Do-It-Your-Soil – a Virtual Course in Applied Soil Science

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Zusammenfassung

Do-It-Your-Soil (DOIT) ist ein virtueller Kurs in angewandter Bodenkunde. Zielgruppe sind Lernende mit Grundwissen in Bodenkunde und ersten Erfahrungen im Umgang mit Bodenprofilen im Feld.

Do-It-Your-Soil besteht aus 5 Modulen:

1. Wasserspeicherung in Böden
2. Dynamik organischer Böden
3. Bodenerosion
4. Bodenbelüftung und -verdichtung
5. Bodenversauerung

Ziel ist, praktisches Wissen über diese wichtigen Bereiche der angewandten Bodenkunde anschaulich zu vermitteln, so dass die Lernenden dieses Wissen bei der Problemlösung in der Praxis anwenden können. Do-It-Your-Soil möchte dazu beitragen, das Wissen und Verständnis von Böden zu verbreiten und ihre nachhaltige Nutzung zu fördern.

Abstract:

Do-It-Your-Soil (DOIT) is a virtual course in applied soil science. Target group are learners with a general background in soil science including first field experiences with soil profiles.

Do-It-Your-Soil consists of 5 modules:

1. Soil and water supply
2. Organic matter decomposition
3. Soil erosion and re-formation
4. Soil consolidation and aeration
5. Soil acidification and buffering

Do-It-Your-Soil wants to facilitate the understanding of these important areas of applied soil science. Learners should be able to apply the knowledge for problem solving in their practical work. Do-It-Your-Soil also wants to help create knowledge and understanding of soils, as well as promote their sustainable use.

Keywords: Applied Soil Ecology, Didactic Design, Information Structure, Flash, WebCT

1. Introduction

In recent years increased relevance of soil sciences in connection with environmental problems has led to completely new tasks for experts in the field of applied soil ecology. In order to respond to the new demand on education, modules of environmental soil science have been newly implemented or considerably extended in many Swiss university curricula (as part of disciplinary sciences as well as in form of completely new curricula) or in postgraduate courses.

Soil is a system of extreme heterogeneity and complexity. Any action intended to manage and protect this precious environmental resource must be fine-tuned to the particular site conditions. This requires the capability to recognize and take adequate account of relevant site characteristics. Furthermore, soil cannot simply be treated as a physico-chemical reactor because also biological processes play a dominating role in soil formation and reactions. Thus, an ecological perspective is required for proper management and protection. One of the major difficulties in teaching soil sciences is to bridge the discrepancy between real soils in the field and abstract model concepts which can be used to anticipate and analyse effects of actions and impacts and design appropriate solutions of management and protection problems.

"Do-It-Your-Soil" (DOIT) is an online course designed to tackle these problems. It was financed by the Swiss Virtual Campus and developed by a joint team of the Universities of Zurich and Neuchâtel and the Swiss Federal Institute of Technology (ETHZ) in Zurich. The idea is to teach problem-solving using example cases of real-world problems. DOIT addresses students which have a general background in soil science including first field experiences. This paper presents an overview of Do-It-Your-Soil.

Do-It-Your-Soil material exists in **German** and **French** language.

2. Frame conditions

The production of web based teaching material requires a fundamentally different approach from e.g. the production of a book or a handout. The reasons for that are the boundary conditions of the medium internet and the changes they impose on human learning behaviour:

- Reading text materials on a screen is experienced as tiresome by many (THISSEN 2000). Size and granularity of the information must be adapted to the screen. (SCHULMEISTER 1996)
- Reading assignments that exceed 1/2 - 1 A4 page should also be available as printouts. This leads to the necessity to integrate online and printable material with each other.
- On the other hand, the computer offers unique opportunities for visualization and simulation. Short movies and sound can be integrated into text sequences.
- Another chance is the cooperation of learners at different places with different backgrounds. However, cooperation needs to be organized and integrated into a schedule.

3. Structure of Do-It-Your-Soil

The didactic design of DOIT follows the idea of the so called "Leitprogramm", i.e. guided learning by solving structured problems (FREY & FREY-EILING 1994). The "Leitprogramm" ideas were modified in the course of DOIT development, in order to allow for more flexibility in choosing learning paths through the material. Advantages of the "Leitprogramm" approach are:

- Students can determine themselves how fast they proceed
- Students proceed step-wise - the next exercise can (or rather: should) only be started when they have mastered the previous one ("mastery principle")
- Examples show how exercises have to be solved and what is expected from the students
- Feedback is given immediately

DOIT consists of **5 modules** on the following topics:

6. Soil and water supply
7. Organic matter decomposition
8. Soil erosion and re-formation
9. Soil consolidation and aeration
10. Soil acidification and buffering

The modules develop from an applied soil ecological problem, such as the "impacts of acid rain on soil pH" or the "effects of a lowered water table on plant productivity". The problem is presented in the form of a **case**, i.e. with data for a specific site.

Each module consists of 3-5 **sequences** (see Fig. 1). At the beginning of each module and of each sequence, students are informed about the learning objectives. Each module ends with a test related to the case presented in the beginning.

The smallest didactical unit of a sequence we call a **brick** It is usually identical to one screen. The need for scrolling is avoided whereever possible.

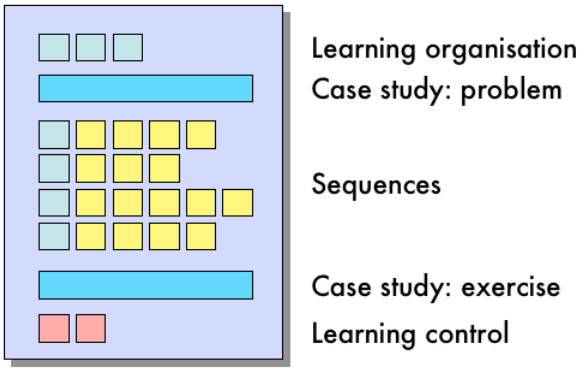

Fig. 1: Structure of a module with 4 sequences.

The flow of information in a sequence is organized an **interactive track** and a **theory track** (see Fig. 2). The **interactive track** contains all interactive elements of a sequence. It is a sequence of “bricks” put in line according to growing complexity. Typically, an introductory “brick” is followed by an interactive “brick” – usually a Flash animation - and concluded by a summary “brick”. An overview about the learning activities here involved has been published by FRISCHHERZ et al. 2003.

The interactive track may contain one or several **self test bricks** (with no tutor being involved). A typical DOIT self test is e.g. the drag-and-drop exercise shown in Fig. 3. The correct choice with the correct feedback can be printed out in the end, to give yet another incentive to do the self test.

The **theory track** (see Fig. 2) is a collection of text and images related to the topic of the module. It can be either read online or downloaded as PDF and printed out. The online version contains active links back to the interactive track.

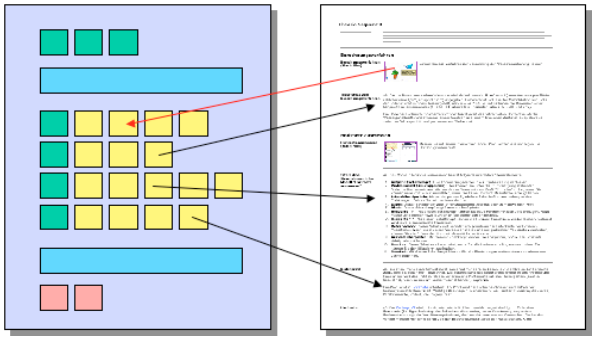

Fig. 2: In Do-It-Your-Soil, the interactive track (left) and the theory track (right) complement each other.

A module is concluded by a final test, the **learning control**, trying to evaluate the learning progress of the students. This test can be set up in different ways, according to the wishes and needs of each individual teacher. Students can, e.g., perform a task and publish their results in a discussion forum, write their solution into a text file and mail it to their tutor or even have a face-to-face test in a room.

Students must complete all modules to receive their ECTS credit points. They should be able to work through 1 sequence within 1 1/2 hours, which adds up to 6-8 hours for one module.

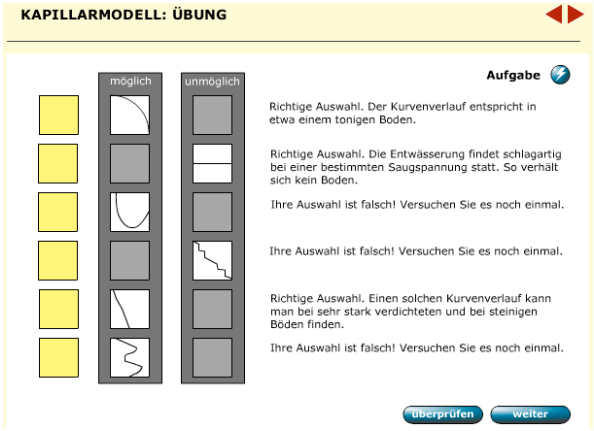

Fig. 3: Drag-and Drop self test on the understanding of curve patterns. The student's task is, to decide whether a curve shape represents a desorption curve or not. The curve pattern is dragged onto the chosen position with the mouse. Clicking "überprüfen" gives direct feedback.

The amount and quality of **tutoring** is crucial for the success of any eLearning project (SEUFERT, BACK & HÄUSLER 2001). However, the role tutors will actually play in a course can be modified by the teacher, depending for example on whether DOIT is used as an online course, or as add-on of a lecture. In an online course setting, tutors will need to be present in the online discussion forums. They can potentially control the efforts of their students by using the tracking tools of WebCT and by browsing through the solutions students have submitted. They may also be present in a startup workshop and in the final examination.

4. Two examples

The first example is taken from module 4 "soil consolidation and aeration" and shows a thematic unit with 5 bricks (Figures 4-8) taken from sequence 1. In this thematic unit, students learn about soil respiration and the factors that influence it.

In step 1 (Fig. 4), the thematic unit is introduced and the general picture is drawn. In step 2 (Fig. 5), a cartoon character (the "small green rock chomper") is used as a metaphore for soil respiration in an explanatory animation, in order to make the abtract concept of soil respiration more tangible.

Fig. 4: Introduction to the thematic unit (step 1).

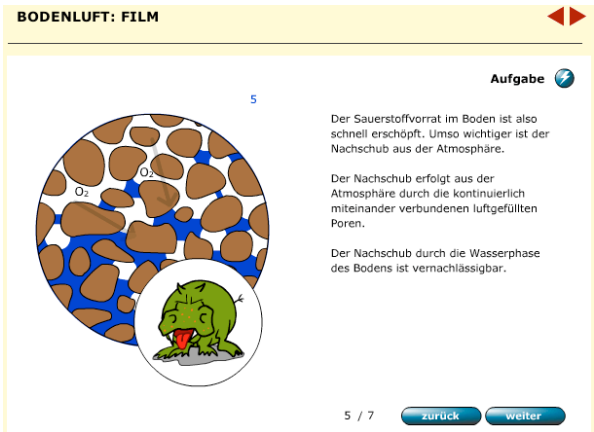

Fig. 5: The "small green rock chomper" in an explanatory animation: The character stands for soil respiration and the living beings that cause it. Step by step, the reactions of this character to increasing soil water content are helping the students to understand soil respiration better (step 2).

In step 3, the animation is followed by an exercise (Fig. 6), where students can directly apply what they have learned to a problem related to agronomy. In the following quiz (step 4, Fig. 7) the students are then confronted with a set of tricky self test questions related to soil respiration.

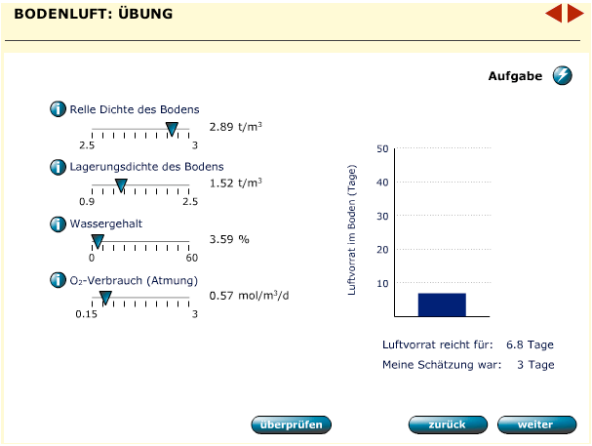

Fig. 6: An exercise on root survival time in the air caught in a loamy soil after a heavy rain event (step 3).

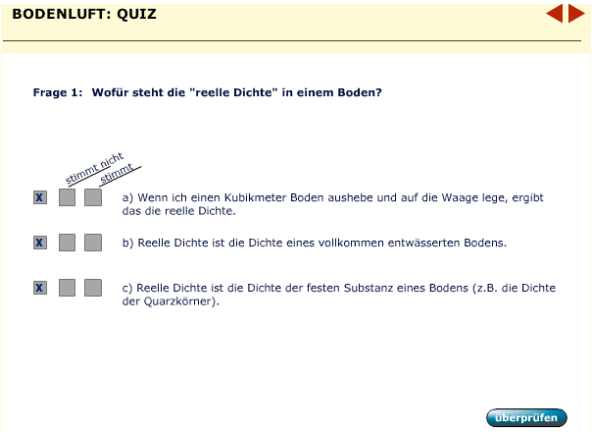

Fig.7: Self test on questions related to soil respiration (step 4).

Fig. 8: Synthesis of the thematic unit (step 5).

Finally, in step 5 the thematic unit is summarized (Fig. 8), in order to to encourage the reflection of the learning material.

The second example (Fig. 9, taken from sequence 3 of module 4) demonstrates the potential of computer supported teaching to facilitate the understanding of complex relations in soil science.

In this simulation model, students can examine heavy machinery and their pressure transmission into the soil. They can compare different types of construction machinery, vary chain length and width and look at different pressure bulbs. By playing with the model, the understanding of the underlying Fröhlich equation is facilitated in an intuitive way.

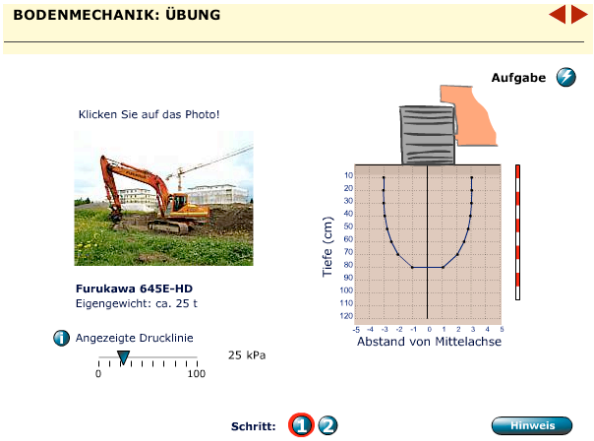

Fig. 9: Simulation model on pressure transmission by heavy machinery to the soil.

In the course of DOIT development, more than 80 animations, calculation models and simulations were conceptualized and developed. More about animations and simulations as learning objects and the background of their development can be found in FRISCHHERZ et al. 2004.

5. Software requirements

The following software is required by users to access DOIT :

- A reasonably modern internet browser, such as "Internet Explorer 5" or newer (Windows), "Safari 1.03" or newer (Mac) or "Firefox 1.0" or newer.
- The plugin "Flash Player 6" or newer
- At minimum a 56k modem connection to the internet
- Java and JavaScript must be activated

On the server side, we are using **WebCT** as basic framework for registration, content organization, communication and learning controls. However,

DOIT is highly **client based**. If WebCT's communication tools are not required, DOIT will also run on any modern webserver and even on any local PC without problems.

6. First experiences

DOIT so far has been used in variuous test settings and in a limited number of courses. Full use will only start this year (2005). In general, feedback by students and tutors was positive and encouraging. A number of our students already had some - positive and negative - experiences with online course material. One of them said: "If course material needs to be online, it should be like Do-It-Your-Soil".

Do-It-Your-Soil's key features are:

- the modular structure of the content, offering different paths through the learning material
- the hybridization of online and offline material in the "interactive" and the printed out "theory tracks"
- the extensive use of Flash animations for the visualization of content and for interaction with exercises and models

We can already conclude that DOIT may considerably help students to understand soil science and apply theory to practical problems. It can, however, not completely substitute person-to-person contacts between teachers and students, and it can't replace field trips. The "smell-and-feel" of soil cannot be transmitted via the internet. We see this course as a valuable complement to traditional forms of teaching soil science and not simply as a substitute.

7. How you can use Do-It-Your-Soil

DOIT has relations to a number of different disciplines, such as, e.g., agronomy, biology, biogeochemistry, ecology, hydrology, environ-mental engineering, forestry etc.

Lecturers or teachers of a university or a university of applied science, within or outside Switzerland, can use DOIT for their teaching, free of charge. There are two options:

1. Using DOIT on our WebCT server
2. Installing DOIT on a server at your school (protected by a password or in the intranet)

Before access is provided, any interested person needs to enter an agreement with the DOIT leading house, regulating copyright issues and further distribution of DOIT . Thereafter, you will receive either access to DOIT on WebCT, or the material.

For an impression of DOIT and some more background information, please check the demo website at http://www.unine.ch/doityoursoil/

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