

# A Mobile Pattern Discourse System

## —モバイルパターン談話システム—

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**あらまし** Design patterns have been used in architecture, software development, interaction design and education in order to document, reason about and communicate reusable best practices. Repurposing and extending our previous works on mobile educational technologies we are developing a system for touch-sensitive mobile devices that supports students of various design disciplines in learning about design patterns in various contexts of matter. It should allow for pattern documentation and wireless discourse. Its interaction principles including collaborative drawing on visual materials and a gesture-based interaction on touch-sensitive devices apply the same usability modules as we already implemented for pen-tablets and whiteboards inside the classroom.

**キーワード** Mobile Learning, Informal Environments, Context, Interaction Design, Learner-Centered Design, Interaction Design Patterns, Touch-Sensitive Devices, Gesture-Based Interaction

## 1. Introduction

Design patterns have been used in architecture, software development [11], interaction design [4] and education [15] in order to reason about and document reusable best practices. Based on the architectural works of Alexander [1] the approach assumes that humane building architecture can be broken down into distinct features and attributes. Recombining these patterns new designs can be generated.

The target audience of pattern descriptions and their collection in pattern libraries or languages has in most cases been professionals, like architects, software or interface designer, or teachers. Still, already in his first publications on patterns Alexander emphasized the potential of his approach to enhance user-participation. He provided a framework of reference with the intention to ease communication not only across a range of different professions, but also between professionals and non-professionals such as architects and the potential users subjected to their constructions. Accordingly future inhabitants (or policy makers in the case of cities) were intended to understand and “speak” the whole “pattern language”. This way design decisions should become more transparent to the public and open up towards a discourse, in which individuals concerned could participate in the development process and influence design decisions. Expressing what they need or desire or

consider aesthetically pleasing users were supposed to inform designs that are better adapted to their surroundings. For instance they may contribute information to specify the “forces” that describe results and trade-offs of applying design solutions. Therefore besides the professionals novices were supposed to learn how to do things with patterns in the context of specific architectural projects.

In the learning sciences such peripheral participation [13] in professional communities of practice has become a definition of “situated” learning itself. Taking part first peripherally in such professional communities participants learn while subsequently growing into more central positions.

Combining these lines of thought we want to use patterns not only as a means for communication, but also as a means for learning in different design disciplines. The idea is that patterns may provide an easy to understand and ease to use framework not only for participative design, but also for design students.

In some of our previous works [5, 6, 7, 9] we started to develop an interaction design pattern language for classroom technologies. Across a variety of devices the same interaction modules could be applied to support learning activities. Extending this approach to be used with mobile devices we aimed for a seamless integration of learning activities in formal and informal settings [8].

An adaptation of this system for the study of patterns should allow users: to analyze and reflect upon design solutions in their natural environment, to identify and construct their own set of potential patterns, and to discuss them with others, like professionals, teachers or peers.

The approach is inspired by learning theories that demand for individual and collaborative learner activity and creative constructions as a necessity to develop deep knowledge.

After discussing previous works on mobile learning (section 2) we line out essential concepts and activities in working with patterns (section 3) and present a scenario (section 4). We specify a mobile system suitable for collecting and supporting discourse on patterns (section 5) and discuss its current implementation (section 6) before drawing some conclusions (section 7).

## 2. Learning with mobile devices

Portable devices have been discussed as a valuable means to support the context-dependent construction of knowledge [12, 20]. Especially their ability to collect data, work collaboratively and location awareness are suited to create new learning opportunities [14]. Handhelds have been described as 'flexible tools that can be adapted to suit the needs of a variety of teaching and learning styles' [10]. In [18], informal learning is described as a process of learning that occurs autonomously and casually without being tied to highly directive curricula or instruction. The same work presents a typology based on the presence of and control over the goals and the process of learning. In supporting informal learning situations, handhelds have been used to collect data in the field [16], consulting information from a remote server or a nearby data-source, as is the case of using PDAs in museums. In [16], authors provide a review of existing work in a number of areas which suggests possibilities for the future of research on mobile learning in informal science settings.

Mobile devices inside the classroom have been used to support collaborative learning activities mainly among small groups. PDAs support learning activities by facilitating social interaction in a face-to-face context, achieving high levels of activity and thus avoiding passivity of the students [20].

One of the biggest merits of this kind of device is the potential to use them both inside and outside the classroom, helping to close the gap between formal and

informal learning. Since such applications still comprise only a small proportion of existing ones, this work aims to make a contribution in this direction.

“Mobile learning is not just about learning using portable devices, but learning across contexts” [19]. We consider the communication and learning about Design Patterns as a suitable approach to be supported with mobile devices since they allow to document, study and discuss pattern instantiations in their original context. Different design disciplines may profit from such an approach.

## 3. What are Design Patterns?

Alexander [1] argued that architectural living patterns are generated by recurring events resulting from ordinary action of people. His patterns define a relationship between a context, a system of forces, which arises in that context repeatedly, and a configuration that allows these forces to resolve themselves in that context. In order to identify patterns one must observe and analyze their instances, and consequently abstract the properties that all good solutions have in common.

Originating from architecture theory they were adapted first to software development [11] and consequently to interaction design [4]. Here they describe standard solutions to recurring design problems and may apply across applications, platforms and devices. Pedagogical patterns have been proposed in order “to capture expert knowledge of the practice of teaching and learning in a portable, salient format” [15]. Patterns may serve to find new solutions due to their “generative” potential [6], to not only document and optimize existing solutions, but to critically reflect upon them in order to generate new ones.

A network of related patterns is called “pattern language”. The term “language” stresses the rule-based order of components that provides coherence and may be used as a method for communication about design. The fact that individual patterns are integrated into pattern languages enables designers to use the collection for patterns generatively. Sub-patterns may be required to resolve more detailed design issues. A pattern language for a given subject usually presents its constitutive patterns in a hierarchical order with various links.

Design patterns comprise three abilities: usability, reusability, and communicability. Communicability is usually related to professional communication within an organization, or with service contractors. Here communicability supports internal stakeholders:

- Providing for a reference and toolset for design and evaluation
- Establishing a common ground to communicate about design
- Retaining a valuable enterprise knowledge base
- Institutionalizing consecutive design thinking and corporate learning

Thus they provide a common ground to collect, discuss and learn about best practices and proven solutions

### 3.1. How to document patterns for educations?

No officially standardized notation for various types of patterns exists so far. Even though the different notations being used are quite similar, the notation itself may be a valuable subject for discussion. Most authors however describe the conflicting forces within the problem domain and examples for the proposed solution as well as related patterns.

Developing a tool for novices we need to avoid barriers and allow scaffolding for learners. Therefore we begin with a relatively low level of formalization and pattern language complexity. Basically, „each pattern is a three-part rule, which expresses a relationship between a certain context, a problem, and a solution“ [1]. Only those, a name and an example of the solution need to be mandatory fields for a basic version of our pattern collection tool. Advanced students may be prompted to add optional information or give feedback, why they do not consider it helpful.

The format we start with provides the following fields for text and visual input or import:

- **Name**
- **Context** is a set of recurring situations where the design problem occurs.
- **Problems** are goals and limits in this context
- A **solution** describes the steps needed for reaching the design goal.
- Conflicting **forces** describe the results and trade-offs of applying the solution.
- Links to **related patterns**: Subordinate Patterns (include) and other related patterns (and, or, not): The recommended linkage between individual patterns helps to create a network of patterns (pattern language).
- References to **evidence** from real-life projects or scientific insight.
- An **image** from a camera or imported file in full-screen or thumbnail view provides examples through sketches, prototypes or views into implemented systems.

Being instantiations of the pattern their graphical format may inform the readers' imagination. They may remain abstract sketches or include some empirical evidence.)

Once these basic categories are well understood additional fields e.g. for variations or status may be added. Also we should allow students to just collect examples with short notes “in the wild” and adding more detailed information in follow-up work at home or in a classroom.

### 3.2. How to Do and Learn Things with Patterns

In his seminal work on “How to do things with words” Austin [2] examined the way words are used in order to elucidate meaning. He worked out how performative utterances (later called speech acts, and opposed to constative utterances) act upon reality. Since this applies to jurisdiction or even ordinary speech learning we may understand why defining a “vocabulary” or “speaking” pattern languages is a challenging exercise. Learning how to extract, modify and apply patterns is design in its own right and working with patterns involves several activities and potentially complex workflows.

In order to define a simplified workflow we adapted a real workflow from a consulting project for a large telecommunications company we participated in. Its essential activities in scouting for new patterns and the creation of a pattern language are:

- Finding or developing solutions
- Reverse engineering of the solution
- Documentation within a pattern format
- Integration into an existing library
- Consolidation of the patterns and the pattern language by referencing additional evidence from literature or competing solutions
- Formative evaluation of the patterns and pattern language within their application in new design projects

### 4. Learning across various contexts

The mobile system for supporting discourse on and learning about patterns inside and outside the classroom should support the pattern format and the activities outlined above. In order to allow for a variety of perspectives and resources for learning and to seamlessly integrate learning activities we look at three settings (see Fig 1): the classroom environment (A), an informal learning environment where students may explore patterns “in the wild” with portable devices (B) and the home environment (C), where a personal computer and portables are available.

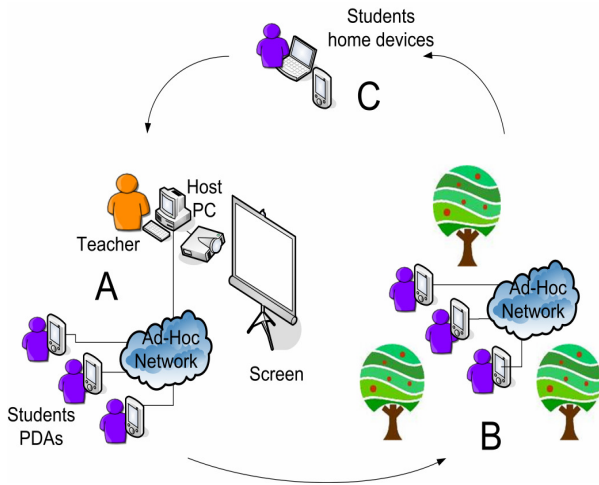


Figure 1: PDAs provide for a unique interface and a seamless transition between the learning environments of the classroom, outside “in the wild,” and at home.

Within the classroom, students and teachers work together on a particular subject like modern architecture. The teacher may prepare an initial presentation introducing the field and point out some problem, like the conflict between the planning of a static structure and the inhabitants’ appropriation of that space, which may be defined in terms of usage patterns.

Over the next few days, the students might be asked to pay attention to such usage patterns in everyday life while walking around the city. They take pictures and notes, and document and comment upon what they see using the pattern format and add extra (e.g. online) material and references at home. In case of doubt if a certain appropriation of space represents a usage pattern, they may connect to other students in their group. Communication functionalities and a shared view on the handheld provide a common anchor for reference. Back in the classroom, each group sends their findings to the interactive whiteboard and the discussion continues.

In an effort to support these activities, we specified and implemented a prototype called MCPattern.

## 5. Specification for Mobile Devices

A specification for mobile devices is based on our previous works on interaction design patterns [6] and extends functionalities of “McSketcher” [8] in order to explore, study, exchange, and thus learn about patterns. Design students run around looking for viable solutions to reoccurring design problems and document them in a structured way. Within the system each pattern is saved as an object or node within an xml-database. The following actions need to be supported:

- (1) Create node to capture a pattern
- (2) Take picture or draw sketch of pattern instantiation in real life
- (3) Draw on image (or blank) or within extra node
- (4) Write or explain pattern (inputting speech or text – freehand or typed – including name, context, problem, forces, solution)
- (5) Draw links to related patterns
- (6) Attach links to further references (e.g. links to websites or literature)
- (5) Write and attach notes
- (8) Save pattern proposition
- (9) Share pattern with other participants
- (10) Edit and discuss using various devices (inside classroom with whiteboards or mobile)
- (11) Browse the pattern library tree, in which each node or pattern is represented by an icon
- (12) Write comment to other participants’ pattern proposition
- (13) Edit pattern library by linking or deleting patterns



Figure 2 (illustrated by Gabriele Heinzel): A student notices an interesting case of appropriation and takes a picture (a). She adds notes creating a pattern proposition (b). She sends her rough pattern proposition to a friend for commenting and adding input on a PC (c). At home she elaborates upon her observations to present her proposition. In class it is discussed on the whiteboard (d).

## 6. Properties of MCPattern

In order to support a seamless transition between the learning environments we want to provide a consistent interaction design across all devices. We decided on a gesture-based interaction paradigm (section 6.1). The basic architecture is being developed with the help of an already existing platform (section 6.2).

### 6.1. Gesture-based Interaction

On small-screen devices like PDAs, menus and widgets consume precious working space and tapping them with a stylus is tedious. Just like on large-screen devices [5] it is desirable to keep user input and system response in the same space in order to facilitate the focus of attention.

Therefore implemented a gesture-based system of interaction as already described in [8] that enables users to create, switch between, share, edit, link, and delete nodes and save the whole structured content. Each node or page here represents one pattern. Bypassing the need for widgets and virtual keyboards the human-computer interaction is based on gestures and freehand writing.

When creating the first page, the user may create different nodes within that page (entering a lower node level of dependant sub-patterns) or create a new page on the same level.

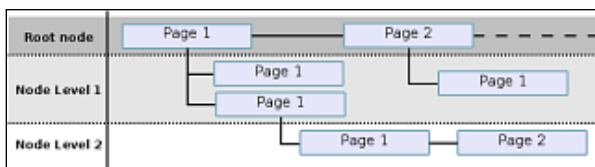


Figure 3. Different levels of nodes define the structure of pages. Previous, next, top and sub pages are easily accessible.

In addition to the gestures the following interface elements have already been implemented:

**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 studies with 12 participants showed that a double-click was oftentimes 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.

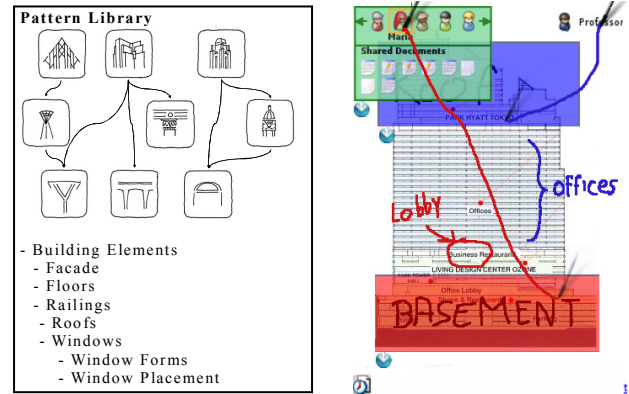


Figure 4. The left image shows a hypothetical pattern library overview with icons, created by the students, representing the patterns and showing their relations. All patterns are also listed within a hierarchical tree below the iconic overview. The right screen shows the currently implemented system: a user dragged one node (basement) to a student and another one to the teacher.

### 6.2. Implementation and Evaluation

MCPattern is currently being programmed with the help of an existing platform [2] that supports the development of learning-oriented mobile applications. The most important characteristics of this platform are a decentralized peer-to-peer schema, a replicated architecture allowing a state-based synchronization, trans-platform middleware is implemented in Java and C#, and support for gesture-based interaction [see 8].

Several aspects of the system may and need to be evaluated: The suitability of the design patterns (in the format we selected) for educational purposes, the usability of the system for PDAs to document patterns in the wild, its ability to seamlessly integrate learning activities in various settings (outside, home, school) and with various devices (handheld devices, tablet-PC, pen-tablets and whiteboards) and its overall contribution to motivate students and reach learning goals. Only two details have formally been evaluated. For classroom activities using interactive whiteboards we validated the ability of the gesture-based interaction and the hierarchical semantic to flexibly support learning activities. The usability of design patterns to support the work of designers and the format we defined to describe them are currently evaluated with 42 interface design students in Potsdam, Germany.

Additionally we conducted informal, formative evaluations of the individual gestures and the dynamic information architecture of the system in order to ensure

their usability. The next step will be controlled formal comparison of two design student groups, one working with pen and paper, the other working with our system for PDAs, their home PC, and with interactive whiteboards, on the collection and documentation of architectural design patterns.

## 7. Conclusions

Picking up the original literature on design patterns as a format for communication we elaborated upon their potential to communicate, but also to learn about design issues. We presented a mobile system for touch-sensitive devices that allows collecting and discussing patterns through gesture-based interaction and dynamic linking of nodes.

The visual anchor playing an important role within the envisioned system is primarily suitable for design disciplines that work with visible materials, like architecture, interior and interface design or fashion. Learning by doing we will have to evaluate in how the system has to be adapted for more abstract forms of design like interaction or software design.

## 8. Acknowledgement

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