Didactical Issues of a Remote Network Laboratory

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1 Introduction

Today's distance learning in the Internet often consists of on-line available lecture notes, sometimes enhanced with exercises that are manually processed and evaluated. Although integrated web-learning environments seem to get more and more accepted, there is still a strong need for advanced didactical concepts in order to make use of the Internet for distance learning. Several Swiss universities are working together towards a common course in the area of computer communication. The goal is to develop a course consisting of various modules developed rather independently by the participating institutes.
The work is being performed within the project called Virtual Telecommunications Laboratory of Switzerland (VITELS), which is one of several projects within the Swiss Virtual Campus (SVC) program funded by the Swiss ministry of education and science.
Our current work focuses on the transformation of an in-house IP-Security laboratory exercise module toward a remotely accessible course module. This is not only a technical challenge but also a didactical one. The goal is to achieve the same degree of education in the remote course as in our traditional one. The increasing number of students and the linking-up of universities require an opening of the laboratory to more students but also demand new ways of teaching and support. Additionally, it is a welcome opportunity to think about the actual didactical concepts in use. This paper will not focus on the technical architectural issues; they are described in "Architectural Issues of a Remote Network Laboratory" (Steinemann et al. 2002).

2 Traditional Exercise

In a first step on the way to the remote course exercises we intensified the evaluation work in our traditional computer network laboratory, which has been attended by small student groups of 2 – 4 students. All students attended a compulsory introduction course on computer networks in advance.
The laboratory is grouped into several modules and each module has the same structure:
Pre laboratory section: The students get general information about the subject and a selection of mandatory readings supplemented with recommended readings. Students have to solve subject specific problems at the end of this section.

Laboratory section: This is the practical work itself in the laboratory. Good preparation is a must, as the presence time in the laboratory room should not exceed 4 hours. The lecture notes and the tutors provide only hints and not complete guides for solving the tasks. This is in a way a guided learning by doing.
Post laboratory section: The students have to solve problems in the same context of the practical work done before. They use traffic dumps and logs of the laboratory work to demonstrate their success and to prove the understanding of the subject.
The students have been observed during their laboratory sessions and both, the preparing homework as also the post laboratory works were analyzed. User feedback forms have been collected after each laboratory exercise. The feedback results explained in detail:
Positive Feedback

- Students like the physical contact with the network equipment. For most of them it is the first time they get into touch with routers, switches, repeaters and even network cables.
- Students like learning by doing. They use the trial and error method instead of copying already prepared configuration scripts. This results in a better understanding of the subject.
- Students enjoy teamwork.
- There is almost always a tutor close to the laboratory

Negative Feedback

- The spectrum of the possible readings is too big. Many students would prefer a narrow and especially prepared lecture.
- There is no FAQ.
- The same tasks are too difficult for some students and too easy for others.

3 Remote Exercise

Our remote course is basically the traditional one with the big difference that it is remotely accessible over the Internet. In order to offer that course in a superior manner than the traditional one, the differences between both have to be pointed out. Especially the differences concerning the didactical aspects have to be found. It is obvious that in a remote course that is open 24 hours a day no tutor is available personally at all time, there is no “in case of any problem go to office 12” sign in the virtual laboratory. And there are no social contacts with other students during the laboratory or students doing homework in the PC pool.
But there are many helpful tools that can at least partly replace these negative aspects or even improve and accelerate the learning process. A web-learning environment called (WebCT) is used to lead through the course modules and we try to use all the tools and features of this platform. The module structure is the same as in the traditional course:
Pre laboratory section: Students get an introduction but not a mandatory list of readings. To select the readings, students use the tool called “Self-Test” (our “intelligent” reference management tool) and get, in case of a wrong answer, a link or source for the best readings. When students feel ready, they can go to the tool called “Quiz” that consists of multiple-choice and essay questions. Essay questions have to be rated by a tutor. Quiz results are logged and can be reviewed by tutors at any time. After successfully passing the quiz, students can access the practical work session. A good preparation of the practical session is more important in the

remote course than in the traditional one as there is at most times no personal assistance available and the laboratory presence time is restricted to 4 hours.
Laboratory section: The WebCT course pages lead also through the practical work session. Students get jobs, detailed explanations and hints in carefully selected portions. For the practical work itself they work in additional browser windows: – One window for WebCT with the main course pages, where it is indicated when and where to do what. – One window for the module infrastructure overview, where students see a graphic of the experimental set and can open connections to the equipment. – One window per host and router of the laboratory exercise.
Post laboratory section: Students have to prove what they have learned before, sending commented traffic dumps and logs from the practical work. Tutors have to rate the traffic dumps and logs. In a final quiz with multiple choice and essay questions students prove their knowledge.
WebCT offers chat rooms, news groups and a White Board where students and tutors can exchange real-time drawings on-line. There is an additional glossary where course specific words are explained.

4 Conclusions

Traditional exercise: Preparation work is urgently needed for the students to successfully perform an exercise. We have discovered that several students did not prepare themselves sufficiently prior to the practical work. Those in particular had significant problems solving the exercise tasks within a reasonable time. The same students had to ask many questions to the tutors during the laboratory session.
Remote exercise: In a remote laboratory, good preparation becomes even more important to successfully pass the exercises as the laboratory hardware can only be used during a previously reserved time window, in our case of 4 hours.
Students like to see network equipment in reality. Therefore, laboratory visits should be organized at the beginning of a distance-learning course, giving the students a feeling about the hardware they will work with.
Common: The available on-line material has been a problem in some cases since still a lot of good information is only available in books. Copyright issues prohibit distributing digitized copies among the students.

5 Outlook

The user feedback of the future remote courses will help us to improve the whole course structure.
For the evaluation of the practical session we intend to integrate an automatic text extraction of the configuration logs and to search for specific configuration phrases. This would allow a much more automated progress control.

6 References

Mentor Technologies vLab Technology, http://www.mentortech.com/vlab/index.shtml

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SVC Swiss Virtual Campus, http://www.virtualcampus.ch/
TU Chemnitz Informations- und Kommunikationssysteme, http://iuk.tu-chemnitz.de/
VITELS Virtual Internet and Telecommunications Laboratory of Switzerland, http://www.vitels.ch
WebCT WebCT, http://www.webct.com