Abstract. The abundance of information and communication technology and especially internet services demands changes in lecturers' head-on teaching methods towards new directives. This article presents some examples of human-centred use of information technology, applied in the subject of Human–Computer Interaction. Examples include the Open Source Learning Management System Moodle, video-based lecturing, remote laboratory of intelligent house and an age simulator - AgeSim. This article presents the planning and execution of teaching processes with use of Moodle web tools and exposes organizational structure as well as characteristics, which appeared during the learning process. Finally we show some benefits and weaknesses that arose during the use of the Moodle environment.

Keywords. E-learning, Information and Communication Technology, Human-Computer Interaction, Remote Laboratory, Webcasting.

1. Introduction

The use of information and communication technology (ICT) has recently broadened so far, that each student has a right to expect information on their study and for the study program to be available via the Internet. Furthermore, students expect to have an option to expand their knowledge via interactive online applications. These requirements must be fulfilled by educational institutions [1, 5]. New learning systems, such as WebCT, BlackBoard [10], commercial and open source environments, for example Moodle [3, 6] provide effective means for achieving this.

Following this, the goals for the lecture Human–Computer Interaction (HCI) have been set to test these technologies with the students, focusing on the following options:

- Learning Management System;
- Video Web Based Lecturing;
- Remote Laboratory;
- Age simulator (AgeSim).

The goal of this project was, besides the use of ICT, to create a new structure for higher education of engineers, considering recent changes in the higher education and the principles of the Bologna process.

This paper presents the experience gained in the pilot run of an international lecture in Human-Computer Interaction (HCI) and Usability Engineering (UE). Further suggestions for organization and execution of subject follow this information.

2. Learning Management System Moodle

Due to its simplicity and multi-language support, the Moodle environment has been chosen to be used by students of Computer-Human Interaction student as option to gain additional knowledge via either classical or interactive e-material. Material exchange and communication tools, such as e-mails, chat rooms and video web lecturing, as well as remotely controlled laboratory experiments are just few of the benefits of such a system.

Synchronous team work with peers from other countries based on communication tools have encouraged students from different
2.1. Course organization

In 2006, the HCI lectures were given in person at the Faculty of Electrical Engineering and Computer Sciences (EECS), and later remotely via Moodle.

Eight students followed the introduction classes in person for 16 hours during the first two days. All the participants had completed university level computer science courses, the majority of them coming from industrial environments with good programming skills. At the end of the introduction, a CD with the required software and further material in English was given to each participant. All further activities were performed remotely and the course finished with a final exam performed at the EECS faculty.

The subject was divided according to the general ADDIE model ("Analysis", "Design", "Development", "Implementation" and "Evaluation") [9]. The output of one step is an input to the next one. Most of this subject’s content is theoretical, however, with only a few mathematical equations.

The lecturer acted as the author of material, exercises, as teacher, tutor and administrator. For the needs of some tasks, additional experts participated.

2.2. Course development indications with Moodle

While running the Moodle environment in the HCI class, the lecturer gained the experiences presented in this section as general guidelines:

- during the first two days, the content of the subject was presented in person, using PowerPoint slides. An average of 30 slides per lecture made 420 slides for the 14 weekly lectures.
- the content of the lecture was split into phases, which had to be studied in two weeks, following the ADDIE model. Each phase was presented in about 70 clearly structured electronic slides (material, exercise, discussion) that defined the required sequence of study. The next phase was shown only after the first one was completed.
- each phase offered e-material for independent study. The content was multimedia based, with a short summary of the content and self-evaluation section. Each e-material was limited to a maximum of two screen pages per learning unit, with the possibility of further compressed material. Each unit contained at least one image with an explanation and one question for self-evaluation.
- the evaluation was made after each phase, where recommended final exam questions have been evaluated and commented. However, the final grade was based, in addition to the final exam results, on the performance at all exercises, homework, projects and discussion.
- for more interesting discussion, specialists for computer-human interaction from other universities were invited to join. This increased the added value of distance learning and the motivation to use the Moodle environment.

The introductory phase was longer in order for the students to become comfortable with the system. Informative evaluation was made in the middle of this phase in order for the students to understand the improvements required to achieve higher grades. Another evaluation was made immediately after the end of the first phase, with an option to correct the subscriptions. The final grade was given few days later. For the next phases, only the final evaluation was made immediately after the end of the phase and the discussion was closed.

3. Teaching process for students

Table 1 presents activities in Moodle environment performed by the student in each phase. Each activity is ranked as compulsory (c) or non-compulsory (n) and the recommended length of time is given.

As seen from the table, each phase may last 24 to 32 hours, which gives an average of 150 hours for 5 phases. This matches the requirement for students by the Bologna process (15 weeks at 10 hours equals 5 credit points (ECTS)).
Table 1. Student activities

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
<th>n/c</th>
<th>Duration (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reading relevant slides</td>
<td>n</td>
<td>4-6</td>
</tr>
<tr>
<td>2</td>
<td>E-material reading</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Answering abc questions in e-material</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Reading the book</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Reading additional scientific material</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Search for examples, adding own contribution to the discussion forum</td>
<td>c</td>
<td>4-6</td>
</tr>
<tr>
<td>7</td>
<td>Reading answering school mate’s answers</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Reading exercise, task solving and end report writing</td>
<td>C</td>
<td>6-8</td>
</tr>
<tr>
<td>9</td>
<td>Completion of current project work and report writing</td>
<td>c</td>
<td>8-10</td>
</tr>
<tr>
<td>10</td>
<td>Answers to exam preparation</td>
<td>n</td>
<td>2</td>
</tr>
</tbody>
</table>

4. Lecture webcasting

Our motivation was to provide additional information and materials for students to enable them to acquire deeper knowledge with the aid of ICT, including students with special needs. One of the possibilities is to develop a video-based system, adapted to their needs, which combines, on a web site, a video and audio of the lectures, presentation slides, subtitles, transcriptions, additional documents, and a table of contents [2, 4]. Because of the complexity of the process of live streaming video and video on demand, the trend towards simplification of the necessary procedures and shortening the implementation times of the video based lectures is evident.

For this reason, we have designed the vELAP system, which allows the recording of the video-based e-lectures for all participants including persons with special needs.

The main features of the vELAP system are:

- Automated video recording lectures with all additional materials for live and on-demand web presentations (presentation slides, visual subtitles, table of contents).
- Inclusion of additional media streams (supplementary video, audio, screen capturing).
- Accessibility options for persons with special needs:
  - for the deaf and hard of hearing, a sign language video with subtitles,
  - for the blind and weak-sighted, audio subtitles, text enlargements and color, background and foreground corrections, JAWS compatibility.

- User-view customization and switching of presented media;

The architecture of the vELAP system consists of three levels:

- Hypermedia Classroom.
- Database and Video Streaming Server.
- Client Application.

The Hypermedia Classroom includes one or more mobile systems (trolleys), with video and audio equipment suitable for recording the lecture. In case of using more mobile systems it is possible to simultaneously record additional streams, for example sign language interpreter, audio subtitles and live subtitling. The server side consists of two servers, for storing data (Microsoft SQL Server 2005) and for streaming videos (Windows Media Services). The user side presents the client side, where the end-users interact with the web portal and have different roles (student, administrator and lecture roles).

The architecture of the systems, which are visible to users, is illustrated in Fig.1.

Additional to the classical lecture webcast elements (video, audio presentations, table of contents and screen capturing), we have also added new elements which are needed by people with special needs (see Fig. 1). These are the video of sign language interpreter for the deaf, subtitles for the deaf and hard of hearing persons, and audio subtitles for the blind and weak-sighted.

![Figure 1. Architecture of vELAP client system](image-url)
The significant feature of our system is its simple and automatic preparation of live streaming lectures with all additional elements: video, audio, presentation slides, video subtitles, audio subtitles and table of contents.

Also user friendliness and simplicity of the system is one of the key factors that we had in mind when designing the system graphical user interface.

Preparation of recording lectures goes with only one press on the switch to turn the system on and several steps for lecture preparation; the whole procedure for recording preparation is feasible in a few minutes, including the system’s initialization, establishing connection, lecture preparation and starting the lecture. Animations in presentation slides are also supported. With this system students could also receive the lecture live at a distance or on demand and acquire more knowledge about the particular topic.

Students in the Human-Computer Interaction class have to evaluate the system as a whole and in particular, for example graphical user interface for people with special needs (deaf for example). Students do not have the possibility of watching the lecture but do have the possibility of designing and evaluating the paradigm into the system.

5. Remote Laboratory – m-house model

Having in mind the possibility of using remote laboratories as a base for designing and implementing of graphical user interface systems remotely, we decided to test the possibility of using a small laboratory house model, which we could control at a distance.

We designed and developed a system, named m-house. The system consists of a wooden model of a house (Fig. 2), which includes a micro-controlled system for control and inspection of devices, connected to the Internet. User interfaces for web sites and for a Personal Digital Assistance device (PDA) were implemented in LabView [8]. Using an appropriately adapted user interface, devices, which are integrated in the house model (e.g. lights, windows, doors, ventilation) can be remotely controlled via web pages and via mobile access to Internet.

The students use this application to become acquainted with ways to use micro-controlled systems, control methods for distance control systems and methods to design user interfaces.

Other educational values of the system are:
- Acquaintance with new area of mobile technologies and remote controlling.
- Acquaintance with non-standard use of interfaces (smaller displays for PDA requires the student to become aware of new demands, on how to solve certain visual limitations)
- Learning how to create less memory consuming applications.

The user interface for web pages and for PDA serves as a platform for insight into the m-house and the function of a micro-controlled system. The graphical user interface offers several different activities to control and inspect the elements. The main activity of the students is to change the first version of the graphical user interfaces according to human-computer interaction rules.

The graphical user interface should give insight on the status of windows and doors (open/closed), the status of ventilation, lights (on/off) and the level of illuminating power. With virtual pressing of the light button, the student can change its binary state (on/off). Changing the status of the ruler on the side changes the level of illuminating power (between 20% and 100%). The user interface should include the temperature indicator, where the current temperature value (measured every second) should be shown graphically and with the number.

In this way the student could effectively and remotely change preferences and the visual design of the user interface and also evaluate...
designs from other students considering rules for effective and usable user interfaces.

6. Simulation of physical and perceptual impairments - AgeSim

Improving the quality of life of elderly people is another issue within Human–Computer Interaction study and research. Devices and user interfaces must be designed in a way to enhance the quality of life of the growing number of elderly people. The main problem is that most of the young students of software engineering are not aware of the constraints and restrictions which elderly people are facing. Students and researchers must be given the possibility of simulating certain physical constraints of the elderly. A good example is AgeSim [7], which is a simulation suit designed to permit a developer to experience the restrictions caused by various types of impairments, whether from age or other causes (Fig. 3). We are of the opinion that, in order to actually understand the difficulties of elderly people, it is of vital importance for the developers to feel and experience these difficulties during the first design iteration.

Figure 3. AgeSim – device for the simulation of physical constraints [7]

The AgeSim suit consists of a boiler suit; the under arms and leg joints are webbed, thereby restricting the height to which the arms can be raised and the length of the stride. A number of weights fit into the pockets of the suits trouser legs, gloves, designed to simulate arthritic joints and the decreasing sense of touch, and a helmet, which reduces sensory perception by more than half. The helmet restricts the mobility of the head and has a number of accessories, one being exchangeable visors to simulate various eye disorders; a further extra is a mountable camera for recording what the user is able to see during the usability tests. The logger and the AgeSim user communicate via a headset. It is also possible to simulate hearing difficulties with this headset.

When students are wearing this suit, they can try to use, for example, a mobile application. Everything is suddenly too small, too difficult to touch, too difficult to see and too difficult to hear. Consequently, students are able to feel the limitations in fine motor skills and visual and auditive impairments and can convincingly understand the necessity for a rethinking of user interface design especially for elderly people.

7. Conclusion

The increased use of ICT will force educational bodies to include ICT in the education process. The problems arising are the choice of tools and material creation.

The Moodle environment with its simplicity and availability helps in this process. A/The common pilot project was run in order to evaluate the planning, design and execution of lectures using Moodle, Remote Laboratory Experiments and Lecture Webcasting. Positive feedback from students has been received for using these tools as primary tools. Electronic slides, multimedia e-material, the book, exercises, project tasks and self-evaluating questions as well as remote experiments have been available to students. In addition, a discussion forum has been used for constant communication.

The problems were not related to the Moodle system but more to the material creation process, communication and remote evaluation. Creation of material requested high input not only by the lecturer but by the whole planning team. The process for the presented project took two years, with minor changes and additions during the following year.

The application of Remote Laboratory and AgeSim can provide students with a new way of acquiring knowledge about the difficulties facing users and gain knowledge on establishing a correct user interface for remote controlling.
8. Acknowledgements

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9. References