The use of COCOON in teaching silviculture

Harald Vacik *, Bernhard Wolfslehner, Josef Spörk, Ernst Kortschak

Department of Forest and Soil Sciences, Institute of Silviculture, University of Natural Resources and Applied Life Sciences, Vienna A-1190 Vienna, Peter Jordanstr. 82, Austria, Europe

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Abstract

At the Institute of Silviculture at the University of Natural Resources and Applied Life Sciences, Vienna, students learn to cross-link ecological, socio-economic and technical knowledge of maintaining, regenerating, tending and utilizing forests in a sustainable way. They learn complex concepts and processes most successfully when they are actively engaged in the learning process. Therefore, the principle of blended learning, a combination of online phases and face-to-face meetings is proposed. In this contribution, a brief description on the didactic concept of the courses in Silviculture, the features of the content management system COCOON, the authoring tool, the process of teaching and the way how students are supported by the integration of different learning objects is given. Rationale, challenges and pitfalls of the approach are discussed.

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1. Introduction

Forests cover a broad range of functions especially in the mountains while having to face particularly difficult climatic and economic constraints. Multi-functionality and the increasing

* Corresponding author. Tel.: +43 1 47654 4052; fax: +43 1 47654 4092.
E-mail address: harald.vacik@boku.ac.at (H. Vacik).
URL: http://waldbau.boku.ac.at/vacik.htm.
demands are hence an important issue frequently raised with respect to sustainable forest management. In this context, silvicultural planning and decision making is tasked to use forests and forest land in a way, and at a rate, that maintains their biodiversity, productivity, generation capacity, vitality and their potential to fulfill, relevant ecological, economic and social functions, at local, national and global levels.

Considering the complexity of natural resource management students should learn to cross-link ecological, socio-economic and technical knowledge. Teachers at the university are forced to enter new fields additional to the classical subjects of forestry to cover the demands of environmental and nature conservation issues as well as planning and coordination techniques. Also the classical concept of classroom teaching at university level has changed in recent years. The general level of integration of information and communication technologies (ICT) in teaching has increased greatly over the past two years among universities in the EU, with three out of four of them experiencing a high level of increase in this regard (PLS, 2004). However, most universities are still at a stage where the use of ICT is limited to treating the computer as sophisticated typewriter and as a means of facilitating communication within traditional pedagogy and didactics patterns in the actual teaching situation, e.g., through the use of presentation programs, data bases or simulation modules. Only a minority of the universities in the EU have yet reached the stage of using ICT as a tool to redesign educational programmes, contents and curricula on the basis of novel didactic frameworks.

Advancing technologies induce changes to current practices in distance education and will expand their possibilities for the future. However, there is still a shortage of high-quality ICT-based teaching material at the universities in the EU or at the University of Natural Resources and Applied Life Sciences, Vienna respectively. Both management and academic staff require inspiration in order to develop their own material. Additionally, developing ICT-supported material and e-learning content is very costly (PLS, 2004). For most universities a primary challenge is to transfer ICT from individual initiatives to becoming a component of mainstream education. This is often impeded by both the absence of a coherent and comprehensive management approach to ICT integration and a certain degree of resistance to change in the university culture.

Although the quality of education in natural resource management might be improved by the use of ICT, only a limited number of e-learning courses as part of both basic academic training and supplementary training is offered (Bryant, 2002; Jenkins & Johnson, 2003; Payer, 1998; Schack-Kirchner, Wöhrle, Wiedenbruch, Hildebrand, & Volz, 2002; Vacik & Spörk, 2000). Moreover, most academic staff lack knowledge concerning the potentials of ICT and the technical and pedagogical aspects for the use of ICT at the university level (PLS, 2004; Schoop, Witt, & Głowalla, 1995).

Distance education has historically generated a great deal of interest in areas where student population was widely distributed. This scenario is characterized by self-motivated individuals working on their own, using course material supplied, print-based media and postal communication, while getting some casual support from tutors via telephone or e-mail (Sherry, 1996). Study courses and programs provided via Internet have given a new dimension to virtual education and raised philosophical and practical issues unique to the method of delivery, interaction and administration of online instruction (Starr, 1998). One of the problems with e-learning in the early days was that learners worked on their own without any interaction with an instructor or other learners. It was soon to become evident that social interaction was an important ingredient to many
learning situations, that there might be need of enriched e-learning solutions. This was essentially the beginning of the concept of “blended learning”. This term refers to a learning solution that incorporates a mix of online and face-to-face elements (Reinmann-Rothmeier, 2003). It has been further refined to the meaning of a learning solution that contains a mix of informational and instructional elements, synchronous and asynchronous learning, self-paced and instructor-led learning, push and pull learning, managed and unmanaged learning, fixed and mobile learning.

Students would learn complex concepts and contents most successfully when they are actively engaged in the learning process. Since not all students learn the same way, nor at the same speed, they would not show the same inner motivation to learn. Thus, students need different levels of stimulation of getting motivated, a responsibility that lies with both the teacher and the teaching method (Palmer, 1998). There are a number of benefits about using a blended learning approach in e-learning situations at universities:

- No decision has to be made about which (technical/didactic) solution is best; a number of solutions might be put together appropriate for each part of a learning problem.
- The opportunity can be taken to blend together more traditional formats with novel ones to initially introduce the students to new ways of learning.
- The variety of different elements causes the students to be more stimulated and motivated than if using just one solution.
- It is also a way to make sure that the presentation of contents is referred to different learner styles, acknowledging that the students’ progress in learning could be gained individually in different ways (e.g., by listening, watching, exploring, practising, discussing, researching).

However, there is one problem with the blended learning approach: unless the different elements of the solution are integrated well, students might pick out the parts of the application they prefer and drop others. This may well be quite acceptable in some learning situations – it may not be a requirement to use them – but in others it will mean that students miss some vital aspects (e-Learning Centre, 2004).

Both the increase of scientific knowledge in the field of natural resource management and the spread of less appropriate tools and techniques for using ICT in web-based learning encouraged us in developing the hypermedia content management system COCOON (COurse COntent ONbline) at the Institute of Silviculture. The customary and usual educational process in silviculture was expected to be supported by ICT using a blended learning approach. In this contribution a brief description on the didactic concept of the courses in Silviculture at the University of Natural Resources and Applied Life Sciences, the features of the content management system, the authoring tool, the process of teaching and the way how students are supported by the integration of different learning objects is given. Rationale, challenges and pitfalls of the approach are discussed.

2. Didactic approach

At the Institute of Silviculture the principle of blended learning is proposed. The institute’s prior objective in teaching is to ensure that students acquire the skills needed for a sound ecosystem-based management of forests. The required knowledge and skills of maintaining,
regenerating, tending and utilizing forests are gained by means of case studies mainly focused on applied lecturing in the field. In this context three models of blended learning can be categorized (Valiathan, 2002):

- skill-driven learning combining self-paced learning with instructor or facilitator support to develop specific knowledge and skills,
- attitude-driven learning mixing various events and delivery-media to develop specific behaviors,
- competency-driven learning blending performance support tools with knowledge management resources and mentoring to develop workplace competencies.

For teaching the courses in silviculture, the skill-driven learning approach is used by means of which different kinds of interaction between students and teacher are linked. This could be via email, discussion forums and face-to-face meetings with self-paced learning such as web-based courses or books. This type of approach could be seen analogous to a chemical reaction, in which interaction with the teacher is acting as a catalyst to achieve the desired reaction-learning. This approach works best when students are gathering content at the knowledge or application levels (Valiathan, 2002). Techniques to incorporate skill-driven blended learning include creating a tightly scheduled group learning plan, using instructor-led overview and closing sessions, using synchronous learning labs and providing support to learners through email.

In the course of the skill-driven learning approach we distinguish three phases. In the first phase of the course, an introduction to the technical aspects of the learning environment of COCOON, the organizational details of the course, a scheduled group learning plan and a motivation impetus to the subject of silviculture is given. This introduction takes place at the very beginning of the course in the training forests of the university. Teachers and students stay a day long outside in the field to get an impression of the purposes and the contents of the lecture in silviculture. This motivation for the lecture during one day field training is similar to the approach prior to the use of COCOON (compare Table 1). Additionally, students are encouraged to drive a test of the learning environment of COCOON.

After the introduction, in the second phase a guided learning process is initialised via the content management system COCOON (Spörk & Vacik, 2002). The students are requested to gain prepared learning material in the web by their own considering the scheduled learning plan, their individual interests and needs. Instead of using hardcopies of Power Point™ slides as learning material, the students get to know the content of the lecture in a problem-oriented way by offering an extensive pool of learning objects (e.g. hypertext, glossary of forest terms, picture and literature data base, search engines). This learning process leads to an evolution of context-free fact knowledge from the transmission (knowing that) to the application of the acquired knowledge (knowing how). During face-to-face meetings with the teacher the students are invited to apply their theoretical knowledge in a more practical sense by discussing different case studies.

Within the third phase, the teacher aims to make students acquainted with the know-how of adapting silvicultural strategies to the management objectives of forest owners by analysing the decision environment of real-world situations. The knowledge acquired in the second phase is to be developed further by the students during practical exercises and excursions in the field. In discussions among students and teachers appropriate forest management techniques are selected to meet various management objectives subject to different settings of ecological and technical
constraints. Applying the acquired knowledge of silviculture techniques and methods should allow students to select context-free rules and attain problem-solution authority. For the third phase there is no online support offered during the excursions and field trips. However, students are requested to use the search facilities of COCOON and make use of their personal notes in the content management system continuously to prepare themselves for the exam.

3. Description of COCOON

When seizing a blended learning approach, the integration of different learning objects offered to the students is most important. The content management system COCOON supports students in the course of their studies by uniting different sources of knowledge and supplying different learning components. Central sources of information are hypertext documents which correspond to the principles of cognitive psychology for supporting natural learning processes to a considerable degree (Euler, 1992). The general argument for hypertext is the principle of cognitive plausibility corresponding to the fact that knowledge is captured and stored in non-linear structures and networks by human brains (Jonassen, 1991). As hypertext is a node-link system based upon semantic structures, it is able to map fairly directly the structure of knowledge it presents. Hypertext structures can reflect the semantic network of an expert and map the expert’s schemata onto

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the novice’s. The network of ideas comprised in a hypertext system can mimic those networks of associated ideas possessed by the author or the learner (Jonassen, 1991). Therefore, hypertext also manifests the principles of cognitive psychology. Instead of transforming information to a linear hierarchical form the information can be transferred into a hypertext structure, still according to the author’s mind. Hence, the learner is able to extract the knowledge within this network of hypertexts without again the process of delinearisation (Baird, MacMorrow, & Hardman, 1988).

3.1. Flow control features

The basic idea of hypertext is to navigate, activate and manipulate knowledge objects that are connected flexibly in the logic of the specific field of application (Rauscher, 1991). These linked knowledge objects are not only restricted to text documents. If for example pictures, videos and audio recordings are additionally integrated, “hypermedia” is employed as a synonym. The knowledge objects are not related in a hierarchy but in a network relation. Each knowledge object constitutes a nodal point in the knowledge network and it is possible to link each nodal point with any other.

Typically, a guided educational course relies initially on a linear structure which helps students to organize their own minds conform to that structure. Flow control features are to make sure that students perceive content pages in a sequential manner building up their own mental knowledge map and keeping confusion and frustration to a minimum. When starting to learn on a new subject, linearity (and hierarchy) is needed at first. In COCOON, a learning path is organized by the flow of hypertext documents. The user is able to go along this path like a guided tour using the “next” and “previous” arrows. The present location is indicated by means of the tree hierarchy of the chapters on screen on the left side and with related chapters visualized in the bottom line (compare Fig. 1). All hypertext documents and chapters visited by a student are marked with different colours. Additionally, the user is able to locate continuously all visited documents according to topic, chapter and time of the last visit in the “history of documents”. Along this path students may mark important chapters by using the “bookmark” feature. Chapters and documents are arranged along this learning path according to the scheduled learning plan. Therefore all knowledge objects (learning contents) might be taken up accordingly to the objectives of the course.

Once a student has gone through this linear learning path, the network of learning objects provided by the hypertext structure is efficient to keep the reselection of material in a course supported by e-learning facilities as low as possible (Smith, Newman, & Parks, 1997). From this point of view it is obvious that students should use other flow control features of COCOON to select the material according to their own interests or knowledge on a specific subject. The screen of the application is divided in four parts: (i) a tree hierarchy for choosing a hypertext document on the left, (ii) the navigation bar for navigating through the hypertext at the bottom right, (iii) the menu for choosing a specific learning object (e.g., discussion forum, search engines, literature base – compare Table 2) at the top right and (iv) the hypertext (including figures, pictures and tables) itself (compare Fig. 1). The tree hierarchy and the navigation bar might be used mostly during the learning path. The use of the menu and the hyperlinks to the glossary, references or related chapters will allow students to examine the course material according to their own interests or in order to apply it to particular problem situations.
3.2. Interaction features

Interaction features are to promote the active processing of learning material by students. A creative design of various dialogues between components of the software application and the students will allow a better understanding of the content presented. In this context different interaction features such as the change of personal settings and notes, the use of search engines, the questionnaires, the glossary or some communication tools (discussion forum, chat) have been implemented in COCOON.
Students have to identify themselves as an authorized user at the start of the course. After the log-in the individual settings (e.g. style-sheet, font-size) for the current student are loaded. Students might change these settings anytime (Fig. 2d). For individual personal notes a scratchpad facility has been implemented. Students may store notes or URLs of external web resources and directly link them to a certain chapter of the content management system (Fig. 2a). When browsing through the learning material these notes will be highlighted, the student may examine them or add some new notes.

Furthermore, different search capabilities are implemented. A full text search engine supports the finding of learning objects with regard to the match of a single word phrase. Additional search capabilities can be offered by means of a thesaurus search engine. The user will be supported during the process of searching by trying to find the most likely results referring to a rule base, which

![Scratchpad Facility](image1)
![Self Evaluation](image2)
![Search Engine](image3)
![User Preferences](image4)

Fig. 2. Examples of interactive learning features of the content management system COCOON.
helps to identify learning objects with a high similarity to the search term. The search engine allows to find text and graphic documents independently (Fig. 2c).

Interactivity is expected to be increased by the application of questions and answers functionalities. Students could do self evaluation with regard to their level of knowledge by multiple choice tests, ranking procedures and other exercises which are linked to specific chapters (Fig. 2b). When browsing through the learning material these tests will be highlighted and students can pass the tests in a sequential manner according to the related chapters or independently from that.

A glossary of forestry related terms is linked automatically to the hypertext documents based on the scientific work of Brünig and Mayer (1989) and Klumpp, Colak, and Pitterle (2002). Terms stored in the glossary database are pointed out by a symbol (🗗) underlain with a hyperlink. This will lead the user to the description in the glossary (Fig. 3).

A discussion forum is used for asynchronous communication, it gives students the opportunity to raise questions per e-mail or organize themselves during the online phase by postings. A chat feature is offered for synchronous communication. Exit polls support a quick and easy exchange regarding organisational details during the online course.

3.3. Presentation and layout

The representation of information is adapted to the needs of forestry students in a descriptive and understandable way by the authors. In this context, the organization of text, the visualization of information and the clarity of representation is most important to meet the demands of the target group (Dörner, 1992). With regard to the organization of text the following rules of thumb have been applied by the authors of the learning material:
for each topic a new hypertext document is started,
- for each learning object (e.g., chapter) the quantity of text is limited to 20 lines,
- each sentence is formulated concisely without redundant or diverting representations (e.g., end-
  lessly repeated decorations, explanations).

Beside text information, pictures and graphics are used to illustrate various topics. Using
graphics causes a simultaneous presentation of the entire information to the reader. Therefore
graphics should be illustrative and compact but as simple as possible. The choice of appropriate
material (graphics, pictures) and a modification by professional graphic assistance was therefore
essential to avoid information overload.

3.4. Motivation

Computer-assisted learning (CAL) applications usually allow to increase the motivation for
learning what contributes to a better processing of the knowledge obtained (Euler, 1992). During
an online course motivative features are important twice. At the beginning of a course the moti-
vation must be stimulated even before the students start to learn. This motivation helps to over-
come cognitive barriers regarding the subject of a course. During the learning process the
motivation must be kept up continuously on a certain level. This will lead to a high level of activity
during the online phases and face-to-face meetings. The content management system CO-
COON tries to cover these aspects of motivation by:

- A catalogue of questions is giving mental impetus (not all questions are directly linked to a spe-
cific chapter).
- Generally, a reference of the authors of the learning material (picture, name, web page) is given
to the students for unveiling the anonymity of COCOON. Students should have the feeling that
“humans” are behind the content management system and no “omniscient power”.
- Feedback on questions and announcements to the learning progress (how much work already
done [%], feedback on test results: how many positive answers).
- Interactive features (scratchpad facility, bookmarks, history, user preferences, self evaluation).

Students will benefit from using these motivative features of COCOON as they are actively en-
gaged in the learning process and will gain a higher inner motivation to learn.

4. Authoring tool

The authoring tool of COCOON supports content processing by various editors such as Word-
Export, GraphicExport, QuickLink, TestEditor and EasyLit (compare Fig. 4). Updating and edit-
ing the learning material is supported by a commercial editor (MS Word™) which makes the use
of any HTML-editor (e.g., Front Page™, Dreamweaver™) nonessential for authors to transfer
learning material to hypertext. Authors are only obliged to use three different templates for pre-
paring (i) a document for the content, (ii) a document for the terms of the glossary or (iii) a doc-
ument for the references used in the hypertext. Authors use the features of MS Word™ for making headings, figure captions or references in the text. All three edited text documents (including graphics, pictures, tables, references) are formatted automatically and worked on over macros, so that all information is put down structured into a database. Before starting with the processing of the documents the author needs to indicate the source (directory on harddisk) and the designation (course database on the server) of each document. General information on course objectives or organisational informations can be filled in a form. After the import the resources are immediately available online on the web server. Depending on the size of the three documents this import process can last between a few seconds and some minutes. The terms included in the glossary document are automatically linked by hyperlinks to the corresponding terms in the specified document containing the content. Also the references used in the hypertext are automatically linked to the corresponding terms in the literature database. Additional editing features, layout specifications for the graphics, features for creating a questions and answers catalogue and a link...
editor can be used by the author (compare Fig. 4). These additional editing features are especially useful to facilitate a straightforward correction of typing errors or adding of additional links to related documents or web resources within the network structure.

Access to the content information of the decentralized data bases is made likewise by inquiries which take place in the form of Query Scripts using server-sided-scripting (PHP) embedded in HTML code. Contents are read in directly from the data base, different style sheets allow a dynamic format of the learning material during the process of the presentation on the web (Kortschak, Vacik, & Wolfslehner, 2001).

5. Findings and aspects on future developments

For evaluation purposes a formal questionnaire was circulated around the students after the first year of the combined use of COCOON and face-to-face meetings. The evaluation tried to cover all aspects of the new didactic approach and the content management system by means of 24 questions. Students were asked to answer these questions with a scoring [ranging from (1) – I totally agree to (5) – I do not agree] and could express their opinions in verbal form. The return rate of the 35 questionnaires was 95%. Beside the feedback of the students, a self-assessment of the teachers helped to identify potentials for future improvements.

The results of the evaluation indicated an advantage of this learning approach by the fact that teachers are given the opportunity to substantially better address the problems and questions of students regarding the subject of the course. It is possible to discuss silviculture related issues with regard to the students’ personal knowledge, interests and experiences. Teachers receive more feedback (e-mails, personal feedback in the classrooms) than with a lecture in the traditional way. A stronger integration of teachers and students might increase or improve social contacts additionally. This will lead to a higher motivation among teacher and students and a higher motivation to cooperate among students.

According to the additional use of the COCOON, the time of face-to-face meetings is reduced by 1/3. This leads to an increase of temporal and spatial independence which causes a better economic situation for the students. In the past, students were forced to travel to Vienna from all over Austria to take part in the classroom teaching of the Silviculture courses. Nowadays, it might be possible to reduce travel time and time of presence. The continuous learning process with the online environment makes it possible for students to pass the exam after the end of the last unit without major additional learning effort. This will lead to a decreasing study time.

However, there are also some disadvantages and shortcomings which come along with the new way of teaching at university level. Due to the reduction of the number of face-to-face meetings in the classroom certain time pressure occurs during the individual meetings due to questions on technical problems with the application or some organisational details thus reducing time for discussions on course contents. Also, teachers have to get used to a new kind of knowledge transfer in dialogue form not at least because preparation for the meetings is expected to be more time consuming for them.

Additionally, it has been observed that in the beginning students underachieved to prepare themselves for the meetings for several reasons (time constraint, limited internet access). This sometimes led to a repetition of the contents already available online during the meetings instead
of an intensive discourse on the material. Therefore, a printable version of the hypertext documents will be offered to the students already before the course starts which should help to make preparation for the discussion easier. So, additional incentives are recommended to encourage students to use the content management system COCOON more often especially in the transition period (chats to be announced for special topics, seminar works distributed to virtual groups). It became also evident that students did not really use the search functionalities to investigate the learning material on their own interests and needs offered by COCOON. Therefore, the advantages and technical functionality of search functionalities should be propagated emphatically, so that students use it increasingly during their studies. The asynchronous communication did not work well in all cases, too. Questions of the students posted in the night before the next face-to-face meeting have been difficult to answer in the discussion forum right in time.

Design and user capability of learning environments are always important to attract students in using an online application. But also the way authors are able to put learning material online is essential, especially at university level. Teachers in natural resource management normally are not used to give online courses or even start to move from the concept of classroom teaching to an integrated use of ICT components. Hence, it is important that an authoring tool should enable teachers to develop online material as easily as possible. As there is no need for the authors to make use of any HTML-editor to get learning material available online the authors are expected to use the tool more intensively also for others courses.

E-learning approaches in a traditional-patterned pedagogic landscape at universities have to bear the obstacles of pioneering work. Both students and teachers often lack experience and technical know-how on the learning process. So there is only limited information available on how students in forestry come along with a blended learning approach using a web application online and attending face-to-face meetings in a classroom in a traditional sense. The positive feedback of students on our efforts to improve the quality of teaching and the availability of opportunities for the use of online resources might lead to further improvements regarding the learning process and the technical features of COCOON.

In cooperation with some European partners it is planned to design and to establish a virtual forestry faculty in Europe (VIEFOR). The principal focus of the activity is on supporting the development of distance learning and on the development of suitable study materials. The VIEFOR project will gain experience of virtual education by establishing joint distance learning modules, by creating new study programmes via Internet, and by modifying existing study material to virtual format. Furthermore, other supporting activities for VIEFOR are designed like an expert exchange module, a teacher training and support module, joint discussion forum to enhance co-operation in Europe and virtual mobility of experts and students. This will lead to a better understanding of the new aspects of using a content management system to improve the classical concept of classroom teaching.

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