

Mobile Computing to Seamlessly Integrate Formal and Informal Learning

¹Henning Breuer, ²Roberto Konow, ³Nelson Baloian, ³Gustavo Zurita

¹*University of Applied Sciences Potsdam, Interaction Design Lab, Potsdam, Germany
breuer@fh-potsdam.de*

²*Universidad Diego Portales, Santiago de Chile, Chile
rkonowr@gmail.com*

³*University of Chile, Department of Computer Science, Santiago de Chile, Chile
nbaloian@dcc.uchile.cl, gnzurita@fen.uchile.cl*

Abstract

Even though PDAs have been discussed as an ideal means to support “learning in the wild”, a seamless integration with classroom technologies is usually missing. This paper discusses a system for students called MCPresenter that facilitates both performing and documenting learning experiences outside the classroom and bringing them into more formal settings for discussion and further development. It supports collaborative learning and applies the same gesture-based interaction principles as software for interactive whiteboards, enabling seamless transition between inside and outside as well as facilitating individual work, peer-to-peer interaction and group discussions.

1. Introduction

Human beings are learning beings. We will never face the same situation twice because the first encounter impacts the second, *ad infinitum*. Still, the interfaces we confront do not usually change from one encounter to the next, and we are forced to cope with their logic, a large part of which has been derived from two assumptions: the paradigm of personal computing, or “the ego and his own” interface (on a laptop, PDA, mobile phone), and the notion of task-oriented activities being performed by some “user.” While users apply their knowledge in order to perform a generally definable task, learners construct and acquire knowledge by exploring and discussing something they do not yet know about. They do this in the classroom (as recognized by constructivist didactics), but also outside of formal learning environments. In fact, the whole world may be interpreted as such an

informal learning environment. However, the technologies supporting learning activities are usually customized to specific learning environments and objectives.

The affordable availability of mobile devices has led to an increased interest in both mobile and informal learning environments. While the applications being developed for these activities and contexts are not yet well-integrated, mobile devices offer the potential to link learning activities inside and outside of formal settings. Our work attempts to utilize that potential by providing students with a consistent environment to explore, comment upon, create, share, and document learning contents using PDAs both inside and outside the classroom. Based on common PDA-functionalities, it should allow them to seamlessly integrate everyday experiences and instructed learning activities. In sum, we will present an application framework that offers: a) a collaborative environment for learning and teaching b) a learner-centered design [4] of educational technologies and c) a seamless integration of interaction design inside and outside of formal learning environments.

Our approach is based on current developments in learning theories, including works on constructivism, collaborative learning, and situated learning. Problem-oriented approaches to teaching and learning combine cognitive and constructivist aspects. They suggest that self-directed and problem-oriented student activities being moderated by the teacher may not only increase students’ motivation but also their understanding and memorization. Instead of focusing on the individual mind, socio-cultural theories of learning (in the tradition of Vygotsky) conceptualize learning as socially constructed and emphasize the need for support provided at the right place and time by a

teacher, other students or resources. Similarly, situated learning [2] stresses the webs of meaning created through experiences.

Instead of discussing distinctions between formal and informal learning [5] we will concentrate on learning support outside the classroom. Our approach can be seen as an attempt to reopen the classroom to everyday experiences while also allowing for some formalization of situated experiences.

2. Seamless Integration of Formal and Informal Learning Environments

While experiencing the value of collaboration may itself be an objective, the idea of collaborative learning refers to the potential to motivate and enhance learning activities through the collaboration of students. Still, collaborative activities inside and outside the classroom and individual activities at home or “in the wild” should be integrated to allow for a variety of perspectives and resources for learning.

In order to seamlessly integrate learning activities and their documentation inside and outside of the classroom we look at three settings for learning: the classroom environment, an informal learning environment where students may explore learning subjects “in the wild” supported by their PDAs and the home environment, where a personal computer and a PDA are available.

Within the classroom, students and teachers work together on a particular subject—for example, modern architecture. The teacher may prepare an initial presentation introducing the field and points out some problem, like the conflict between the planning of a static structure and the inhabitants’ appropriation of that space. After the presentation, students may discuss and the teacher may assemble students’ ideas and examples on the whiteboard. Students may come to the whiteboard, write down and link their ideas and questions. The content created in class is saved with its exact structure and sent to the students’ PDAs. Different groups of students can then be assigned to different aspects of the subject.

Over the next few days, the students might be asked to pay attention to the subjects discussed in class while walking around the city, to document and comment upon what they see, and to find answers to certain questions. While running around the city with their PDAs, they may take notes and find and record (with a camera in the PDA) interesting works of architecture or examples of inhabitants’ appropriation of space. In case of doubt or lack of time for discussion regarding a particular finding, they may connect to other students

in their group. Communication functionalities and a shared view on the PDA are needed as a common anchor for reference.

Having transferred the data from the PDA, students may add to the notes they took in the field, review and edit the information they collected, and incorporate content they retrieved online in order to prepare a contribution for the classroom discussion and exchange it with other students in the same group. Back in the classroom, each group sends their findings to the interactive whiteboard and the discussion continues. MCPresenter was developed to support these activities.

3. Implementation of MCPresenter

In order to support a seamless transition between the learning environments, we aimed for a consistent interaction design across all devices (especially for the interactive whiteboard and the PDAs) and decided on a gesture-based interaction paradigm.

On small-screen devices like PDAs, menus and widgets consume precious working space and tapping them with a stylus is tedious. Other than on desktop applications, no right mouse-click is available to provide context-dependent popup-menus. In order to facilitate the focus of attention, it would be desirable to keep user input and system response in the same space.

On large-screen devices spending too much time on activities which are not directly related to teaching (typing, file searching) may interrupt the dynamic flow of the lecture and distract the attention of the audience. It is therefore desirable that the teacher perform all teaching activities on the whiteboard as the unique input and output device [1]. For these reasons we decided to implement a gesture-based system of interaction that enables users to create, import, edit, link, and delete pieces of content. As on the whiteboard, the human-to-handheld interaction is based on gestures and freehand writing, bypassing the need for widgets and virtual keyboards.

When creating the first blank page, the user may create different nodes within that page (entering the node level below) or create a new page on the same level. The following are the so far implemented gestures to flip between pages, create and edit content:

Flipping to next/previous slide: Moving the stylus from one vertical edge of the PDA screen to the other the user flips between different pages.

Creating a node: By drawing half a rectangle the user creates a node. Handwritten or other content within the rectangle will be included and stored within that node. These nodes are by default private but may

be shared with other students' PDAs or shown on the interactive whiteboard.

Deleting a node: A node may be deleted by drawing an "x" in one stroke across its boundaries.

Sharing a node: The content of a node may be shared with other students or the teacher. This is done by dragging the node to the icon of a single participant or a group of participants. Dragging the node to an icon of the whiteboard sends the node to the whiteboard. To share content in a shared-screen mode is essential to support collaborative activities and discussion when the students are outside of the classroom.

Linking nodes: Two nodes may be linked by drawing a straight line from one node to another. In this way, a network of nodes may be created.

Saving structured content: By moving the stylus from the top edge of the PDA screen to the bottom edge, the network of nodes is saved. The content of the generated documents is organized as a concept map, which gives more flexibility to reorganize and merge individual nodes.

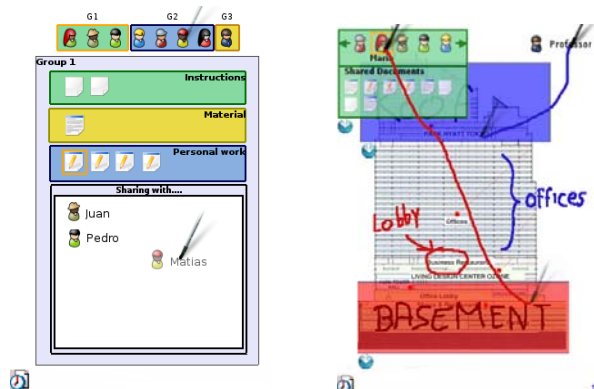


Figure 1. On the left, an overview of different documents (instructions, material and personal work) that may be shared with other participants. On the right, the user drags one node (basement) to a student and another one to the teacher.

In addition to these gestures, we implemented the following interface elements:

Active participant representation: Participants currently present in the system are shown as icons at the top of the screen. The teacher may assign individual participants to groups.

Showing a node as a page: Clicking on a button underneath the node brings it up as a page. Here we experimented with various solutions. Informal user tests showed that double-clicking was often performed unintentionally when users did not want to open a

page. For the same reason, we abandoned the idea of drawing from outside of the node on the page to the inside.

4. Conclusions

Based on learning theoretical concerns and the need to provide a consistent framework to support learning activities in formal and informal settings, we have developed a software prototype for PDAs and interactive whiteboards. Informal user studies have shown that the system's basic gestures are easy to learn, and errors due to misinterpretation of gestures are rare. Since the current solution provides a unique interaction framework for a variety of learning fields and objectives, we expect that it will be easily adaptable to specific curricula.

Application scenarios like the one described above are difficult to simulate and evaluate using low-fidelity prototypes. Instead, we are conducting a formative evaluation focusing on technical and educational usability criteria [3] within a science class using MCPresenter and interactive whiteboard software. The next step will be a more comprehensive study with two groups of students, one working with MCPresenter and another following the same didactic approach but in which students take notes outside the classroom and present their findings using an interactive whiteboard with standard software. Using a questionnaire, we will compare students' preferences as well as the quality of the outcomes of each class as judged by independent teachers.

5. References

- [1] Breuer, H. & Baloian, N., "Augmenting Whiteboard Interaction in the Classroom", In: P. Kommers, G. Richards. (Eds.). *Proceedings of ED-Media 2005*, Montreal, 2005, pp. 1214-1221.
- [2] Lave, J. & Wenger, E., *Situated learning: Legitimate peripheral participation*. Cambridge University Press, New York, 1991.
- [3] Nokelainen, P., "The Technical and Pedagogical Usability Criteria for Digital Learning Material", *Proceedings of ED-Media 2005*, Montreal, Canada, 2005, pp. 1011-1016.
- [4] Quintana, C., Carra, A., Krajcik, J., & Soloway, E., "Learner-centered design: Reflections and new directions", In: J. M. Carroll (Ed.), *Human-computer interaction in the new millennium*, Addison-Wesley, Massachusetts, 2001, pp. 605-624.
- [5] Straka, G. A., "Informal learning: genealogy, concepts, antagonisms and questions". In: K. Künzel (Hrsg.),

International yearbook of adult education, Boehlau Verlag,
Koeln, Germany, 2005, pp. 27-45.