Interaction Design Patterns for Classroom Environments

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Abstract. In our research, we synthesize two lines of development that have been dealt with independently so far: 1) the development and evaluation of educational technologies to support problem-oriented and collaborative learning activities inside and outside of the classroom, and 2) interaction design patterns as a means to document and generate design knowledge. Primary contributions are software prototypes for enhancing classroom interaction through interactive whiteboards, multiple clients with pen-tablets and PDAs, and a basic layout of a pattern language for formal and informal learning environments.

Keywords: Interaction Design Patterns, Educational Technology, Learning Theories, Activity Theory, Classroom, Whiteboards, Pen-Tablets, PDAs, Gesture-based Interaction, Open Space.

1 Technologies in the Classroom and Some of Their Problems

In the last 10 years a variety of new, computerized media has moved into the educational settings. Students carry mobile phones, PDAs and laptop computers into classrooms, which are equipped with interactive whiteboards and wireless network connections. During class or at home they retrieve and also contribute information online, handling different interfaces and functionalities. However most of the applications of these media have been developed for other purposes mostly related to business and task-oriented activities. A reasonably consistent learner-centered interaction design across programs and devices may promise to ease the interaction and should flexibly enhance opportunities for learning. Within an ongoing research and development project we therefore try to elaborate upon, implement and evaluate interaction design patterns for formal and informal learning environments using computer technology in the classroom. The first software prototypes we developed address the following problems:

- Oftentimes interaction design principles for personal computing and desktop applications are being transferred to new devices without taking into account their specific properties, potentials and the contexts of their use.
- Interactive whiteboards are usually used in classrooms as presentation media with annotating features. Instead of encouraging active student participation.
and contribution, teachers often tend to proceed from one slide to the next of a prefabricated show [4].

- Generating, structuring and documenting learning materials created on the fly during lecture in the class is not sufficiently supported by standard software (like SMART Notebook or PowerPoint).
- There is limited support for group learning activities or for enabling students to contribute to the generation of content on the whiteboard.
- Limited financial resources usually do not allow providing students with “fat” hardware clients like tablet PCs or laptops. Multiple low cost input devices like mice, pen-tablets accessing a single application synchronously on the other hand are not supported by “personal computing” machines.
- Even though PDAs have been discussed as an ideal means to support “learning outside the classroom”, a seamless integration with classroom technologies is still missing.
- Consistency in the interaction design principles and compatibility across devices, applications and environments is missing.

In order to solve these problems we developed various software prototypes (chapter 3). They enhance the interaction with whiteboards, allow students to work in groups and access whiteboard spaces through pen-tablets and PDAs. Since the problems and solutions are recurring for technology enhanced learning scenarios we then abstract from the individual implementations to describe our solution as interaction design patterns (chapter 4). Following this bottom-up approach we finally elaborate upon the emerging system or “language” of interrelated patterns (chapter 5) that should ensure consistency across devices and application scenarios.

2 Related Works

A distinguishing feature of our approach is to support individual and collaborative learning with the help of different devices. In the following paragraphs we give an overview on research on each of those devices and the discourse on patterns in design.

**Electronic Board equipped Classrooms:** Examples of early usages of electronic boards as an integral part of a computer-integrated classroom can be seen in the Hypercourse [16], in Taiwan secondary schools [24] and in the COSOFT project [2]. The computer-integrated classroom combines positive aspects of the classical chalkboard approach, particularly its flexibility in the spontaneous elaboration of ideas, with the potential of modern networked multimedia. The value added lies on the avoidance of discontinuities in representations (“media breaks”), e.g., when the solution that a student has individually elaborated on is copied again by hand to the chalkboard. Another example can be found in the European NIMIS project [10]. Target users for this version were young schoolchildren (4-8 years old) and it was aimed to develop children’s reading/writing skills.

**Multiple pen-tablet input:** Collaborative learning in computer enhanced environments needs to support collaborative content creation and presentation. LiveNotes connects tablet PCs by a wireless network [13]. However, a different challenge comes up when