

E-Learning for Geoscience: An Educational Approach

Gerrit Toxopeus, Evert Slob and Monique Draijer, Department of Applied Earth Sciences, Delft University of Technology, The Netherlands.

Introduction

In the summer of 1999, the department of Applied Earth Sciences of Delft University of Technology started a project to stimulate instructors in the use of a web-based learning environment. The idea was that instructors would electronically support their B.Sc. and M.Sc. level educational courses. A small group of enthusiastic instructors was kick-started with an introductory course, and they began to use the virtual learning environment *BlackBoard*.

It was soon discovered that this new environment changed the tutor-student relationship completely, and questions arose on how to use course content in such an environment, and what role it should play in the new communications options.

Here we explore some of the problems faced, and we illustrate them with five examples of how the knowledge model can be used, and how the creative thinking of our instructors has enriched our educational program.

A changed tutor-student role model

The different components of any modern virtual learning environment can be arranged under three main headings, as shown in Table 1. The model is based on the role between a tutor, or a group of tutors, and their students. The three headings are: *Obtaining Shared Information, Communication, and Interaction.*

This model gives a clear answer to the question of what role should a tutor play within a particular component. From left to right, tutor-student interaction increases. The first column is primarily passive and can be compared to the way information is obtained in a "traditional" lecture. Here, multimedia can be used to enrich and stimulate learning and knowledge transfer. It is the tutor's task to offer this new information. The last two columns invoke more interaction, the levels of which can be divided into 'delayed in time', and

'real time' or 'live'. The options 'discussion board' and 'drop box', especially, differ from traditional lectures, while 'live' education is comparable to a classroom.

Obtaining shared Information, a typical course

Traditionally, course documents are the most important content carriers of a course. Most of the course documents are made available in PDF format, or files from the Microsoft Office suite. The arrangement of these documents in the virtual learning environment is important, and we have found that a map structure outlining the lectures improves content-finding rates.

When a student opens the directory of the first lecture, the lecture viewgraphs and the course documents are found. As most documents contain pictures, e.g. illustrating the derivation of derivation equation an equation, or showing a seismic section, the size of these documents can easily exceed 10 Mb and this can be a problem, limiting a student's potential for easy document viewing at home.



Figure 1 Remote Sensing course in BlackBoard.

| Obtaining Shared Information | Communication | Interaction |
|--|---|------------------|
| Announcements | Individual/Group Electronic mail | Discussion board |
| Course Manual | Group page | Assignments |
| Course Documents: Sheets, text books, readers Old exam / Assignments Related Web sites Multimedia (Animation, Movie) | Individual / Group Send and Receive (Drop Box) Old exam / Assignments | Time-schedule |

Table 1 The Model

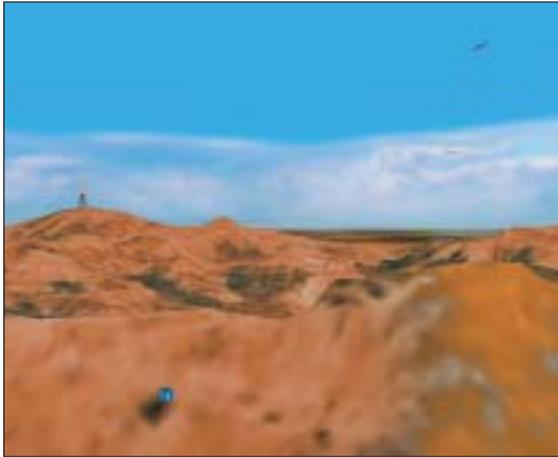


Figure 2 Virtual fieldwork, 3D flyover map of the Huesca area.

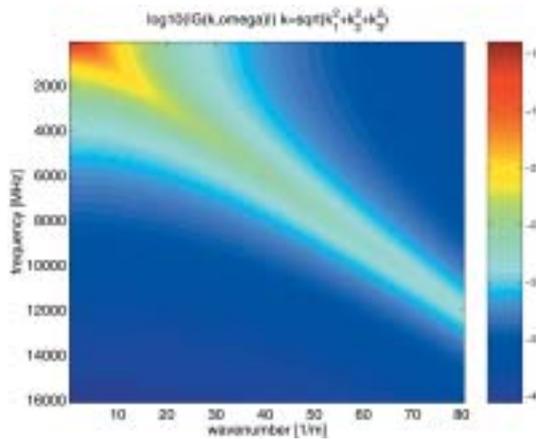


Figure 3 Matlab exercise to gain insight into Green's Functions.



Figure 4 Coupling video, PowerPoint and the course book.

Adding multimedia applications, like animated prograding dunes, or a video showing how a satellite works (as depicted in Figure 1) opens new ways of transferring knowledge. To help instructors upload all this content, a so-called "Student Wizard Assisting Teacher" or SWAT is employed (Wedman and Diggs, 2001).

Discussion board

Part of the course "Introduction to Geology" is a classroom discussion about an important social topic related to geology; for example the greenhouse effect. The instructor had the idea of carrying out this debate on the 'discussion board' (a private newsgroup). After posting an introduction with links to websites and the actual proposition, the students could start the discussion. After a few weeks, however, only a few students had contributed to the discussion, most of them simply replying with "me too".

The instructor asked his students what to do. The answer was that the students wanted the instructor to participate more. As in a real live situation, the students wanted the instructor to lead and give direction to the developing discussion; e.g. by summarising parts of it. The instructor agreed to try this on the next group of students, and thereafter a stimulating discussion developed in which the students used new web links to support their views. This shows the importance of the instructor taking the right role in successful use of new knowledge transfer technologies.

Group Communication

The question was how to use E-Learning in a two weeks spell of fieldwork in Huesca, Spain? The assignment for the students was to write a single group report highlighting the geology of the area. All participating students were to contribute to this report in groups of two.

After a student enrolled in the course, the instructors used group electronic mail to communicate. During the fieldwork, the students had a laptop with word processing software, and a digital fly-over map providing a realistic 3D view of the area (see Figure 2). This virtual fieldwork helped the students to understand the regional geology and use that knowledge on their own small patch. The virtual environment also allowed the instructor to supply new sources of information. By spreading information boxes geographically in the virtual terrain (see the box in Figure 2), information was provided on related scientific papers or actual well-log data. Back at the university, the group report was sent digitally to the instructors. They used marker options in the text editor to correct the students' text, and provide hints for improvements. After putting the corrected text online again, the students could edit their part and a moderator compiled the final version. This use of group mail is very appealing and pragmatic, especially for the moderator.

Assignments

The course on rock-fluid interaction provides descriptive and practical sections on oil production from a hydrocarbon reservoir. In the practical section, the students acquire insight into the parameters of the derived equations. The instructor makes exercises available in both Matlab (see Figure 3 for a geophysical course example) and Excel (Visual Basic). The result of the exercises is sent back to the

instructor via a 'drop box', and this may be followed by a private discussion with the student. The instructor observed that students know very well how to use the copy-and-paste function, and that most questions came at the end of the lecture. To tackle this last problem the instructor now uses a predefined time-schedule, which limits access to the exercises.

Multimedia

Technically, it is now possible to integrate video, *PowerPoint* and course books as shown in Figure 4. By providing parts, or the whole of a course, time- and space-independent education can be provided to students or alumni (life long learning). There are attractive new options to stop a movie, have a closer look at the slide presented, or look up the link presented in the course book or in a related website. Similar functionality can be found at MIT's World (www.mitworld.mit.edu) and the SEG website (www.seg.org), where the last Annual Conference presentations can be found.

Discussion

After a slow start, blended learning is now really getting 'up to speed'. All the examples show the importance of the instructor being aware of his active or passive role in promoting the successful use of the new content to be found in a virtual learning environment. The examples show, furthermore, that although geoscience covers a broad range of subjects, the online material is not limited to traditional course material, which would only satisfy the heading "Obtaining shared information". A lecture makes use of "Communication", e.g., via a discussion group, of "Interaction", e.g. via interactive assignments, or even of "Obtaining shared information" and "Interaction", e.g. by using a virtual fieldwork area.

Many of the elements described can also be related directly to the geoscience industry, which currently uses virtual environments to transfer knowledge to its employees. Now, new students too become familiar with this new way of acquiring knowledge.

Suggested reading

Visit www.ta.tudelft.nl/PrivatePages/G.Toxopeus/fb/ for a preview of the material presented here, and suggested reading.

Reference

Wedman, J. and L. Diggs, 2001. Identifying barriers to technology-enhanced learning environments in teacher education. *Computers in Human Behaviour* 17, 421-430.

Acknowledgement

We thank all the TUD instructors for their enthusiastic contributions and Norsk Hydro for permission to publish the multimedia example.