will help to make e-learning visible and known.

5. CONCLUSIONS AND OUTLOOK

In Germany new chances for e-learning activities are caused by the changeover from the single-track Diploma courses to the Bachelor/Master system. It is the hope that this transition forces some of the mentioned actions on university level. Since it seems to be unrealistic that single universities will be able to guarantee sustainable maintenance of e-learning courses and updates of course contents, across-university cooperation is essential. One possibility to achieve a broader cooperation is tested in Switzerland: the Swiss GIS e-learning project GITTA (Fisler 2005) has released their basic level lessons and case studies as open content under the Creative Commons license. Free use, copy, distribution, translation of the lessons is accepted as long as it is not for commercial use. As a community project GITTA coordinators are looking for partners who are willing to contribute to project activities.

In Germany, cooperation of the main course developers will be realised in a project proposal *geo-kiosk* which is currently submitted to the Federal Ministry of Education and Research (Schiewe 2005). Within this project, e-learning materials and services in the field of geoinformatics, remote sensing and geography will be integrated, additional services such as translations or migration to LMS will be offered, which hopefully will lead to the use of e-learning as a flexible and standard teaching format in the near future.

6. REFERENCES

- Bähr, H.-P., 2005: eLearning – The Possible and Impossible. In: Fritsch, D. (Ed.): *Photogrammetric Week 05*, Wichmann, Heidelberg, pp. 311-319.
- Dörschlag, D., Drerup, J., Plümer, L., 2005: Customizing Lectures and Extending the Content Pool by Using GEOINFORMATION.NET. In: *Proceedings of ISPRS VI/1 & VI/2 Workshop on 'Tools and Techniques for E-Learning'*, Potsdam. Volume XXXVI-6/W30, pp. 114-117.
- European Commission, 2005: eLearning – Designing Tomorrow's Education. Report on the consultation workshop 'Access Rights for e-Learning Content'. Web-Document. http://europa.eu.int/comm/education/programmes/elearning/doc/workshops/elearning%20content/workshop_report_en.pdf, 18 pages, (9.4.2006).
- Fisler, J., Bleisch, S., Niederhuber, M., 2005: Development of Sustainable E-Learning Content with the Open Source eLESSON Markup Language eLML. In: *Proceedings of ISPRS VI/1 & VI/2 Workshop on 'Tools and Techniques for E-Learning'*, Potsdam. Volume XXXVI-6/W30, pp. 49-54.
- Katterfeld, C., Sester, M., 2005: Virtual Landscapes: An Interactive E-Learning-Environment based on XML encoded Geodata. In: *Proceedings of the 22th International Cartographic Conference (ICC)*, A Coruña / Spain, 10 pages.
- Koenig, G., Weser T., 2004: A Servlet Based Training Course for Remote Sensing. In: *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Istanbul, Turkey, Vol. XXXV, Part B6, pp. 139-144.
- Krüger, A., Brinkhoff, T., 2005: Development of E-Learning Modules in Spatial Data Management. In: *Proceedings of ISPRS VI/1 & VI/2 Workshop on 'Tools and Techniques for E-Learning'*, Potsdam. Volume XXXVI-6/W30, pp. 18-22.
- Müller, M., 2004: gimolus – GIS- und modellgestützte Lernmodule für umweltwissenschaftliche Studiengänge. In: Plümer, L., Asche, H. (Hrsg.): *Geoinformation – Neue Medien für eine neue Disziplin*. Wichmann, Heidelberg, S. 155-166.
- Schiewe, J., 2005: Quo vadis Education in Photogrammetry ? The Contribution of E-Learning. In: Fritsch, D. (Ed.): *Photogrammetric Week 05*, Wichmann, Heidelberg, pp. 295-302.
- D. Thürkow, Gläßer, C., Kratsch, S., 2005: Virtual Landscapes and Excursions - Innovative Tools as a Means of Training in Geograpy. In: *Proceedings of ISPRS VI/1 & VI/2 Workshop on 'Tools and Techniques for E-Learning'*, Potsdam. Volume XXXVI-6/W30, pp. 61-64.