FIELD REPORT ON FIVE YEARS OF eLEARNING
Observations and Inspirations

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Keywords: eLearning, Course evaluation, Case study.

Abstract: Due to the limitations of staff, especially at small universities, eLearning is a perfect addition to traditional courses. Nonetheless, the development and maintenance of online courses is not trivial. The usage of these courses can also be quite challenging for students, who are generally familiar with traditional lectures.
In this paper, we are contributing our experience in creating and maintaining online courses. We will also describe different types of blended and pure online courses used in our department. Some of the observations made during this evaluation do not only apply for online courses, but are also true for traditional courses. Finally several interesting features to improve eLearning are presented.

1 INTRODUCTION

The advances in computer and network technologies over the last decade resulted in a continuously growing availability of Internet services and networked applications. Following this development, many universities started to offer online courses.

The advancement of eLearning is not only recognized by universities, but also the industry discovered the advantages of eLearning. particularly to provide continuing education to their employees. Compared to a traditional course or workshop, an eLearning course does not require all participants to attend the course at the same time. Rather, it offers participants the opportunity to define individual schedules that allow them to optimize their use of time. Furthermore, the employer can easily oversee the professional development of his/her employees. IBM, for example offers online training not only for its employees, but also to those of other companies (IBM Training, 2009).

Most eLearning courses consist of text, graphics and remote hands-on exercises. They can be used as a complement or as a replacement for traditional lectures. When eLearning content is supporting regular courses it is referred to as blended learning.

In this paper we present an overview of current learning methods used at the Computer Science Department of the University of Neuchâtel (Switzerland), as well as observations made from their usage. The presented learning methods are in use since about 5 years. The contribution of this paper is an evaluation of online and blended courses from the perspective of the tutors and developers. First, we will explain some contextual particularities of the universities in Switzerland, followed by a discussion of related work. Section 2 describes the context and background of our eLearning activities, which are then reviewed in the following section. Our proposals to improve eLearning are presented in Section 4. Finally we conclude our work in Section 5.

1.1 Swiss Context

In the year 2000 the Swiss Virtual Campus project (SVC) (Swiss Virtual Campus, 2009) was launched. Its main goal was the development of internet-based courses at the Swiss institutions of higher education. Nine years later, 82 courses were available covering a wide range of disciplines, from computer science to law or history. One requirement for the development of these courses was that at least three different institutions had to participate in their creation.

The SVC closely collaborates with the SWITCH foundation (SWITCH, 2009), which provides Swiss wide IT-solutions at institutions of higher education. One of its services is SWITCHaai, a single sign-on solution for eLearning and web applications available to all participating universities in Switzerland. The SWITCHaai service (see Fig. 1) is improving interoperability, privacy, security and trust. Through this large scale user management system, students can at-

Sturzrehm H., Fautsch C. and Kropf P. (2010).
FIELD REPORT ON FIVE YEARS OF eLEARNING - Observations and Inspirations.
In *Proceedings of the 2nd International Conference on Computer Supported Education*, pages 317-324
DOI: 10.5220/0002779003170324

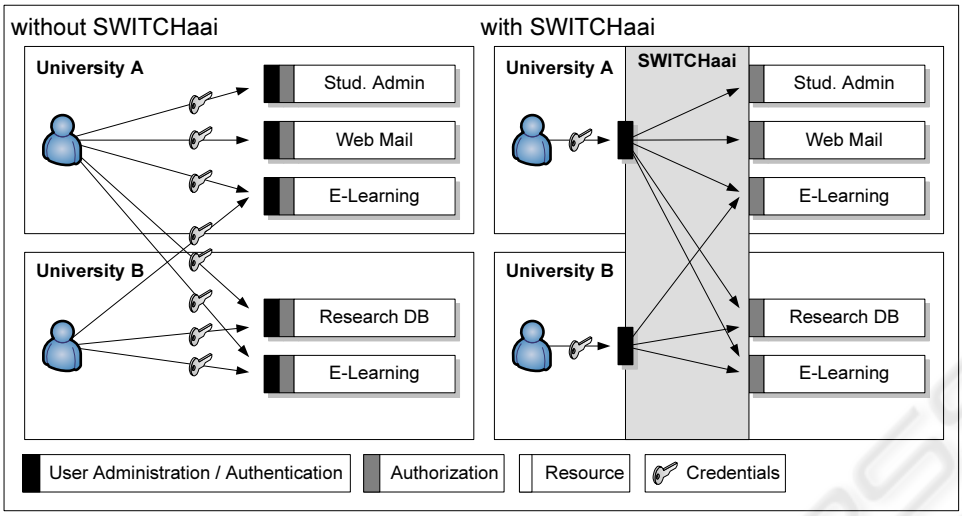

Figure 1: Features of SWITCHaai.

tend all SVC courses independently from the location of their home university.

Most Swiss universities are quite small compared to the ones in other European countries. As a result, the collaboration between them is well established. One of these collaborations is the BeNeFri network of universities (BeNeFri Network, 2009). All students enrolled at the Universities of Bern, Neuchâtel and Fribourg can attend courses and acquire credits at the other facilities. Furthermore, the schedules are adapted to their needs taking into account that the travel time between the facilities is at most one hour by train.

One particularity of BeNeFri concerns the different teaching languages. In Bern, the main language is German, in Neuchâtel it's French, and in Fribourg both languages are used in classes. However, with the introduction of BeNeFri, more and more classes are taught in English at all three universities. With the help of joint online courses, the time the students need to travel can be reduced and a larger variety of courses can be offered to the students.

1.2 Related Work

eLearning has been regularly used at universities for more than a decade. Consequently many of them are evaluating those courses now. For instance, Jung *et al.* (Jung et al., 2008) are focusing their analysis on the acceptance of eLearning by the users. They identified a relation between the student's perceived usefulness of an eLearning system and the student's attitude towards it. Therefore, it is very important to explain the system to the students and to guide them appropriately, in order to improve the student's attitude toward the course.

Dalsgaard is focusing more on the self-organized learning aspect (Dalsgaard, 2006). He concludes that Web 2.0 tools like wikis or blogs can be used to support independent lifelong learning. When using these tools in a self-governed and problem-based learning approach they could improve the learning impact. Unfortunately eLeaning courses at universities can not be as open-ended as proposed by him, because degree programs are always aiming a certain goal, e.g., graduating or passing a course exam.

Concerning hands-on laboratories many implementations are available by now, e.g., VISIR (Virtual Instrument Systems In Reality) from the Blekinge Institute of Technology (Sweden) (Gustavsson et al., 2008) or our NeOS (Neuchtel Online System) (Sturzrehm et al., 2008). Unfortunately, most of them can only be used in a certain area of expertise. VISIR is a hands-on tool, which allows students to perform electrical engineering experiments from home. Some of these experiments would normally include quite expensive lab equipment, which can be simulated to prevent damages, or be remotely shared between universities to reduce costs. On the other hand our NeOS is constrained to programming tasks and could hardly be used in other domains.

2 APPLICATION

We will start our case study with a description of the eLearning architecture used at the University of Neuchâtel, followed by brief descriptions of our eLearning and blended learning courses.

2.1 Technologies in Use

For the traditional lectures at the University of Neuchâtel the open source eLearning platform Claroline (Claroline, 2009) is used[1]. Unfortunately, often only a few of the available features of the system are utilized, e.g., the system is used as a storage for presentation slides or as submission portal for exercises. Other available features included such as chat, forum or wiki are rarely used.

Another platform, called WebCT[1] from Blackboard (WebCT, 2009), is used for the BeNeFri online courses, which are part of the SVC. Again the mainly used feature is the content storage, but in contrast to traditional lectures the content is presented in the form of HTML documents. The evaluation of the students' acquired knowledge is done using this portal with multiple choice questions and hands-on experiments.

Since some of our experiments can only handle one user at a time, we need to schedule their access. For those hands-on tasks, we are using a custom built reservation system (Wulff et al., 2008) allowing the students to reserve a time slot for conducting their experiments.

In order to protect the lab machines, we are using the architecture (Braun et al., 2006) shown in Figure 2. The lab machine is protected from the internet with a firewall which can only be passed through a ssh connection. When the students want to access the lab machine, they have to connect to the Apache Tomcat web server (Apache Tomcat, 2009), which is using the Shibboleth (Shibboleth, 2009) plug-in. This plug-in serves as connector to the SWITCHaai and the reservation system. After successful authentication the student can access the lab machine via a single-use ssh channel. Normally the access is granted for one hour. Afterwards the ssh account is disabled.

The technologies used for the exercises are diverse. In one task, the students have to configure routers and switches using a Java applet serving as network simulator. In an other task the students have to implement a driver for an USB radio device in the C language. To realize this assignment, they have console access to the lab machine to which the device is connected.

In order to generalize the implementation environment for assignments, we developed a configurable hands-on application called NeOS (Sturzrehm et al., 2008). It is using the same architecture as described above and consists of a Java applet located on the Shibboleth web server and a Java application on the lab machine. Both parts allow users to locally program in an editor-like user interface and then test the program on a well secured remote machine. During this test run the implementation is automatically evaluated and a feedback is returned to the student. When their program successfully solves the task, an encrypted file is sent to the student. This file is submitted to the course portal as final solution. The encryption enables us to identify the student and raises the efforts needed to betray. For the decryption of this file, so that the tutor can grade it, our framework is aiding the tutor with a small application. This tool is also supporting a cross check system for detecting plagiarism in the solutions.

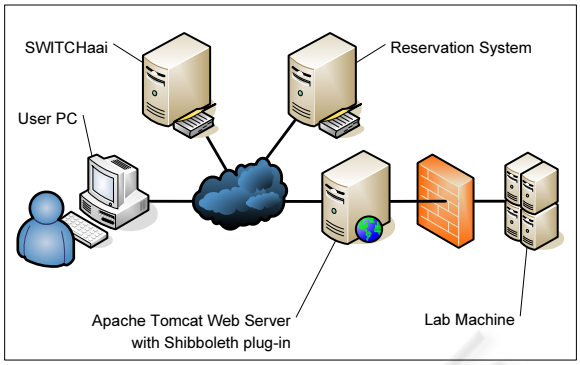

Figure 2: Architecture for our hands-on tasks.

2.2 SVC Online Courses

Our department took part in the development of two online courses created for the SVC. Both courses use English as teaching language.

The first course covers the topics of telecommunications and computer networks and is called Virtual Internet and Telecommunications Laboratory of Switzerland (VITELS) (VITELS, 2009). It was a joint development of the universities of Bern, Fribourg, Geneva and Neuchâtel as well as the Engineering School of Fribourg. Ten modules were available covering the following content: (i) Simulation if IP Network Configuration, (ii) Client/Server Concepts, (iii) IP Security, (iv) Sockets and RPC, (v) Remote Method Invocation, (vi) Application Server, (vii) Security and Privacy in the Internet, (viii) Firewall Management, (ix) Protocol Analysis, and (x) Wireless LAN. After several years of usage, only the first seven modules are still available, due to technical limitations.

After the creation of the VITELS course, a sec-

[1]The decision to use the mentioned software is not part of this publication, nor is this an evaluation of those platforms. The presentation and discussions related to specific eLearning platforms shall then be considered without loss of generality.

ond course was created learning from the experiences made with VITELS. This course is covering the topics of operating systems and is called Operating System Laboratory (OSLab) (OSLab, 2009). The participants for this project were the universities of Bern, Fribourg and Neuchâtel as well as the University of Rostock (Germany). At the moment five modules out of seven are available, namely (i) Device Driver and Input/Output, (ii) Process Scheduling, (iii) Memory Management, (iv) File Systems, and (v) Security. The modules Distributed File Systems and Inter Process Communication are still under development and should be released soon.

Both courses follow the same general scheme (3) based on Bloom's new Taxonomy (Passig, 2003), an updated version of Bloom's Taxonomy (Bloom et al., 1964). First, the topic is introduced and requirements for this module are presented. In the second chapter, the theory of this module is conveyed to the students. It consists of replenished lectures and required or recommended readings, e.g., papers or books. At the end of this part, the students can perform a self test to check their knowledge. Afterwards, they have to prove their knowledge of the theory in completing a quiz consisting of multiple choice and free responses. In the third chapter, the students must apply their knowledge in hands-on sessions. These sessions are all available online, as described in Section 2.1. Some exercises require real hardware which is accessed remotely, while for others the hardware is simulated. After mastering the hands-on sessions the students can finalize the module with a conclusive test. For the final evaluation of the course the students have to pass an oral exam to demonstrate their knowledge of all completed modules.

2.3 Blended Learning

As mentioned previously, the Claroline platform is used at our university for blended learning. As an example we will present the advanced software engineering (ASE) course and exercises held at our department since several years. The goal of the course is to familiarize the students with the application of sophisticated software development tools and development cycles. The theory is presented in traditional lectures with slides. Those are made available online on the course portal a posteriori. In the exercises the students have to solve task sheets and submit their results to the portal. The tasks range from programming to sketching rapid prototypes. The evaluation of their tasks is presented to them as well via the Claroline platform.

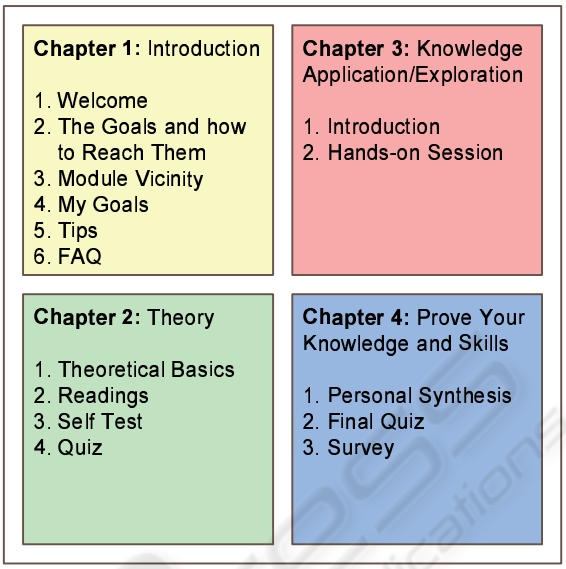

Figure 3: Structure of our online course modules.

3 OBSERVATIONS

This section considers the observations we have made using the two online courses, VITELS and OSLab, and the blended course ASE. The two online courses are offered to the students since five (VITELS) respectively three (OSLab) years. The blended learning approach is already in use since eight years at our university.

3.1 Students

A first major observation made during five years of eLearning is that only a motivated and interested student is capable to fully benefit from an online course. An unmotivated student, doing the course only because he/she has to, is likely to postpone the workload as long as possible. This will result in average performance. In our opinion, it is therefore important to fix a schedule for each task and to present the content in an interesting way.

Another fact that occurred to us, is the minimal knowledge the students retain from online courses. There is a discrepancy between the knowledge the students think they acquired and the knowledge they actually have absorbed. During the final oral exams, we realized many times that students can remember headings of a topic, but unfortunately not the more detailed content. Or they cannot apply or combine their knowledge. Normally, those students just printed out the content of the course or read it online. They missed to take notes, either electronically or on pa-

per. Furthermore, it seems that they are not able to differentiate between important information and facts included in the course and secondary or additional information.

A further problem is that not all available modules of the proposed eLearning courses require the same amount of work from the students, however the same number of credits is given to each module. As a result students are preferring the ones with the least perceived effort, since they can chose which module they take.

Also, the audio-visual absorption of knowledge during a traditional lecture is missing, which in our opinion improves the long term memorization. Even though the students may not actively listen, they still learn subconsciously (implicit learning (Cleeremans, 1997)). In addition, the tutor might spontaneously point out important features, which is not possible for a self-learning course. Later, when students are preparing the exam, the probability of losing this memory is quite high. The students concentrate themselves on the passing of the exam and thus forget that the long term memorization and especially application of knowledge are actually the main goals of their studies.

In some of the VITELS hands-on exercises the students had to program on a distant lab machine via the console. With the improvement of the Internet technologies we wanted to support them with a better programming environment. We therefore introduced the NeOS framework in the hands-on exercises of the OSLab. It provided them with an editor-like Java applet in which they could implement their tasks. Nonetheless, most students just programmed in their favorite integrated development environment (IDE), like Eclipse (Eclipse IDE, 2009) or NetBeans (Netbeans IDE, 2009), and copied their solutions to our tool. According to the students' statements, their main reason to use an external IDE rather than the proposed one, was the lack of automatic correction and error detection offered by the IDE, i.e., missing features.

In our online courses the students have to plan their advancement on their own ensuring a maximum of flexibility. As a result, quizzes and tests are done at different times, but still they have always the same questions. So there is a high probability that they just exchange the questions and answers among each other.

3.2 Tutors

In this section we briefly outline the experiences of tutors with online and blended courses and the challenges they face. We refer to tutor as the person which the students approach if they need any assistance. The responsibilities of the tutor are generally limited to maintain the course portal and guide the students. It is thus important to offer the tutors an introduction to the handling and usage of the respective platforms.

For eLearning courses, evaluating quizzes is also part of the tutor's task. Commonly used eLearning platforms provide evaluation tools, e.g., showing the student's solutions as well as the expected solution. For multiple choice tests, a pre-evaluation can be provided. This approach considerably simplify the task of the tutor. However, the exercises and the solutions are generally provided by the developers, knowledgeable of the topic, at the same time the course is created. It can thus happen that the solutions are very short or incomplete, especially if the developers assume that the tutors are also knowledgeable of the topic, which is not necessary the case.

Another problem that might occur with predefined solutions, is that they are out of date. For instance, in the server-client module of VITELS, one task of the students is to collect HTML communications with a certain web server. Over the years, the used technology on this server changed, resulting in a discrepancy to the original solution. Therefore there should exist a defined cycle for regular updating these courses.

For blended courses, the tutor is generally assisting the course instructor. The tutor prepares and holds exercise sessions and gives assistance to the students. The tutor also manages the online platform for the given course, e.g., making the slides of the courses available, handling the submitted exercises, or making announcements.

A problem observed using blended learning concerned the evaluation of tasks. It happens that students submit their solutions by email or by paper rather than using the online portal. Introducing the evaluation results in the platform can then be quite complicated, since one can only evaluate content directly submitted to the portal. In fact, the tutor normally has to use an alternative method to store the results of the students, e.g., on paper or in spread sheets. These other result collections are most of the time not available online. Consequently, the students need also to store their results externally. A solution to this problem is to inform the students of the procedures to be used, and grade only assignments correctly submitted.

3.3 Developers

Besides students and tutors, developers play an important role in eLearning courses. Online courses are

often developed in the boundaries of a project lasting only a few years, but the course will be used over a longer time period. Staff members (e.g., PhD students) are enrolled to design the courses, however, due to the academic environment, the staff changes rapidly. Consequently, it is possible that different persons are in charge of initial planing, final stage, maintenance and tutoring. Even though each step is documented, details on technical issues, interpretation of exercises, or content might be lost, making especially maintenance and tutoring difficult.

In most cases the content for an online course is already available from a traditional lecture. Still, the adaption is not trivial, since the slides of a lecture are not presenting the whole course. Often the professors are adding additional content like examples or explaining certain points in detail.

Another issue can occur in the development of foreign language courses, but not exclusively. When creating the content, typing or grammatical errors can occur. To minimize those, peer reviews and professional editing are important and recommended. Additionally, a cooperate design should be chosen for the whole course to improve recognition.

4 PROPOSALS TO IMPROVE ONLINE COURSES

In the previous sections we presented our experiences with blended learning and eLearning. In this section, we discuss several approaches which could improve all kinds of blended learning and eLearning.

4.1 Motivation

In this first part we want to point out strategies to increase the morale of the students. Lately casual games have become quite a big economical success, e.g., games like Dr. Kawashima's Brain Age for the Nintendo DS (a.k.a. Brain Training). This game is based on the research of Dr. Kawashima (Kawashima, 2005). Those games consist of a collection of mini games, i.e., games which normally last just a few minutes. With the success rate and a success graph the user is motivated to improve and redo the games. Those games can address many different skills, mental and physical ones. For instance skills like dexterity, eye reaction, calculating, foreign languages or logic can be conveyed.

Our proposal is to apply this concept as well to eLearning courses, so the students are learning by playing. In the domain of computer networks for example, imagine a game where the student is acting as a firewall and has to decide if arriving or departing packets pass or have to be blocked. The time the student needs to process a certain amount of packets correctly can be used as indicator for their performance. One could also support the student with different tools, which are an abstraction of real used approaches, e.g., black or white lists. Additionally, the students could have the possibility to compare their results with their colleagues or play in an attacker-defender scenario.

Another idea concerns the adaption of the achievement concept also known from computer games. It is used to award special behavior or achieved goals. In terms of online courses it could be used to motivate the students to solve their task very well. The reward could for instance be a joker for another exercise or the oral exam, i.e., the student could ask for a small clue in a question.

4.2 Memorization

As we mentioned already in Section 3.1 it is important that students do more than just reading the theory. Therefore we present below features to overcome this gap.

For instance, it could be useful that each time the students enter the course portal, they have to answer a question regarding already finished modules, or there could be a pop-up window in the portal with a known content randomly chosen. A very experimental approach could be that only students with good results from the daily quizzes can unlock the additional or following content.

In Section 3.2 we outlined the difficulties with shifted schedules and their influence on quizzes. As a solution we think a randomized test would be appropriate. When the questions the students are asked vary, it becomes useless to pass on the questions and solutions to the fellow students. Of course, the developers of a course have to create more than twice more questions and they shoould be replaced over time. Eventually, each question could also be given a level of difficulty, in order to present to each student a variety of questions with different levels of difficulty.

To support students not just with plain text or pictures, maybe an audio book of the content could be helpful. They could listen to it while reading the content or doing other activities. The audio stream could contain additional examples or could explain pictures in a more detailed way.

4.3 Simplicity

Last but not least, the usability of online courses should not be disregarded, since the student should focus on the content and not on the handling of the interface.

In the OSLab course (see Section 3.1), most of the students used the Eclipse IDE. Since this is an open source platform supporting plug-ins, we think it could be a good improvement to create an interface to our secured architecture. It would have the advantage that the students can program in their usual environment while still providing the needed security for the access to the lab machines.

In our opinion, eLearning environments could be improved by using a topic specific wiki for the content, which can only be edited by approved tutors. This could be done nation- or world-wide to gather the knowledge for a specific lecture topic. With a special license, e.g., Creative Commons (Creative Commons, 2009), the content could then be reused in other eLearning courses, which is not necessarily the case with books.

It could also be a great advantage to use a standard content creation language, independent from the used content management system. For instance wiki- or Tex-based systems would be a good solution, since these markup languages are widely used at universities and are designed for easy content creation and document layout.

5 CONCLUSIONS

In this field study we presented the eLearning environment (SVC and the SWITCH) as used in Switzerland. Furthermore, we described our two online courses (OSLab and VITELS) and presented our realization of the blended learning concept.

In the following parts we analyzed the attitude of students, tutors, and developers, resulting in possibly new approaches to improve eLearning as well as blended learning courses, from the view point of the staff.

The main observation of this paper is the high relevance of the students' motivation. Contrary to traditional courses, online courses do not have regular schedules, where for instance the students have to attend once a week lectures and exercises. Furthermore, the content of an eLearning course should be presented in an attractive and diversified way in order to keep the students focused over a longer time period. In addition, the students should not have the impression that eLearning courses are a burden or a free ride compared to traditional courses. Otherwise, eLearning courses will not be accepted by the students and thus conventional courses would lead to greater success.

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