

## Chapter 4.2

# Human Computer Interaction for Computer–Based Classroom Teaching

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### ABSTRACT

This chapter focuses on HCI aspects to overcome problems arising from technologies and applications that may hinder the normal teaching process in ICT-ready classrooms. It investigates different input devices on their usage and interactivity for classroom teaching and argues that pen-based computing is the mode of choice for lecturing in modern lecture halls. It also discusses the software design of the interface where digital ink, as a “first class” data type is used to communicate visual contents and interact with the ICT.

### INTRODUCTION

Utilizing *information and communication technology (ICT)* in modern classrooms for the

purpose of teaching offers several advantages. These include (worldwide) access to digital materials during lectures, recording and archiving of both the presented materials as well as the whole live event, and transmitting the lecture (live or recorded) to remote locations—a concept of tele-teaching. Consequently, conventional equipment, such as blackboards and chalk as well as overhead projectors and transparencies, have almost disappeared from the classrooms and lecture halls at many institutions and have been replaced with computers and data projectors. Integrating ICT in the classroom raises a myriad of technical questions related to the implementation of the respective devices and services. It is generally agreed, that details of the technical installation should be hidden from the presenters and teachers. Thus, in an ideal scenario, the teacher walks into the lecture room and, if anything, just has to

press one button in order to switch on the whole equipment and having all the infrastructure readily available. In this chapter, we are concentrating on the user's perspective once all equipment is up and running and operated by the teacher during the lecture. In doing so, we focus on questions related to *human computer interaction (HCI)*: How can people access the functionality offered by the installed ICT? How do they interact with the available infrastructure? What are the best possible approaches for the interface design in order to support the teaching process? And so on.

Generally, the way in which people interact with any kind of ICT is influenced by two aspects. The first aspect is the input devices, that is, the hardware that specifies what information is exchanged between man and machine and how this exchange takes place. For example, by moving a mouse, a user sends "events" to a computer that encodes information such as relative coordinates representing mouse movements. The second aspect is the software design of the user interface and the way in which the technical signals exchanged by the hardware are interpreted. For example, incoming signals from mouse movements (representing relative coordinates) are generally mapped to absolute pointer movements on the screen and as such visualized to the user. Unfortunately, traditional HCI concepts, such as conventional "desktop" input devices (the keyboard and mouse) and their related classical interface designs are not well suited for the tasks appearing in a classroom, forcing teachers to modify and adapt their teaching styles to the used equipment.

Following the point of view described before, this chapter is organized into two parts. First, we address input devices, that is, hardware-related issues for operating and using ICT in classrooms. We describe current and future trends in the usage of different devices using examples and case studies from our past and ongoing research projects as well as our experiences in actual teaching scenarios. We identify a subtle, yet promis-

ing trend that can be observed developing in the educational world—more and more pen-based input devices are used in classrooms and lecture halls. Examples of such devices include interactive electronic whiteboards, graphics tablets, Tablet PCs, and personal digital assistants. The second part of this chapter is devoted to the software designs and interaction paradigms for interactive classroom teaching using ICT. We describe different aspects in relation to pen-based interaction with the installed ICT. "Digital ink" is described as a new, "first-class" data type serving both, an exchange of information between teacher and students, as well as a new metaphor for interacting with the installed ICT via newly introduced gesture commands. Generally, we concentrate on instructional talks and presentations, where a presenter (i.e., the teacher) faces an audience (i.e., the students) and presents some content in a typical classroom setting. More interactive classroom settings, such as seminars or other arrangements involving group work, are discussed in a concluding future trends section at the end of this chapter.

## **HARDWARE-RELATED ISSUES: INPUT DEVICES**

### **Background: Ubiquitous Computing Environments**

As mentioned in the introduction, ICT usage in classrooms offers great opportunities to support and improve teaching. However, traditional input and output devices often prove to be a hindrance for the direct interaction between teacher and students. They draw too much of the lecturer's attention to the operation of the respective hardware. Keyboard and mouse cannot be used to provide content to the students as naturally as chalk is used to write on blackboards. Monitors, even the small ones from laptop computers, can stand between the audience and the teacher building a

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