

## TOWARDS A SUSTAINABLE E-LEARNING SOLUTION FOR GI-EDUCATION

Antje KRUEGER <sup>a</sup>, Thomas BRINKHOFF <sup>a</sup>, Beata GRENDUS <sup>b</sup>

<sup>a</sup> Institute for Applied Photogrammetry and Geoinformation (IAPG), FH Oldenburg/Ostfriesland/Wilhelmshaven (University of Applied Sciences), Ofener Str. 16/19, D-26121 Oldenburg, GERMANY – antje.krueger@fh-oldenburg, thomas.brinkhoff@fh-oldenburg.de

<sup>b</sup> Institute for Geoinformatics and Remote Sensing (IGF), University Osnabrueck, Kolpingstr. 7, 49074 Osnabrueck, GERMANY – bgrendus@fzg.uni-osnabrueck.de

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### ABSTRACT:

Computer aided learning, also known as eLearning, plays a decisive role for technology-orientated subjects with a high innovation rate and it is an indispensable aid to support the process of lifelong learning. Within the past years, many universities discovered the advantages of eLearning such as offering flexibility in learning, keeping the content up-to-date easily and having the possibility to integrate multimedia methods to visualize learning content. A large number of eLearning projects at universities have come into being, which often are financially supported by governments. However past has shown that funded projects often have difficulties to be effective and independent after the time of funding. This paper tries to give some ideas about finding sustainable solutions for forthcoming or still existing eLearning projects considering as example the FerGI-project in Germany (FerGI = Fernstudienmaterialien Geoinformatik, engl.: distance learning material for geoinformatics). Conceptional and didactical issues as well as technical aspects provide the basis for this approach. Furthermore, we will introduce the project briefly, present first evaluation results and future strategies.

### 1. INTRODUCTION

Knowledge nowadays continuously increases and underlies significant changes. Some disciplines – especially the ones closely connected to technology like GI Sciences – are extremely “short-living”. Some years ago, eLearning was expected to take the challenge of this development and to modernise learning and teaching methods. Today we must revise this judgement: Often eLearning can be seen merely as a very useful support for conventional learning processes, but not as substitute. Nevertheless, this trend brought up various promising eLearning projects. Many of them had been or still are developed at universities or other educational institutes as confirmed in an online survey about existing eLearning initiatives in Germany (see chapter 4). After an enthusiastic start and a successful finish of those funded projects, the question for sustainability is often answered either too late or not sufficiently enough. In consequence, after the time of funding the produced contents can not be maintained or further developed. That again means the content will be not up-to-date after a fairly short time. FerGI, the latest eLearning-project for GI-Sciences in Germany, tries to avoid that development by having a solid conceptional fundament and by detecting future strategies to establish a sustainable solution.

### 2. THE FERGI-PROJECT

FerGI started in October 2003 and will finish by the end of 2006. During those 3 years, 22 small and compact eLearning modules will be produced, which do not reflect the whole GI-curriculum, but concentrate on special GI-topics with high topicality. The contents of the modules will be given in German and / or English.

FerGI is a cooperative project of the Center of Excellence in Geoinformatics in Lower Saxony (GiN) and the eLearning network VIA Online. The GiN partners – five institutes from the University of Hanover, the University of Osnabrueck and the University of Applied Sciences in Oldenburg will develop the contents whereas VIA Online, represented by the University of Hildesheim gives didactic support. More information about FerGI can be found at <http://www.fergi-online.de>.

Each module belongs to one of these 5 topics:






-  Spatial data capturing,
-  Spatial data management,
-  Spatial analysis,
-  Spatial data presentation,
-  GI-applications

Figure 1 depicts all FerGI-modules (light coloured modules have been not completed yet).



Figure 1. Modules in FerGI.

### 3. CONCEPTIONAL ISSUES

#### 3.1 Project aims and target group

Intensively dealing with conceptual and didactical issues definitely has a huge impact on the success of eLearning. Key factors within this aspect are to define the project aims and to carefully analyse the target group. In the end, both must be adjusted to each other. At first glance, this work seems to be trivial, but questions about needs, precognition and requirements of the target group are often not answered very easily. It is a complex venture, which demands professional action considering experiences from past projects and learn from their mistakes. The conception of a computer aided learning environment in general needs much more rigid planning than the conception of face-to-face learning, since the flexibility and spontaneity of the teaching person should be reflected in the computer based learning system.

Analysing the target group means to know learners motivation, their pre-knowledge and learning habits. Certainly this can not be done for each individual, but for groups of people. There are two different kinds of motivation to deal with the learning content. On the one hand students like to learn because they are interested in the subject. In this case the module should contain substantial information, allow flexibility in the learning path and vary in the presentation of content to keep curiosity. On the other hand the motivation can be target orientated, e.g. the expected acquisition of a certificate. This requires incentives in the beginning of the module such as explain learning targets, present the material in the same scheme and divide it into small units. Tests as feedback for the learning progress are absolutely essential in this context. Judging the motivation of learners incorrectly would certainly discourage students (Kerres, 1998).

Since the target group in the FerGI-project is comparatively inhomogeneous, the second scenario was chosen. So it was possible to offer FerGI-modules to students of geoinformatics, geodesy, geography and environmental sciences as well as to participants of further education programs. Using the modules for further education, each course starts with an introductory event, where participants get to know each other and finishes with a summary in a final event. In between there are self-study parts, occasional events for asking questions and workshops.

FerGI's main project target is to produce small units within each module, in order to guarantee exchangeability with other educational institutions and reusability in general. Modules can

be easily altered, restructured and maintained, which has a very positive effect on economic efficiency and sustainability.

#### 3.2 Content in general and layout

The careful choice of teaching material is of central importance and greatly influences the quality of the material. Since the modules are accessed via internet, the material should be less storage consuming to avoid waiting times and interruptions in the learning flow.

Another factor often underestimated is the degree of acceptance of the interface, also known as "look and feel". Common symbols and colours should be used in order to keep the clarity and enable the user to work intuitively with the interface without spending too much time on getting used to it. Figure 2 depicts an example.

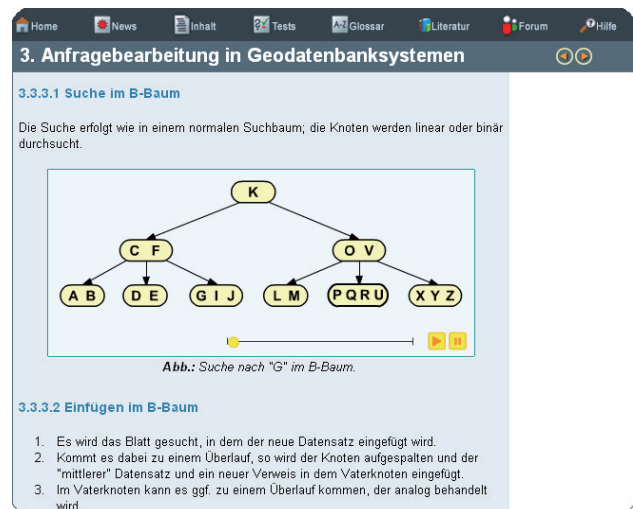


Figure 2. Layout of a FerGI-module.

#### 3.3 Interaction and Communication

eLearning development showed that blended learning, as a combination of long-distance learning and face-to-face learning, is more effective than pure eLearning. The larger the self-study component, the more interactive parts must be involved. Interactivity is in general the most important aspect, and even more in online learning environments compared to conventional lectures and books. FerGI also integrated animations for explaining contents that are difficult to learn. By using them, the time of learning can be shortened and the comprehension can be increased. Since it is fairly time consuming and costly to produce animations, it is advisable to analyse deeply the effectiveness of using animations. Sometimes a single picture can express the same content as good as an animation, but producing it is much faster and therefore cheaper.

Interaction can also be reached by using special tools and applets that are strongly integrated into the learning issue. The more general such a tool, the more often it can be applied within different courses. Figure 3 shows an example of a Java applet for demonstrating different models of topological relationships.

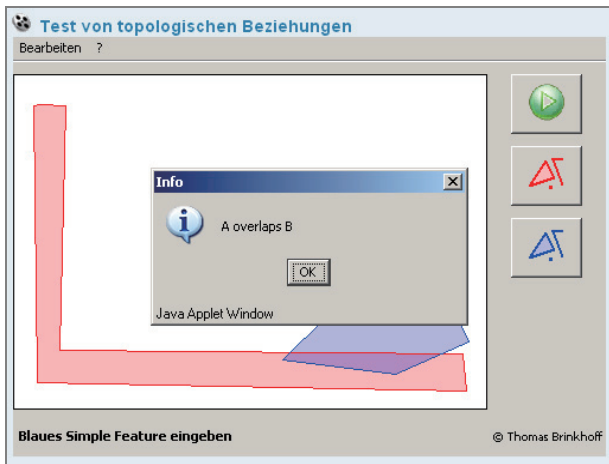


Figure 3. A Java applet for testing topological relations between geometries as an example for interaction.

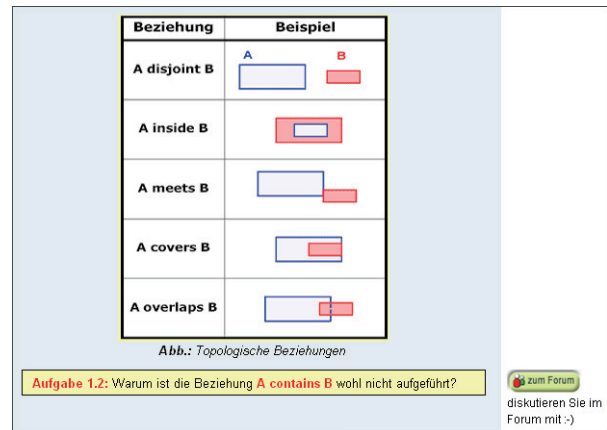


Figure 5. Example for interposed questions with the request of using the forum to discuss.

### 3.4 Tests and exercises

Life-long learning demands a high frequency change between gaining new expertise, using it, and solving problems (Strobl, 2004). Therefore, learning material should be particularly coupled with practical exercises. This step motivates learners over a longer period of time and consolidates gained knowledge. Besides students are able to judge their progress and define areas of their knowledge which requires more work.

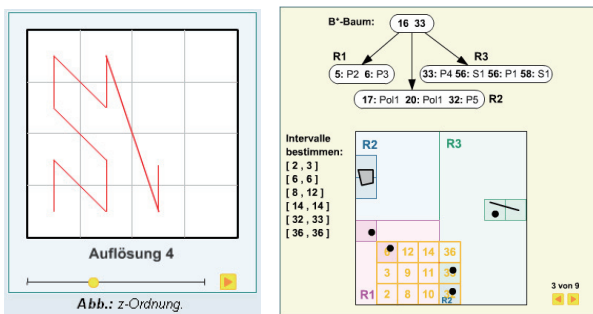


Figure 4. Examples for animations.

Learning in general is a social process, which requires communication between lecturer and student as well as between student and student to give feedback in learning progress. Therefore, suitable communication models must be developed in computer aided learning environments to stop isolated learning and to simulate the social dynamics of learning groups, including conventional face-to-face learning situations with their short feedback times. This is essential for the success of eLearning, but demands a high consumption of time resources (Strobl, 2004). In order to achieve that goal, FerGI offers forums where learners and teachers can exchange opinions, ask questions and give feedback to each other. Furthermore, interposed questions (see figure 5) within the learning material can be discussed in those forums.

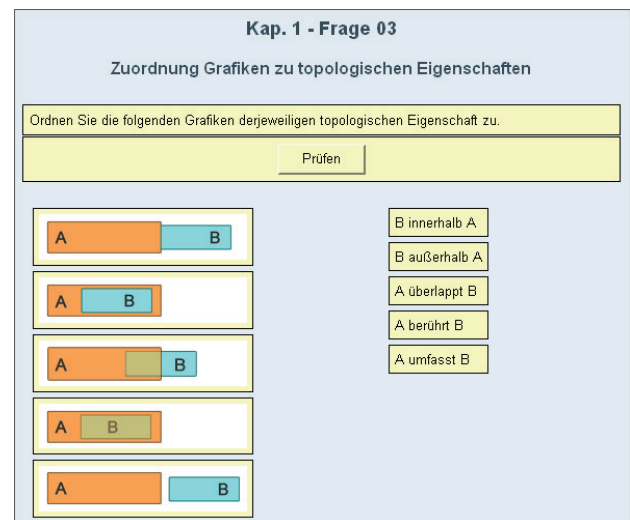


Figure 6. Hot Potatoes™ questions (part of the module “Geodatabase Systems”).

FerGI uses the Hot Potatoes™ for performing tests (see <http://hotpot.uvic.ca>). This software offers various different question types for automatic corrected tests. Hot Potatoes is free for non-profit use, provided that the Hot Potatoe questions are freely accessible to everybody in the internet. The produced questions are compatible with FerGI’s favoured Open Source learning system Moodle (see <http://moodle.org>).

FerGI also uses certain tools for exercises such as the Spatial Database Viewer shown in figure 7. This tool (Brinkhoff, 2005) is a web-based interface for visualization of spatial tables, complex attributes and metadata using Oracle Spatial or PostGIS on the top of PostgreSQL. The tool is intensively used

by the FerGI-modules “Spatial Database Systems” and “Object-relational Database Systems”.

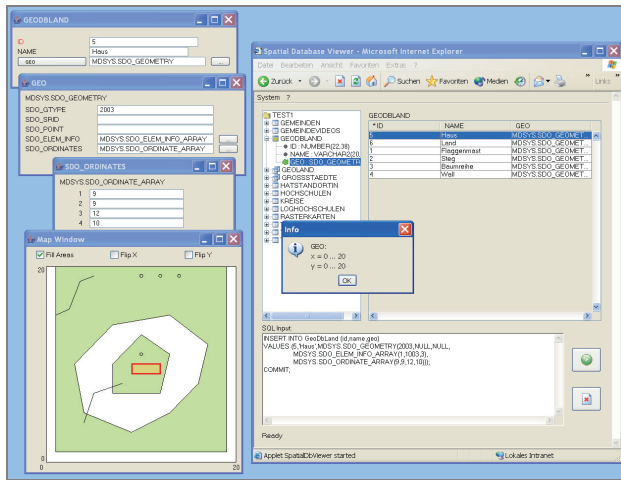


Figure 7. Spatial Database Viewer.

#### 4. TECHNICAL ISSUES

Many projects in the past focused highly on the technical development of the learning environment and neglected didactical aspects. Others decided to take an already existing learning system, but finding the appropriate one to fulfil the didactical aims is often highly time-consuming. Standard techniques, which are reliable in functionality and usability, should be used, so that didactical aspects can be concentrated on and technical aspects take a back seat (Kerres, 1998).

FerGI-modules run as a stand-alone HTML Version, but it can be easily integrated into learning management systems as well – STUD.IP/Illias and Moodle had been successfully tested so far.

Another fundamental aspect concerning sustainability is to build up courses in a way that content modification can be executed rapidly and not necessarily by the person who developed the content. In this context XML-based techniques and standards in general are often mentioned. Indeed, complex XML schemas can be used perfectly for structuring and transforming content but complicate the content development. Therefore FerGI has chosen HTML in connection with Cascading Style Sheets (CSS). The advantage of HTML is that editing the content is less time consuming and requires less skills. Furthermore, our experiences have shown that such an approach allows an easy transfer to mobile devices like PDAs (see figure 8). Especially for modules about mobile data capturing this possibility is very reasonable. Such integration of eLearning content also means to adapt to customers' needs and to be competitive.

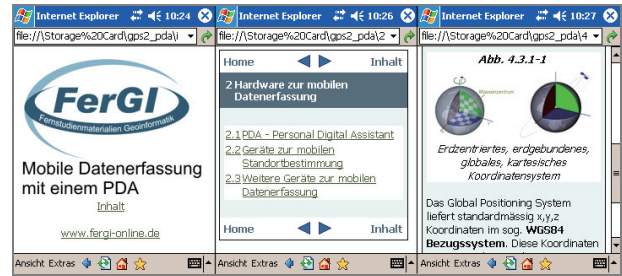


Figure 8. Version for mobile devices like PDA.

#### 5. USERS AND EVALUATION

Since June 2005 all completed FerGI-modules are available free of charge. Only an online-registration is required. This resource has been used by 308 persons so far, from which 25% of them are directly or indirectly connected to the institutes and universities participating in the FerGI-project. Those are for example, students, lecturers or other staff members. Another 25% corresponds to users from schools or other universities, and 50%, the largest part, corresponds to users from business and administration areas outside universities or schools. Those numbers were not expected and considering the fact that the project is not yet finished, they also might express the particular need for such offers. Another important aspect is to have a good marketing concept to transfer the information about the project to potential users. An online survey carried out by FerGI in cooperation with the Bernhard Harzer Verlag, a publishing house specialized on GI-topics in Germany, showed that many simple or complex eLearning offers in the GIS field already exist (see <http://www.gin-online.de/elearning>), but their marketing is not well developed. Although the high number of projects indicates that eLearning is experiencing an important development, the heterogeneity of these projects and their users may negatively influence its clarity. A central access point to the projects is missing. Thus, the market potential is not exploited, yet. FerGIs follow-up project “geo-kiosk” will try to raise transparency and bundle the GI eLearning projects in Germany. More information about “geo-kiosk” can be found in the passage about “future strategies”.

All users of FerGI-modules are requested to evaluate the modules using an online questionnaire. Evaluation is an essential instrument for quality assurance, which has an impact on the acceptance, too. Since it is advisable to activate several channels of evaluation, FerGI also uses expert opinions from other lecturers of the partner universities as well as of other institutions. The tendency of those evaluations especially amongst students is relatively clear. The wish for blended learning and not pure eLearning is very often mentioned as well as the claim for more interactive elements, examples, tests and interposed questions. More support services are also often demanded, e.g., if the content is not clear enough or if users need help with solving certain problems within exercises.

#### 6. FUTURE STRATEGIES

In the already mentioned online survey about existing eLearning initiatives, we found that 75% of all listed projects had been developed at universities with the aid of public funding. As reported in the beginning, the lack of sustainability did not allow maintenance and further development of the learning material after the time of funding. Possible problems might be the excessive effort on searching for a suitable learning management system, and the technical challenge

concerning the implementation of contents. Besides, there is a deficit of experience and expertise to formulate a successful business model in connection with marketing strategies and related legal issues. Another possible problem is that up to now universities cannot act as self-regulated business companies.

Having mentioned learning management systems the licence costs should be considered, unless an Open Source system has been chosen. FerGI's experiences with learning systems show that Moodle, as such an Open Source system, is a very powerful tool to build effective learning environments. The latest evaluation study on behalf of the Austrian Federal Ministry for education, research and culture (Kristöfl, 2005) gives some interesting details about the functionality of Moodle in comparison with other learning systems.

FerGI took steps towards a sustainable solution by integrating FerGI-modules into existing successful programs like the GIS-CombiCourse (<http://www.igf.uni-osnabrueck.de/kurse>) at the University of Osnabrueck to create a GIS-CombiPlusCourse. The usual GIS-CombiCourse contains one week of conventional face-to-face-lectures and eight weeks of practical exercises with online-support. The GIS-CombiPlusCourse is basically the GIS-CombiCourse with an extra FerGI-module for the students to work with. This extra enables the learner to receive a certificate at the end of the course.

Another approach is to use FerGI-modules for GEOWIN (<http://www.igf.uni-osnabrueck.de/geowin>) the GIS further education program for small and medium-sized enterprises (SMEs) in Lower Saxony. The target of GEOWIN is to offer SMEs a cost-effective and tailor-made possibility of further education in GIS within 18 weeks of blended learning with FerGI-modules. Again, there will be a certificate in the end of a successfully completed GEOWIN-course. GEOWIN is also a funded project.

A similar approach is taken by the project "Further Education in Geoinformatics" at the University of Applied Sciences in Oldenburg ([http://www.fh-oow.de/institute/iapg/projekte/geoinf\\_weiterbildung](http://www.fh-oow.de/institute/iapg/projekte/geoinf_weiterbildung)). This EU-funded project offers (among others) an eLearning course about object-relational and spatial database systems that is based on FerGI-modules and finishes the eLearning phase with a one-day workshop for all participants in Oldenburg.

Last but not least, there could be the follow-up project, the geokiosk (<http://www.geo-kiosk.com>), which is intended to bundle the largest eLearning-projects for geoinformatics and geography in Germany: FerGI (University of Osnabrueck), geoinformation.net (University of Bonn), gimolus (University of Stuttgart) and Webgeo (University of Freiburg) to build an effective marketing concept and a service portal for technical, organizing, didactical and economical services for high-quality eLearning-material. Although geo-kiosk has not been yet approved, it is scheduled to start approximately in July 2006.

## 7. CONCLUSIONS

In this paper, we presented ideas concerning the conceptional, didactical and methodical design as well as the technical issues for developing eLearning-modules, with emphasis on the example of FerGI. Some evaluation results of completed FerGI modules and an overview of existing users had been given. We also identified some problems that often occur after the time of

funding and tried to find ways towards a sustainable solution for eLearning projects.

## 8. ACKNOWLEDGEMENTS

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