DEVELOPMENT OF AN INTERACTIVE E-LEARNING AND E-TESTING TOOL FOR TECHNICAL ASPECTS IN GEO-SCIENCES

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ABSTRACT

Positioning technology becomes increasingly a black box, used by a growing number of people who lack the basics of it. Misuse and inability to handle problems or failures of the technology becomes an important problem and demands new solutions in training and education

The Geography department, Ghent University, develops an ICT tool using an interactive website to explain the techniques on contemporary positioning involving GPS, photogrammetry, remote sensing, GIS and cartography. The project uses the possibilities of the internet together with classic didactical learning methods into an integrated learning concept. It offers learning and 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.

INTRODUCTION

Information and communication technology has been integrated in all aspects of daily life. Even in education, new teaching methods based on multimedia technology are used to stimulate active learning. Students are becoming more multimedia literate and have an expectation that information will be delivered in alternative methods to the traditional lecture and printed page (Editorial in Journal of Geography in higher education, vol. 26 No.1). The arrival and rapid dissemination of digital technology in the last decades of the 20th century has made our students the first so called “digital natives” (Prensky M., 2001). They are used to receiving information very fast, skip long texts, prefer graphics above text and receive instantaneous feed-back. Prensky points out that if instructors, being digital immigrants, don’t change their learning methods, they will never reach their students.

PROJECT DESCRIPTION

In October 2004, in the framework of the European Bologna declaration, the Ghent University started with the introduction of the Bachelor-Master (BAMA) structure. This structure allows greater student mobility not only between different universities over Europe, but also between different course outlines. The introduction of this BAMA structure was a big opportunity to change some course contents adapting them to the needs of students with different background education.

Science and technology of positioning and spatial referencing rapidly change: the transition of optical to electronic observations and the introduction of the Global Positioning System (GPS) added another dimension to topographic measurements. In remote sensing, new sensors produce images with higher spatial and spectral resolution. Geocentric continental or global reference systems are replacing astronomic-geodetic positioning with different datum definitions for each country. Geographic Information Systems allow efficient management and analyses of spatial information and are needed for optimal graphic or cartographic presentations.

Spatial data-sets, from various sources, such as GPS, topographic measurements, photogrammetry, remote sensing, field observations and maps are increasingly used in various application domains. To mention a few examples: spatial information is needed when locating different archaeological findings, 3D reconstruction of historic buildings, for investigating the problem of traffic jams, calculating the optimal distribution of, for example, emergency services, for crime distribution analyses, for location analysis of flora, habitat investigations of fauna and wildlife conservation and for geological structure analyses.

While spatial datasets are increasingly used, gathering and handling spatial information becomes a black box. Basic knowledge is often uncared-for, with consequences of misuse and inability to handle technology failures. The education in gathering and handling spatial information demands a great effort both in technology costs and in training personnel. High tech (and expensive) equipment and software are rarely available in large quantities at the university so that education has to be done in small groups. In contradiction to the overall evolution of rationalizing education, this subdividing student groups becomes a pressing problem for the time management of educators.

The Geography department at the Ghent University develops an interactive website on the training of technical aspects in geo-sciences. It aims to explain the basic principles on GIS, cartography, positioning and remote sensing. The project is sub-divided in different modules and includes theoretical explanations combined with small interactive tests with instant feed-back. At the end of each module, students will have to go through a semi-automated module test where multiple choice or multiple select questions are altered with open questions. The website is used as a training aid rather than replacing traditional lectures.

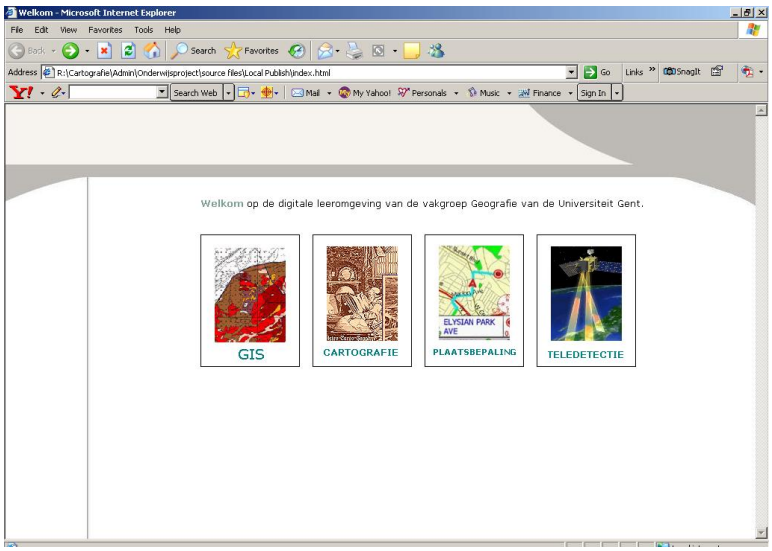

Figure 1: Project Welcome Page

AIM AND EDUCATIONAL CONCEPT

Almost all university education has traditionally been imparted through the lecture-tutorial-laboratory paradigm [Metternicht G., 2003]. With a globalizing world and a more flexible student mobility, students with different pre-university education, e.g. of other European countries, come together following the same course. Even more, due to rationalizing education, a course is given to different education lines making it even harder to bring all students together in a classroom. This project responds to the need of more flexibility on place and time demanding new solutions in training and education.

The project endorses the educational vision of the Ghent University where the concept of active learning students plays a big role. It aims to stimulate an active learning attitude offering students means of self-study with integrated permanent evaluation. The website is problem-driven and consists of a large set of practical examples and exercises. Working through the exercises, students get to understand the theoretical concepts behind and develop a problem-solving attitude.

The project uses the potentials of the internet together with classic didactical learning methods into an integrated learning concept. It offers learning, and 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. Like Wentz (Wentz et al, 1999), we think that for this specific situation of 1st year's students, E-learning should be seen as complementary rather than replacement technology. Sui and Bednarz (1999) emphasize that each communication medium plays its own role in shaping human consciousness and social development and they stress the continuous need of books and face-to-face human interaction, even in the

internet era. Students have different learning needs and expectations to delivery methods so that a combination of different education models can enhance learning results (Zerger et al.., 2002).

TARGET GROUP

By choosing the subject as broad as "contemporary positioning", a wide range of users is aimed. The project was first designed for the training of the geography, surveying and geomatics students, but will also be used for students in geology, archaeology and history. Different learning trajectories specified for different groups of students will be outlined. The e-learning tool is adaptable for training at different levels of higher education.

METHODOLOGY

As in the project described by Mendler (Mendler et al. 2002), the teaching structure of the existing program was first analyzed and subdivided in different teaching components. The possible student-computer interactions and the benefits or drawbacks of online learning above a traditional classroom meeting were then matched for each learning component.

An interactive website illustrated with a lot of examples and questions with feed-back is being set up for the learning components of Cartography, Positioning, GIS and Remote Sensing. Table 1 gives an overview of the progress of the different modules. In each learning module, theory and worked examples are altered with small problems including problem solving aid and instantaneous feed-back. Special attention has been given to problems covering core concepts identified by academic staff where students have experienced difficulties without specific visual or interactive support.

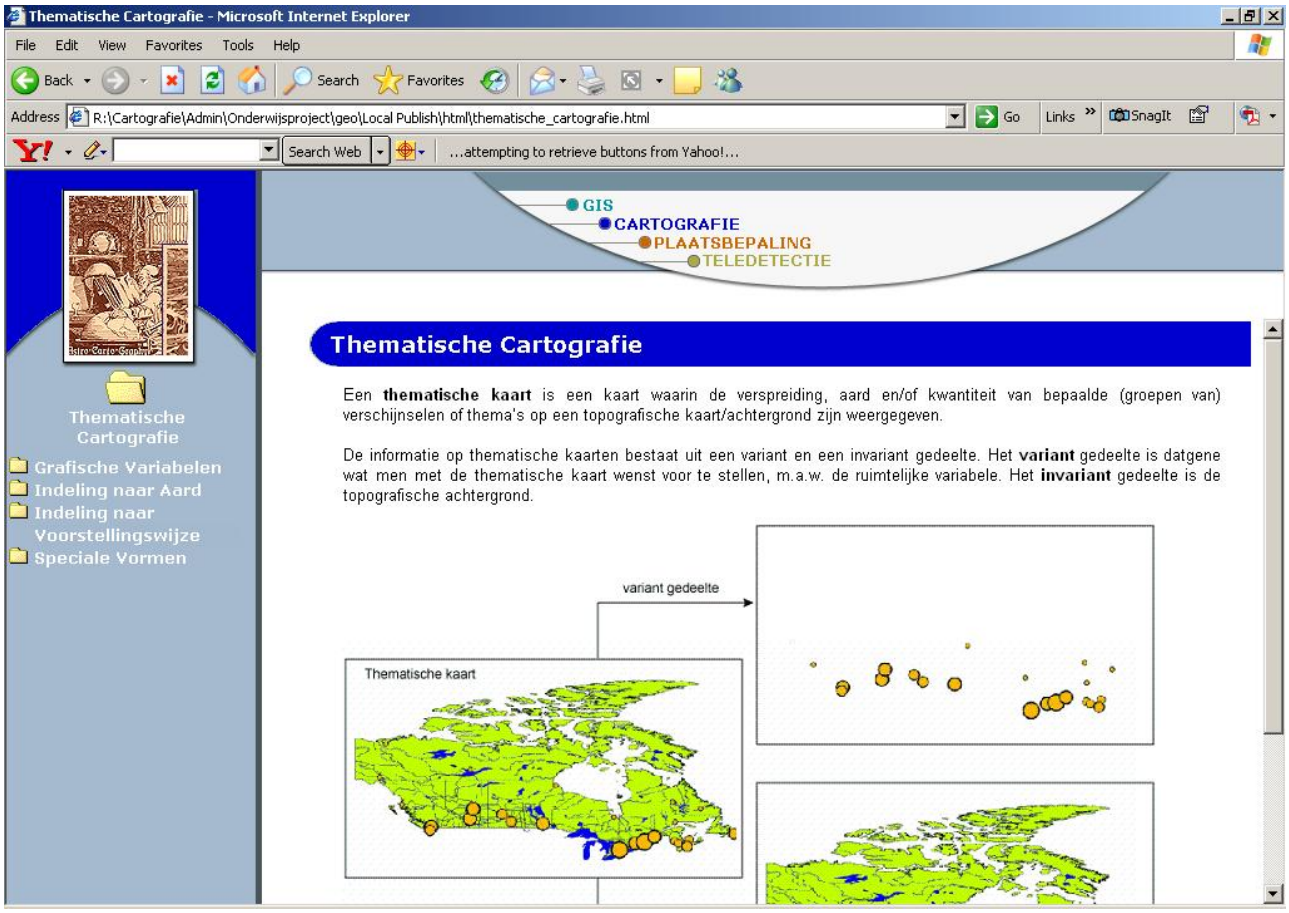

Figure 2: Web page for explaining graphic variables in thematic mapping

At the end of a learning module, an elaborate online test allows instructors to evaluate students understanding of the learned subject. Lecturers of other similar programs have noticed that many students do not voluntarily access this kind of learning material (Zerger et al.,2002). Therefore, the modules are integrated in the formal assessment and the module

test is obliged for each student, although this moves away from the focus on constructivist learning. Still, the issue of managing and assessing individual contributions and possible team work exists (Livingstone D., Lynch K., 2002). Bringing students together in one room diminishes the advantages of online, self-paced learning, but is the only way preventing cheating and illegal team work.

Module name	Theory	Exercises	Module test	Comments
GIS	X			
Cartography	X	some	X	Module test already experimented with 80 students
Positioning	some	some		
Remote Sensing				

Table 1: Module realizations on May 1st 2005

E-TESTING

Many e-learning and e-testing products already exist. The part of the project concerning e-testing will be put into practice by using TeleTendo (Van Grimbergen et al., 2002). TeleTendo is a multi-media web based e-learning and e-testing system developed by RAMIT in close cooperation with Ghent University. As a result of concentrating on the development of innovative e-testing solutions, TeleTendo provides a user-friendly, secure, web based, multimedia, and domain independent e-testing tool. The application can be used for: 1) pre-tests, 2) e-learning and self-assessment, 3) examinations and polls, 4) continuous progress follow-up and 5) functional interpretation of test results.

TeleTendo offers an on-line question and examination generator existing of an authoring tool with question editor, test builder, report builder and user management. The on-line generator allows the user to categorize content, to edit questions and feedbacks and to build tests. Questions in a test can be delivered sequentially or randomly. TeleTendo offers easy-to-use wizards for adding and modifying content, WYSIWYG rendering, real-time extended reporting tools and extended feedback. Import and export functionalities of the question-database are available.

As in most systems, basic question types, like multiple choice, multiple select, text fields and dropdown questions are available. The answers to open questions are grouped for the tutor. Questions can be supported by multimedia including images, movies, audio and flash. All the question types can be combined with additional features like built-in time limits, and image zoom and scroll functions. Unlike other systems, graphical question types like (single or multiple) click zone and free shape zone definitions are possible. These types of questions especially test the recognition and interpretation skills of students.

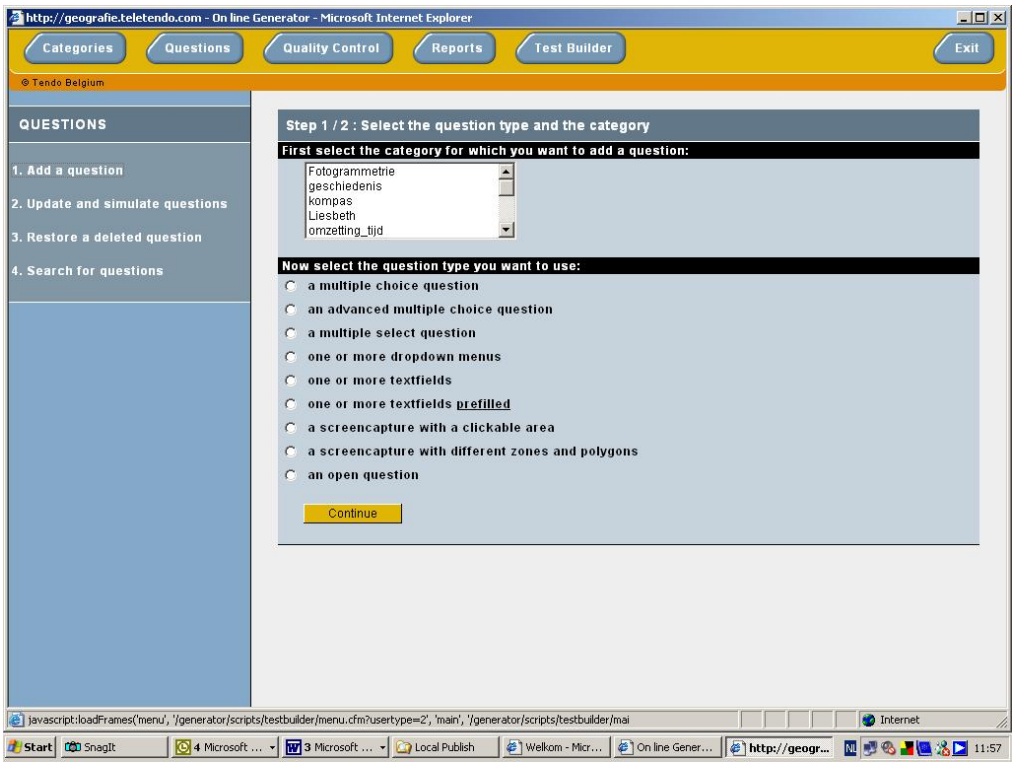

Figure 3: Question builder with in-built question types at TeleTendo

TeleTendo is not limited to question and test building functions, the system also allows lecturers to correct anonymously for open questions. Using a student-centered database, lecturers can follow students' progress on one hand and detect frequent occurring errors on the other hand. The different test reports can be easily exported.

ADVANTAGES AND PROBLEMS OF COMPUTER-AIDED LEARNING

In spite of the fact that the project is not yet fully implemented in the student curriculum, a few advantages and drawbacks of computer-aided learning (CAL) can already be mentioned.

First, we have to point out that technology is evolving very rapidly. Designing a computer-aided learning system implies a technology-minded team to constantly update the system to modern standards. Moreover, different browsers will rarely display the same web page correctly. Program designers are thus faced with two choices: either use old technologies that will display on all browsers correctly, or use cutting-edge technology and supply requisite hardware and software to the students (Mendler J., et al., 2002). In this project, because it doesn't focus on distant learning, students with no up-to-date technology at home can use the university facilities.

The main goal of the program is to make a set of practical examples and exercises available to the student. Most of the data sets however (maps, spatial data sources, …) are subject to copyright. Therefore the program could not be set open to the whole internet and severe restrictions to the user group are set. Because this course is mainly seen as an introductory course in the first year of college, the Dutch version, the teaching language at the Ghent University, of the interactive website will been given priority over the English one.

Producing material for a computer screen has different requirements than the traditionally hardcopy formats. Low resolution and limited space without having to scroll makes reading on a computer screen more difficult. In most cases, a picture says more than a thousand words. Therefore website designers should catch the attention of the readers with pictures, animation and sound whenever possible. Text should be limited and information should be divided in small learning steps. However, contrary to this general rule of reducing text, we decided to allow scrolling when necessary. In this project, the website is only created as an introduction and/or feed-back for practical exercises. A thorough selection has been made in the course topics dealt with in the CAL system and others to deal with in a traditional classroom lecture. The CAL does not simply repeats the traditional course book, but focuses on specific topics and adds pictures, worked-out interactive examples, animations, and self-tests.

However, keeping in mind these few limitations of a CAL, the system reveals an unlimited flexibility to preliminary training. Students are no longer bound to place and time. The benefit to reach students via an additional channel opens an opportunity of student and teacher motivation. Moreover, the program is an adequate tool to bring every student on the same level: students can use the tool to train on their weak points. The CAL facilitates active and experimental learning and gives an answer to the ever-growing amount of students to be reached (Mendler J., et al., 2002). The lecturer can use the CAL to increase his teaching efficiency and to focus on specific topics during his theoretical lectures. Some earlier experiences with online learning (Mendler J., et al., 2002) however point out that providing a computer-aided learning system does not necessarily lead to a reduction of staff time. Students sometimes demand a high level of problem-solving both on technical issues as well as concerning content.

During the academic year 2004-2005, students were obliged to go through a first module test on cartography. This first small test was generally appreciated, both by students and by lecturers. Yet, 37% of the students find this way of testing should not be included in the formal assessment and an even larger group of students find online testing not fair (55%). Due to network problems, some students had to log in more than once, loosing any previous answers.

Other examples in literature point out students commonly want to receive information fast and might complain about the downloading speed (Zerger et al., 2002). In this project, special attention has been given to minimizing downloading speed by excluding high resolution images and sophisticated animations.

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BIOGRAPHY

Nele De Wolf graduated in July 2002 as a master in Geography. In her final dissertation, she made a historic study about the Lafreri atlases or IATO atlases (Italian Atlas To Order).
She works now as a research associate at the Ghent University, Department of Geography, where she develops an interactive website for introducing geomatics to first years' students. Her main research interests are: Cartography as communication tool, digital learning environments and quality of maps.