

Tools and Learning Management Functions for a Competence-Oriented Integration of Remote Sensing in Classrooms

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Abstract

The project FIS – Fernerkundung in Schulen (German for ‘Remote Sensing in Schools’) – aims at a better integration of remote sensing in school lessons. In addition to the contribution to natural science education and working on present questions, the use of satellite images in class offers further advantages, e.g. demonstrating ways for problem-oriented working, the improvement of spatial orientation competence, methodological competence, as well as analysis and practice skills. Respectively, the overall objective is to teach pupils from primary school up to high-school graduation basics and applications of remote sensing. For this reason, a comprehensive and well-structured learning portal was established. Here, we present the functions of the FIS learning portal, describe its learning management functionalities and show how E-learning can encourage pupils to work with satellite imagery in the context of natural science education.

1 The Portal’s Content

With the FIS learning portal, information about the use of remote sensing in classrooms as well as the correspondent learning material is disseminated in a structured manner. The material is complemented by specific curriculum-related suggestions to reduce the amount of time teachers have to invest into preparing the lesson. The learning portal’s underlying didactic principle is based on moderate constructivist approaches (NUNES & MCPHERSON 2003). Therefore, the learning portal focuses on the interactive analysis of remote sensing data for solving real-world issues or curriculum-specific tasks. An effective connection of theory and practice is achieved through individual working, creativity, and critical reflection.

The core of the learning portal consists of digital and interactive learning modules that cover remote sensing topics while following the curriculum for specific school grades (cf. Fig. 1). In order to deal with different aspects of remote sensing, learning modules for the subjects geography, biology, physics, maths and informatics have been developed. The learning modules’ design enables users to apply remote sensing methods by using interactive tools. The complexity of the analyses is reduced to several core functions and, thus, the

pupil's cognitive load is much lower compared to the use of conventional remote sensing software. The general concept of the FIS learning modules is described in VOSS et al. (2011).

The learning modules are available for download, including a didactic commentary and background information. Additionally, all interactive learning modules can be executed online. Accordingly, the provided learning material includes multi-media applications and allows a high degree of interaction. Moreover, specific tools for research, analysis and exchange are integrated, thus independent working and discovery-based learning is encouraged in terms of a practice-oriented approach. By imparting knowledge about remote sensing with interactive learning modules combined with research tools for individual learning, the FIS learning portal addresses aspects that are not covered by knowledge portals like DLR_next (<http://www.dlr.de/next/>), ESA kids (<http://www.esa.int/esaKIDSde/>), or SEOS (<http://www.seos-project.eu/home.html>), which focus on the provision of information through didactically prepared texts and images.



Fig. 1: Learning module and user interaction by typing in answers to a question

In the section “What is remote sensing?” users find a brief introduction to remote sensing that describe the principles of remote sensing, the data that can be explored and example applications of remote sensing. To improve individual, discovery-based learning, the pupils find extensive background information on remote sensing in the ‘research tools’ section. Here, a digital glossary (‘Info-Box’), an image gallery, and links to external information provide comprehensive background information for pupils as well as teachers. The Info-Box is a digital encyclopaedia for terms and basics of remote sensing. Additionally, pupils and teachers can search for supplementary visual material in the image gallery.

Individual learning is put forward in the section called analysis tools. The tools offer means to analyse digital images directly and independently from their embedment in a learning module. An ‘image calculator’ enables users to perform simple arithmetic calculations with digital images, for example the vegetation index NDVI or simple image differencing. A tool for ‘image classification’ delivers the functions needed to derive a thematic map from a (true colour) satellite image. With a tool like this, pupils can experience the ‘selective truth’ of maps (MONMONIER 2005) while creating a custom map from raw (satellite) data representing a snapshot of reality. The ‘MeteoViewer’ shows images of the geostationary Me-

teosat-10 satellite (MSG-3). Pupils can watch image loops of the last 3- or 24-hours for the full disk and for Europe to draw conclusions regarding present weather conditions. Besides near true colour images, a second version of the MeteoViewer provides imagery for differentiating cold and warm air masses, identify the jet stream, and to observe cyclogenesis.

2 Learning Management Tools

The content and all learning material described above is accessible to all visitors of the FIS learning portal. Additionally, we implemented some basic learning management functions that are available after registration. The advantage of those learning management tools takes effect when students work with the learning modules. The learning management functions affect the portal's handling for students as well as for teachers. For students, the advantage of registration is the automatic storage of the learning module's intermediate results. Without registration, users will have to start a module from the beginning if they are preparing for a new lesson or for homework. A registration in the learning portal allows users to proceed with their work at the point they have left the module before. The benefit of registering for teachers is the opportunity to see, analyse, and evaluate their students' intermediate and final results.

We decided to implement customised learning management functions into the learning portal instead of using a full Course Management System (CMS). In the FIS learning portal the learners have access to the complete content all the time instead of being in a virtual classroom where only selected material is provided by the teacher. As a result, pupils can search for information in the 'Info-Box' or the image gallery while working with a learning module.

We implemented two roles in the system: 'teacher' and 'pupil'. A teacher can create new classes, manage and delete existing classes; he can create student accounts, assign students to classes, give working instructions, attach learning modules to classes, evaluate the progress of a class within a learning module, and see the students' answers to questions given in a learning module as well as their test results. Teachers provide the pupils' account information. Therefore, there is no need to register pupils with their email addresses in the system.

3 Experiences with the Learning Portal

A very important aspect of developing and implementing a digital learning portal is a steady assessment of feedback, critics, problems as well as an evaluation of the general demand for the offered tools. For this purpose we have implemented an evaluation section, where teachers and pupils can evaluate the learning material separately (for the structure and the concept of the questionnaire cf. VOSS et al. 2008). Additionally, the log-files of the learning portal are analyzed monthly.

Figure 2 shows the download numbers of all FIS learning modules. We can see a total amount of 3,162 downloads from the launch of the learning portal in July 2012 until December 2012 (527 downloads/month). The most demanded learning modules can be identi-

fied as those bearing names with curriculum-relevant topics in Germany. Among these are learning modules dealing with the atmospheric circulation (547), oases (322), or brown coal (224) (German versions). Teaching units, which are highly relevant from a 'remote sensing perspective' like 'Images to maps' (219) or 'Pixel off the right path' (210), are also downloaded constantly. Because FIS is a German project, the German versions (2,706) of the learning units are, of course, downloaded more often than the English ones (456). A deeper look into the log files indicates that the English teaching material is particularly downloaded by German schools leading to the suggestion that the material is implemented in bilingual teaching. The demand for the currently nine modules that can be executed online without download is also shown in figure 2. The online versions of the learning modules have been executed 1,159 times in the period July-December 2012. Interestingly, it is not a geographical learning module that is demanded most, but a Physics unit dealing with the processes of reflection and colour composition ('Tracing the invisible') (237).

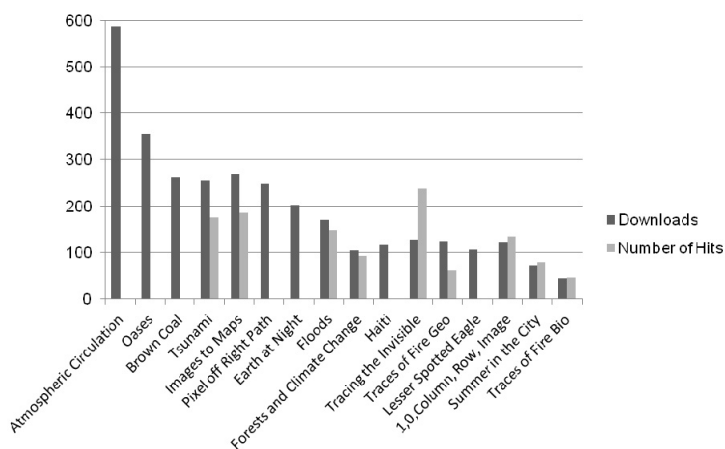


Fig. 2: Download counts (full zip-file download) and number of hits (online version of modules) of the FIS learning modules (July-December 2012)

4 Conclusion and Outlook

The FIS learning portal is intended to offer an easy entrance point into the scientific method of remote sensing for pupils as well as for teachers. Pushing learners into a more active role in combination with an intensive interaction with the learning material is one of the major aims of the portal. The core of the portal consists of interactive learning modules which are accompanied by a digital interactive glossary about remote sensing, and simple tools for digital image analysis. It puts pupils into a position where they can perform specific research tasks independently. There is an opportunity for increasing the learners' and lecturers' motivation by combining two fascinating facets of remote sensing, being (1) the use of modern technology and (2) studying environmental interrelations and developments. This can offer new possibilities to transfer complex matters more easily, to initiate individual learning, to foster interdisciplinary thinking, and to minimise the gap between the use of and the knowledge about geomedial in everyday life.

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