Flop or Top - Experiences with E-Learning in Academic Education

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SUMMARY

At the BOKU - University of Natural Resource Management and Applied Life Sciences, Vienna (BOKU), geomatics education is an essential part in several study programs on bachelor and on master degree. The huge volume of courses (lectures and/or practicals) for more than 450 students must be managed by the teaching staff of the Institute of Surveying, Remote Sensing and Land Information (IVFL). Modern teaching methodologies and techniques are utilised by the 8 lecturers to meet the challenges for offering high level education to all students. 6 years ago the concept of *Blended Learning* was introduced at the institute using the provided e-learning platforms of the university.

The paper summarises the experiences of three staff members in the application of e-learning tools in general and their operating experience with the software package *Moodle* in particular. Results of a SWOT (strengths, weaknesses, opportunities, threats) analysis of the *Blended Learning* – concept at the institute are presented by covering items, like availability of tools for knowledge transfer, the possibility to appraise the student's knowledge, the economy of time, the usability of the provided e-learning platform, the acceptance by students, and the flexibility of schedule.

The results of the analysis are proven by a variety of applications. At the IVFL *Blended Learning* is provided for various courses with a broad spectrum of specifications, ranging from courses for a few to a large number of students or from introduction courses to advanced courses. The concept of *Blended Learning* is used for lectures as well as for practicals.

1. INTRODUCTION

Knowledge is an important resource for high-industrialised countries. The fundamental ingredients for the development of this resource are education and training (Hartermann 1999). But knowledge is not only a privilege for industrialised countries, it is a resource needed all over the globe. The globalisation of economy as well as the complexity of global ecology demand well-educated experts in every country and in every region of the earth.

Research organisations and education institutions are in charge for the development and the transfer of the resource *knowledge*. They have to prepare and to provide high-quality education and up-to-date training for students and experts in specific professions. Research and educational bodies, like universities, have to adapt their course programs to the demands

of the specific fields of profession and they are obliged to introduce modern teaching technologies.

The Institute of Surveying, Remote Sensing and Land Information (IVFL) is admitting to the above mentioned responsibilities and introduced e-learning activities to improve the knowledge transfer to the students.

2. E-LEARNING: DEFINITION AND CONCEPTS

E-Learning can be defined as an approach to facilitate and enhance learning through computer using appropriate software and modern communication technology. The evolution of the largely technology driven e-learning concept has been pushed with the development and penetration of web-services enabling students a higher flexibility and an easier access to learning resources. But e-learning is much more than a technological tool for placing existing learning resources online and for reaching a wider body of students: it must be seen as a pedagogical means for enhancing the learning environment (Veenendaal et al. 2005). The potentials of e-learning can be characterised by three aspects (Kerres 2004, Frommann & Phan Tan 2005):

- Other teaching and learning methods can be applied.
- Increased flexibility of time and place offer a better organisation of learning.
- A shorter study time can be achieved.

These potentials do not evolve automatically by using e-learning concepts and environment, but e-learning triggers and helps to realise these potentials. Enhanced possibilities in the organisation of courses disburden teachers, in particular those who have to deal with a large number of students. For practicals the time schedule often does not allow deepened exercises. Especially students appreciate the flexibility of time and place.

Teachers and students often prefer face-to-face learning. So the success of e-learning depends on the implementation and compilation of computer-supported courses. Only if advantages in comparison to the classical teaching are obvious, new media will have a chance in teaching (Bischoff & Bähr 2002).

The additional value of a complementary or replacing use of electronic media for teaching purposes in the GIS domain at various education levels is well accepted in the meantime (Glowalla 2005, Schiewe et al. 2005). Especially in the fast developing field of geomatics, new learning methods are required. A large number of courses were established (e.g. UniGIS - various universities, like University of Salzburg, Austria; University of West Hungary; FerGI - University of Vechta, Germany; geoinformation.net - University of Bonn, Germany; GITTA - University of Zurich, Switzerland). Several papers describe these projects and discuss their applications (e.g. Krüger & Brinkhoff 2005, Fisler et al. 2005).

Two main concepts of e-learning courses can be distinguished:

- **Blended learning** describes the combination of online and traditional face-to-face teaching approaches. The tools provided by an e-learning platform should complement traditional face-to-face learning.

- **Distance learning** does not require a physical presence of students at the university. Courses and teaching material is provided exclusively in a digital form and teachers and students communicate via electronic media.

Within the last decade numerous e-learning-software platforms (e.g. *Blackboard*, *Hyperwave*, *Ilias*, *Metacoon*, *Moodle*) were developed with different concepts and supporting different operating systems. Most of them offer a wide range of functionality:

- for the publication of documents,
- for promoting the interactive cooperation and communication between lecturers and students, and
- for administration purposes.

In detail the systems have features, like electronic assignment submissions, virtual areas for group work, self-assessment quizzes and online testing, tracked specific student activity, poll, glossary, survey, discussion forums, and links to external web-sites.

Standards were introduced to enable the exchange and the delivery of courses over various teaching platforms. Some relevant initiatives for the standardisation of e-learning are AICC (Aviation Industry CBT Committee), ADL (Advanced Distribution Learning Initiative, IMS (Instructional Management Systems Project), IEEE LTSC (Learning Technology Standards Committee of IEEE) and SCORM (Sharable Contend Object Reference Module) (Häfele 2002).

3. TEACHING AT BOKU AND IVFL

The BOKU is a teaching and a research institution that focuses on renewable natural resources. The relationship between human beings, society and environment for securing the well-being of future generations form the basis of all activities at BOKU. 5000 students – of which 15% are international – are educated in various courses to achieve competence in fields, like:

- Land and water management,
- Environmental Sciences,
- Agricultural, Forestry and Wood Sciences,
- Biotechnology and Food Technology.

In order to fulfil the requirements of the EU's Bologna Agreement with respect to curriculum development, the university has redesigned the study course (curriculum) structure from five diploma courses to 9 bachelors and 19 master study courses (curricula) within the last four years.

The IVFL focuses on the development of rational and engineer-orientated approaches for the solution of environmental issues. The institute has expertise in the quantitative assessment and modelling of spatial information. The main objective of the teaching activities is the provision of solution-orientated competence and not only the delivery of knowledge.

IVFL offers education in geomatics for several study programs on bachelor and master degree (*Figure 1*). The whole spectrum of geomatics - including field and cadastral surveying, photogrammetry, remote sensing, GIS and GPS - must be provided for approximately 450 students per year.

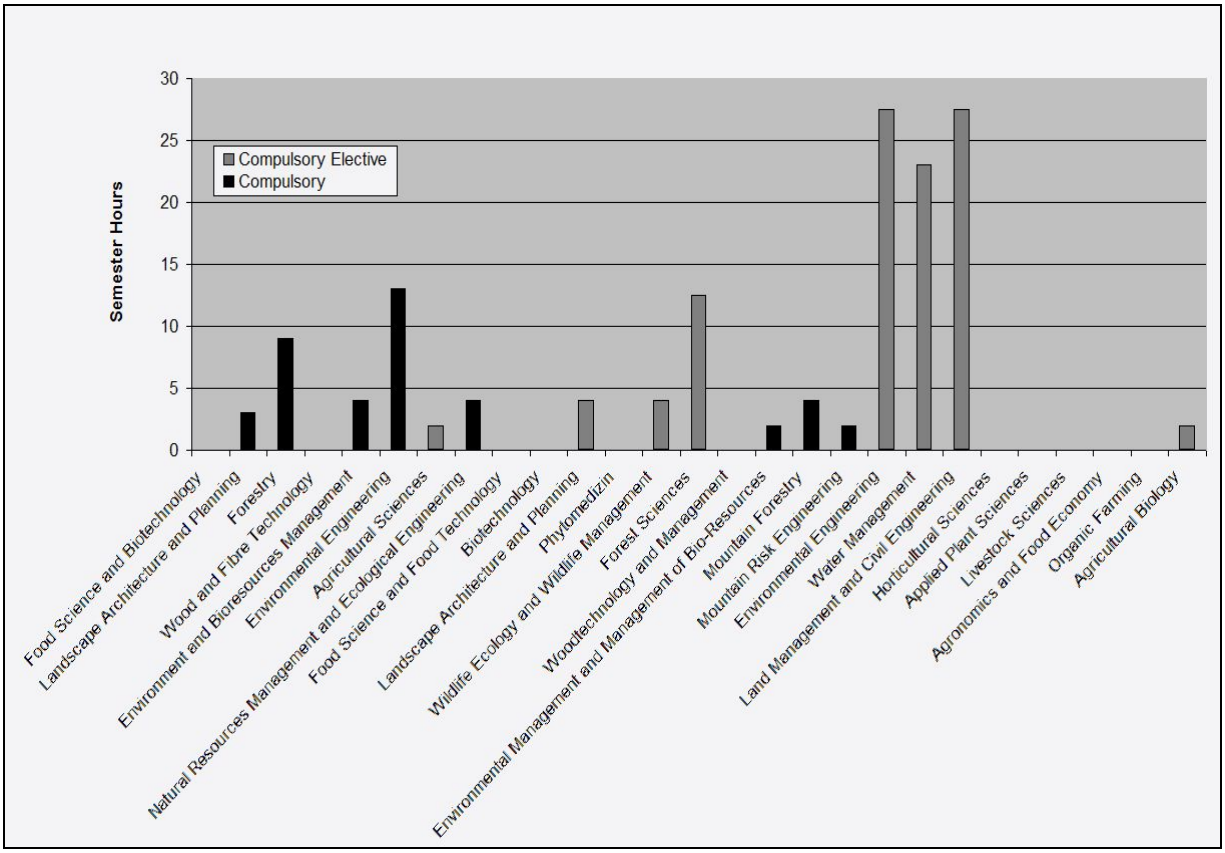

Figure 1: Courses provided with geomatics education at BOKU (in 2005/2006)

Taking into account that some of the courses are offered for two or three study programs simultaneously, the 8 members of permanent teaching staff still have to manage and to provide the huge volume of approximately 110 semester hours (1 semester hour represents one instruction unit per week with a length of 45 minutes for the duration of a semester).

It is obvious that education plays a central role at IVFL and that therefore members of IVFL are interested in didactic issues and in modern teaching technologies. The objective of all these efforts is to improve the quality of education and simultaneously – from the point of view of an academic staff member - to shift working time from teaching activities to research activities.

4. E-LEARNING AT BOKU AND AT IVFL

In 2001 e-learning was introduced at BOKU. In the last couple of years, several platforms were tested and benchmarked. The first software package supported by BOKU was *Ilias*, an Open Source Learning Management System that is offered free of charge. At this time the software and also the whole e-learning components had a less usability and a weak performance. Therefore the software in particular and the e-learning concept in general were hardly accepted by teachers and by students with the consequence that *Ilias* was replaced by the e-learning platform *Hyperwave*. Unfortunately this e-learning platform could not fully be integrated to the BOKU administration system.

In autumn 2005 the virtual learning environment *Moodle* (Moodle 2006) was implemented at BOKU. *Moodle* is a free, Open Source software package with a large and diverse user community. It is widely used in education and was recommended by the Austrian Ministry for Education, Science and Culture. *Moodle* offers a number of modules and features that meet the requirements of teachers as well as the requirements of students. Within the last 7 months more than 130 courses were established at this platform. More than 2100 students are currently registered for these courses (that are approximately 45 percent of all the students). At the moment about 11000 accesses are counted per day, whereas all the mentioned numbers are increasing steadily.

IVFL was a pioneer in the use of BOKU-provided e-learning tools and witnessed all the ups and downs during the implementation process. At this time the institute intended to achieve the following two goals by using e-learning tools:

- Saving teaching time in the lecture hall: the high number of students in some of the study courses requires the splitting in smaller teaching units, especially for exercises and for practical fieldworks. The one-time preparation of selected course modules within the e-learning environment enables a multiple virtual delivery of knowledge and training material to all teaching units (up to 10!!).
- Harmonisation of the knowledge: due to the various options of a pre-university education the students have different levels of knowledge in mathematics and statistics. Self-assessment quizzes enable the students to identify their weak points and provided training material (e.g. on trigonometry as a prerequisite for surveying) helps them to overcome these lacks.

Potentially there is one additional reason why the institute supported the e-learning initiatives at BOKU from the very beginning: Surveying is characterised as an engineering science. Surveyors are well-educated in computer-sciences and they have a special interest for technical tools. Therefore the e-learning software with its various technical components (e.g. content management systems, web based communication tools) is a big challenge for *Techno-Freaks*.

During the last 6 years the institute became power user of the e-learning platform and gained a lot of know-how in e-learning. The operating experiences with three different platforms *(ILIAS, Hyperwave, Moodle*) and the continuous feedback from the students were important inputs to optimise the organisation, the content and the shape of virtual courses. Today the e-learning software is also used as a communication tool between teachers and students. A couple of examinations are handled by the powerful online test features.

5. E-LEARNING COURSES PROVIDED BY IVFL

In the study year 2005/2006 IVFL provides a total of 31 courses in the fields of surveying, remote sensing and Geographical Information Systems for 5 bachelor study programmes and for 11 master study programmes at BOKU. The number of students per teaching unit is varying between 5 and 160. 10 of the courses are supported by e-learning modules. *Table 1* outlines the various characteristics of these courses, including the number of credits of the European Credit Transfer System.

COURSE	Credits	# of students	Compulsory (C) or Comp. Elective (E)
Surveying for Landscape Architecture and Planning (Bachelor course level)	2.0 ECTS	160	C
Geo-Informatics (Bachelor course level)	4.0 ECTS	30	C
Surveying and Mapping (Bachelor course level)	1.0 ECTS	20	C
Geo-Data-Management (Master course level)	3.0 ECTS	15	E
International Land Management (Master course level)	2.0 ECTS	5	E
Remote Sensing and GIS in Natur. Resource Mngmt. (Master course level)	3.0 ECTS	20	E
Surveying for Environmental Engineering (Bachelor course level)	3.0 ECTS	112	C
Location and Navigation Using Satellites (Master course level)	3.0 ECTS	25	E
Remote Sensing (Bachelor course level)	2.0 ECTS	112	C
Geographical Information Systems (Bachelor course level)	1.0 ECTS	160	C

Table 1: e-learning supported courses at IVFL (study year 2005/2006)

The intensity of e-learning support in the specified courses is different and can be classified into four stages as shown in the following chapters. Considering as example for each of the different levels of e-learning support a representative course will be presented.

5.1 Provision of course materials (*Location and Navigation Using Satellites*)

The compulsory elective (students have to select *n* out of *m* offered courses within a field of science) course *Location and Navigation Using Satellites* is provided for three different master programmes. Principles of Satellite Positioning Systems and especially their applications in water and civil engineering, agriculture, and forestry are taught in face-to-face courses. In field works the students are skilled in the practical handling with GPS.

The following activities are supported by the e-learning software:

- Delivery of news (e.g. change of dates for course, meeting points)
- Delivery of teaching documents (presentation slides, textbook)
- Board for the announcement of examination results

5.2 Blended learning (*Surveying for Environmental Engineering*)

The aim of the course *Surveying for Environmental Engineering* is to give the students an understanding of basic surveying theory and about standard surveying equipments. Methods of surveying and methods of calculation are presented. Emphasis is placed on accuracy of measurements and valuation of errors, since these are important criteria for choosing an appropriate method in the practice. The courses aim to provide the information and skills needed for this particular decision-making process. The students should also gain a basic understanding of the use of public available planning documents (e.g. available control points, real estate data base, cadastral and topographic maps).

Additional to face-to-face teaching units and additional to e-learning features outlined in *Chapter 5.1* the following activities are supported by the e-learning software:

- Handling of the whole date definition
- Discussion forums (teacher ⇔ students, students ⇔ students)
- Online chat
- Self assessment quizzes to harmonise the knowledge of students
- Links to web-published literature
- Down- and upload of assignments (including information to tasks and grading)
- Online tests (see also *Chapter 5.4*)
- General administration (e.g. access statistics, quiz results, analysis of quiz questions)

5.3 Distance learning (*Geo-Informatics*)

The theoretical and practical course *Geo-Informatics* is an introduction course. The aim of this course is to give the students an understanding of the theoretical and practical background on which geographical information systems are built up. While the theoretical part gives an overview of definitions and terms related to geographic information processing, the practical part of the course demonstrates the functionality of specific software tools. The first one is based on a face-to-face classroom.

Due to the limitation of workstations in the computer lab, the practical part has to be split up into several groups. One group was offered as an e-learning module. Students are given a student license of a GIS which is installed at their own PCs or notebooks. The web-based e-

learning course explains the functionality of the software and with the help of several exercises students can practice their skills. The course is built up on a small project. Starting with georeferencing a scanned map, digitizing objects, the GIS is finally used as a decision making tool. At the end a map including the results of the analysis has to be submitted by the students. Voluntary face-to-face tutorials help the students to improve their skills.

In addition to face-to-face teaching units and additional to e-learning features outlined in *Chapter 5.2* the following activities were supported by the *Moodle* software:

- Animated gifs and films to advice students in the handling of software tools
- Surveys for evaluation of course acceptance

5.4 Self assessment quizzes and tests (examinations)

A very time-consuming process in the field of teaching is the taking of examinations. The appraisal of students should be objective, transparent and traceable. In practice this means a couple of test questions for checking the students regarding their knowledge in the field of science and their achieved competency for solving specific problems. And finally, the whole examination process has to be documented.

The IVFL has to examine approximately 1200 students per year. Dependent on the subject and dependent on the character of the teaching unit this normally was done by oral and/or written examinations.

Since three months at IVFL some of the examinations are taken by an electronic way using the test feature of *Moodle*, which is a very powerful tool. Teachers have various options for the performance of tests, like the definition of a time limit or attempts allowed and the possibility to shuffle the sequence of questions and answers (in the case of multiple choice questions). The system offers a bundle of security options for providing the tests only to the examinees. The time-frame for tests can be specified and the access to tests can be restricted by password and network addresses of computers.

The variety of question tools provided by the e-learning platform and the organisation of questions in categories allow the checking of the knowledge of the students in a specific field of science but they also enable the check of their understanding regarding the contexts. Using the grading facilities included in the test module the students will receive immediately the results of the examination after the closing of the test. As an option feedback to individual answers can be provided by the teachers.

In the meantime the institute got some experience with this test module. 200 examinations were taken using the infrastructure of the computer lab (15 working stations) of the institute. Approximately 300 questions were prepared using some of the following test possibilities: single answer questions, multiple answer questions, true-false questions, embedded answers, matching, numerical examples.

As mentioned in *Chapter 4* the homogeneity of knowledge is – due to the different pre-education of students - a critical issue at the beginning of each course. At IVFL this gap could be closed by the implementation of self assessment quizzes. Most of the students used this opportunity for checking their knowledge and most of them downloaded basic teaching materials for upgrading or updating their knowledge to the required level.

But self assessment quizzes also were used for encouraging the students to learn continuously. In an interval of approximately four weeks the students could take a short test to verify their actual standard of knowledge. Incentives for absolving the test were given in form of bonus points.

6. SWOT-ANALYSIS

The analysis of the pros and cons is based on the experience of teachers involved, on the feedback given by students (through personal contacts and/or discussion forums) and on a survey linked to one of the courses. The SWOT analysis will discuss the implementation of e-learning at IVFL in general but also will focus on the software platform *Moodle* provided by BOKU.

6.1 Strengths

One of the main strengths of e-learning is the high flexibility in regard to the workplace and to time for lecturers as well as for students. This statement is top ranked by all respondents.

Traditional teaching is mainly based on frontal instruction, while e-learning promotes interaction and self-active learning. Especially for computer oriented practicals that are supported by e-learning, students have more time for practicing with the software. Animations (animated GIFs) and short films can help to advice students in the application of specific software tools.

Students appreciate the easy access to learning materials and the possibility to test their knowledge using self-assessment quizzes and online tests. These features are seen as an ideal preparation for the final examination. From a lecturer's point of view, self-assessment quizzes lead to a harmonisation of knowledge. This fact could be experienced during face-to-face courses.

As stated above, the *Moodle* software offers excellent tools to design and to set quizzes consisting of a variety of question types. Quizzes were not only used for self-assessment but also for the final examination in order to deal with the large number of students. Final examinations were held in the computer lab of the IVFL. The designing of the quizzes was time consuming, but the implementation was a big relief for teachers. Results of the examinations were immediately provided to students and extensive marking was not necessary. Furthermore, it could be observed that the results of computer-supported examinations were better accepted by students than the results of conventional examinations.

The overall experience is that *Moodle* is user-friendly and self explanatory. Students and teachers had no problems to get used to the platform. Compared to other platforms tested at the BOKU, *Moodle* offers high stability and good performance.

6.2 Weaknesses

An advantage of e-learning argued sometimes by university administrations is its cost efficiency. While e-learning offers high flexibility, the design of courses is a time-consuming process. The preparation of e-learning courses needs more human resources than the preparation of traditional courses. This was experienced by all teachers so far. Course materials have to be adapted in a different way. Cost efficiency is given when e-learning replaces parallel courses.

One of the critical points is the communication with students. For the communication, discussion boards can be established. The main problem is an asynchronous exchange of questions and answers. While in traditional teaching problems can be resolved immediately, e-learning bears the risk that students have to wait for the answer and get stuck with a problem. This might lead to frustration.

The acceptance of e-learning courses at the IVFL is somehow ambivalent and a fear of contact could be noted. For example, at one course all places offered for the practicals with face-to-face learning were immediately fully booked while the offered e-learning group was still empty. One reason is, that the new e-learning platform at the *BOKU* was introduced just a couple of months ago and students were still not familiar with the new technology.

Another disadvantage is the lack of infrastructure. It cannot be assumed that all students have access to computers and internet at home. Normally, computer labs at the university are overcrowded and not ideally suited for self-studying. The increased screen handling was also criticised by some students.

It could be observed that tools as the discussion boards for some courses were not used as aimed by the teachers. The idea was that students could help each other for solving specific problems thus reducing the intervention of teachers. In reality, mostly teachers had to answer the questions, as too few students were online at the same time or as they had not the knowledge to solve the posted problem.

It was argued by students that e-learning courses are more time-consuming than traditional face-to-face courses. This fact is true for software courses.

6.3 Opportunities

State-of-the-Art e-learning platforms offer a number of tools for teachers. They include access to course materials and documents that students need for the selected course. The design of e-learning courses is not easier and not more time-saving compared to traditional learning, but it can be seen as a kind of creative work rather than routine work. Especially for holding courses with many parallel groups, e-learning offers an advantage. Instead of teaching small groups of students several times, all students can be advised at once.

Moodle offers a number of tools to control the progress of the students. It documents student activities in a concise manner. The application of quizzes and tasks help teachers to monitor the progress of students.

6.4 Threats

Regarding the final examinations based on online tests, the first implementation revealed weak points of the software. The *Secure Window* of the *Moodle* software did not work as expected and offered students the possibility to access course materials during the examination. Teachers should adhere to the phrase: *Trust is good, control is better*. As for conventional written examinations, supervision is essential.

A strict time table for a course based on e-learning is advisable as students tend to finish a course *last-minute*. The partition of an online course into smaller units is of advantage.

Pure distance learning was not appreciated by all students. For them e-learning also means that the time in front of the computer is increasing with the extension of courses based on this new technology.

7. CONCLUSION

The experiences of teachers at the IVFL confirm that e-learning tools offer a number of advantages in comparison to traditional teaching methods. From the authors' point of view, e-learning makes an essential contribution to quality assurance in education.

The acceptance of e-learning at the BOKU is still somehow ambivalent. Both teachers and students have sometimes reservations regarding new teaching approaches. With increasing computer knowledge of students (and staff) and increasing internet penetration this fact will be reduced in the future. A prerequisite for an efficient application of e-learning is a perfect adjusted hard- and software environment combined with a support unit.

Face-to-face teaching will not be replaced by e-learning but the concept of *Blended Learning* will be an important teaching methodology in the future. At the IVFL the e-learning supported study program will be extended and additional courses in the field of geomatics will be offered.

There is no doubt that e-learning enables new opportunities for knowledge transfer – also in terms of life long learning. Alumni will be given access to further education and they will get proper possibilities to update their knowledge.

E-learning will open new potentials for co-operations between universities. Study programs of different universities will be linked and virtual lecture halls will improve the international knowledge transfer.

And finally to answer the question in the title of this publication: At BOKU in general and at IVFL in particular, the first implementation of e-learning was due to infrastructural and software specific problems a FLOP. But in the meantime the situation has changed in a positive way and the authors now agree in their opinion – based on their experiences of the last months: e-Learning in academic education is TOP!

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