Meta-design in Co-located Meetings

Li Zhu[1] and Thomas Herrmann[2]

[1] Dipartimento di Informatica, Università degli Studi di Milano
Via Comelico 39/41 20139 Milano, Italy
zhu@dico.unimi.it
[2] Information and Technology Management, Ruhr-University of Bochum,
Universitaetsstr. 150, 44780 Bochum, Germany
thomas.herrmann@rub.de

Abstract. In this paper we present a web-based design-environment – MikiWiki – which demonstrates how the concept of meta-design can be practically supported. It enables and fosters collaboration between meta-designers, designers and end-users. By running a case study to evaluate the appropriateness of MikiWiki in a co-located setting, the effects on interaction between these roles and the support of creativity were observed to derive socio-technical options for improvement. Conducting such an evaluation requires clarifying the basic properties of meta-design in a way that makes its effects observable.

Keywords: Meta-design, creativity, Creativity Barometer, MikiWiki, Hive-Mind Space Model, co-located collaborative design.

1 Introduction

Meta-design is a powerful concept that helps designers and end-users to elaborate needs and requirements, but also to iteratively specify what a software solution should look like. We characterize meta-design by referring to the following principles (Fischer and Herrmann 2011):

- Support of a fluid transition between design for use and design in use.
- Underdesign: representations of solutions (e.g. models or prototypes) do not only include determined specifications but also preliminary, incomplete or imprecise specifications so that designers and end-users are inspired to think about variations or to add further ideas.
- Cultures of participation where several roles and stakeholders can contribute with respect to their interests and find a space of communication and collaboration to exchange their perspectives.
- Empowerment of adaptation by helping end-users or their supporters (software-developers, administrators, power-users, facilitators etc.) to modify a software design with respect to their needs.

By complying with these principles we expect that meta-design provides a framework within which end-user and designer closely interact to conduct the development of a system. The advantage of meta-design can become evident with respect to:

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- Creativity support covering divergence (the generation of multiple ideas) as well as convergence (Guilford 1950) (building synergy and merging a variety of ideas) which leads to a concrete design.
- Integration of the knowledge and experience of meta-designers, designers and end users.

The role of the meta-designers is *to provide an environment,* which is used by designers *to draft or develop a solution and to demonstrate it* as immediately as possible so that end users can *directly influence the design of the solution by communicating with the designer or by interacting with electronic media*.

The research challenge is to give examples for concrete meta-design environments to demonstrate how it can be brought to reality, and how its features and benefits can be specified in a way that helps to make them observable within an empirical evaluation. This is necessary to understand the extra effort, which is caused by offering flexibility and multiple solutions with the meta-design approach, and whether the resulting benefits justify an additional workload.

In this paper a concrete web-based meta-design environment – MikiWiki (Zhu 2011) is introduced and evaluated within a co-located meeting support setting (Herrmann 2010). The leading question is how far small groups of people with various roles (such as meta-designer, designer or end user) can use MikiWiki as a collaboration space, how far they are supported to express and to creatively elaborate their needs and ideas, and what hints can be derived for improving socio-technical meta-design environments. Focusing on co-located design is guided by the intention to understand how situated creativity in action (comparable with reflection in action (Schön 1983)) can become possible when people can easily describe their ideas to others by using various tools and material.

The next section will introduce the Hive Mind Space model, a meta-design conceptual model focused on supporting collaborative design. It serves as a framework to summarize related work in the context of meta-design. Subsequently, this model will be illustrated by a concrete environment – MikiWiki. On this basis, the following sections will describe the methodology of a case study being based on five co-located meeting sessions using MikiWiki, our findings and the conclusion.

2 Mikiwiki

In order to evaluate a meta-design model and provide some concrete guidelines for implementing a meta-design model, we implemented MikiWiki (Zhu 2011) as an Hive-Mind Space model (HMS) model prototype.

2.1 The Hive-Mind Space Model

The HMS-model is grounded on several paradigms and frameworks. It aims to bring collaborative design and social creativity together to achieve better collaboration.

The Hive-Mind Space model is a meta-design framework derived from the Software Shaping Workshop methodology (SSW) (Costabile et al. 2007) that integrates

the "seeding, evolutionary growth, reseeding" model (Fischer et al. 2001). The bottom-up approach inherent in this framework breaks down static social structures so as to support richer ecologies of participation. It provides the means for structuring communication and appropriation. The model's open mediation mechanism tackles unanticipated communication gaps among different design communities (Zhu 2012).

2.2 Deriving Features of the MikiWiki from the HMS-Model

MikiWiki is a structured programmable wiki, with a hierarchical page organization made of "pages" and "folder pages".

Table 1. Feature of MikiWiki derived from HMS model

HMS conceptual model (Model)	**MikiWiki (System features)**
Habitable environments	Folders, Environment Page, Lookup mechanism
HMS – boundary objects (Star and Griesemer 1989)	Nuggets (Social application units)
Communication channel (Konkola 2001)	Accessible pages, open environments (folders accessible by design communities)
Mediation mechanism (Ardito et al. 2011)	Format page, environments and Lookup mechanism
Different levels of participation (Costabile et al. 2007) Different levels of tailoring (Mørch 1997)	Meta-design level: design environments, creating format page with JavaScript editor Design level: use design environment, browsing, editing visualization pages, data pages and format pages with JavaScript editor or rich-text editor Use level: browse visualization pages, creating visualization pages with rich-text editor
Open infrastructure (Fischer and Giaccardi 2006)	End-user development approach to allow client-side programming and programming by examples Enabling flexible switching between different design levels Extensibility to the existing Web ecosystem
SER model (Fischer et al. 2001)	Providing just enough features to be useful, and at the same time leaving code short and simple to be quickly understood and modifiable so that the set of features can be easily extended.

Table 1 depicts how each feature of the HMS model maps to MikiWiki. A habitable environment can be seen as a folder containing an environment page. In the environment page, users can specify certain behaviors and attributes that apply to all pages in the environment. Within MikiWiki, nuggets are drafted in analogy to boundary objects. Open environments accessible to all groups or communities can be seen

as the boundary zone. The mediation mechanism and support for the different levels of participation and tailoring are also reflected in MikiWiki. This might not be precisely a one-to-one mapping, as many theoretical concepts, such as boundary objects, cannot be reduced to simple software system components.

Collaborative and communication features in MikiWiki are not in-built in the system, but they are made available as underdesigned "nuggets" on top of the system. Hence, they are also seeds (Fischer et al. 1994) for encouraging appropriation and modification.

2.3 Nuggets

In MikiWiki, nuggets are explicitly designed to support the instantiation of the HMS model's boundary objects. A nugget is a page, which can be used as an embeddedable component within another page, in order to create sharable remixable components.

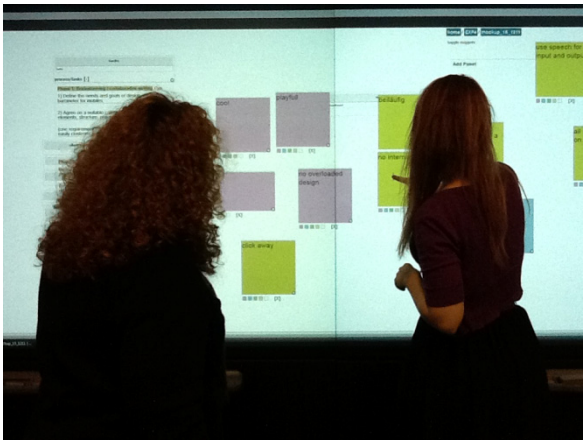

Fig. 1. Using the note nugget for brainstorming

Nuggets are MikiWiki pages, written in HTML, CSS and JavaScript. Non-programmers can easily start using and remixing existing nuggets, while advanced users can clone and modify these nuggets and consequently introduce new behaviors. To support collaborative design, we categorize nuggets in order to address collaborative design from different perspectives - for instance, *chat, comment* and *wall* nuggets support communication; *notify* and *activeuser* nuggets can be used to enhance awareness among design communities; and *todo* and *list* nuggets can be used to coordinate co-located and distributed activities (Hutchins 1995). Figure 1 gives an example of a nugget which supports participants creating PostIt notes, writing down their ideas and clustering them in different colors, while Figure 2 demonstrates participants designing a mobile interface with various nuggets, e.g. different *toolbox*, *canvas* and *trash* nuggets, etc. A decisive characteristic of nuggets is that the representation of ideas, which can be created with different nuggets, can be interrelated to each other. Therefore nuggets can intertwine the

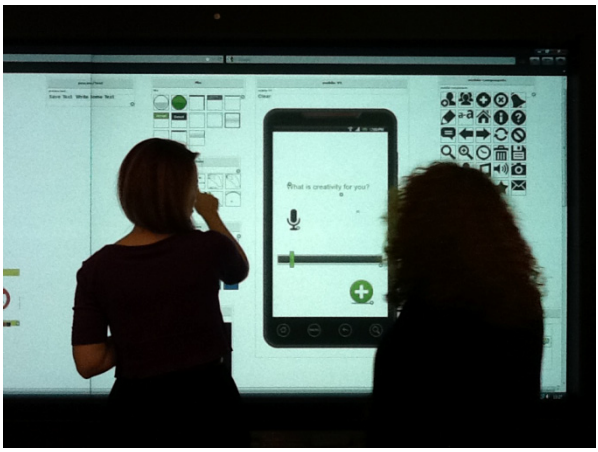

Fig. 2. Designing a mobile interface with various nuggets

various perspectives of different participants and they can bridge various phases of the design (see also Table 3).

3 A Case Study

The design study was done in collaboration with the Information and Technology Management Group at the Ruhr-University of Bochum, Germany. Meta-designers, designers and users were tasked to collaboratively design an Android phone version of a micro-survey tool, the creativity barometer (Herrmann et al. 2011) which is currently under development. The purpose of the creativity barometer is to conduct surveys to continuously understand and assess the climate of employee creativity.

Increasing economic pressure, competition and emergent project problems require employees to come up with creative campaigns, services or strategies in a very short time and cope with high workload under high pressure. However, these very high workloads and employee uncertainty about continued employment are major obstacles to creativity (Amabile 1999).

The creativity barometer allows companies to periodically repeat surveys and get immediate feedback. It can also provide a good opportunity for employees to reflect on the development of their own attitude and comprehend how their colleagues perceive the creativity climate. After a pre-specified time period (e.g. eight months), the company can summarize the feedback and plan interventions to improve the creativity climate. Since continuous surveying can disturb the employees, the idea is to support them to post their answers as "en passant" as possible, e.g. with smart phones. To draft the design of an appropriate smart phone solution seemed to be a reasonable task to test the meta-design concept by employing MikiWiki.

The case study was intended to evaluate:

1) Whether MikiWiki supports a fluid transition between design for use and design in use, as well as the interplay between meta-designers, designers and users.
2) Whether MikiWiki supports cultures of participation by providing lightweight means to allow participants with different background and different roles to articulate and share their ideas, which in turn enhance social creativity.

A decisive criterion with respect to these questions is creativity is supported or employed:

- Do design environments support the creativity of designers and users, in that participants continuously adapt nuggets to form a design space in order to perform their design tasks at that moment and use the design space to externalize their thoughts immediately?
- Does it allow designing the design environment as an activity at the meta-design level, in that the meta-designer sets up the initial design environment for the design session and constantly evolves it opportunistically to cope with emergent socio-technical issues without needing to change server-side code?

3.1 Environment Setting: Features of the Modlab

The design study was conducted in the modlab of the Information and Technology Management Group. It was established to develop and evaluate computer support for facilitated, co-located meetings. The following characteristics provided an appropriate setting for five collaborative design sessions supported with MikiWiki:

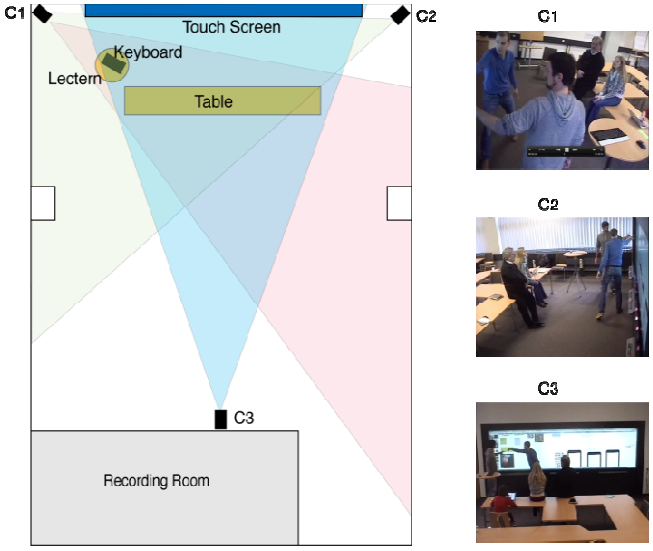

Fig. 3. Environment setting

- A large, high-resolution interactive wall (4,80m x 1,20m; 4320x1050 pixels) which seamlessly integrates three rear projection boards (see Figure 3). The touch screen displayed the MikiWiki mockup environment. Touch is recognized via six cameras which view the reflection of infrared light caused by fingers (Herrmann 2010). The view cones of the cameras are overlapping to support uninterrupted dragging actions over the entire wall.
- A table for users to sit down and get an overview of the design stage;
- A lectern where designers could use a keyboard to input text and interact with the screen;
- iPads as additional input devices which are connected via WLAN, since the interactive wall does not support multi-user interaction. This allows participants to input text and operate actions directly on the screen or via iPads.
- Three cameras recording the sessions from different angles to support observational analysis.

The screen-capture software records all the interactions on the interactive wall and outputs video clips, which can be used to further reflect on the design process, and on how users create new artifacts, interact, reuse, arrange and extend them.

While MikiWiki works for synchronous as well as asynchronous and distributed design collaboration, the modlab is focused on synchronous, co-located meetings. This focus has the advantage that the interaction between the participants and the possibilities of observing them are very direct. Furthermore, less coordination is needed and more attention is available for the actual design task. The disadvantage of co-located meetings is that people cannot freely switch between working in solitude, communication or incubation phases. However, the focus on co-location is a reasonable start for gathering immediate feedback on the strengths of MikiWiki and the underlying meta-design concept or on needs for improvement,

3.2 Methodology

The evaluation approach is an empirical and explorative observation-based field method. A design session follows these steps:

- Meta-designers (in this case the authors) prepare an environment for gathering ideas and sketching mockups in MikiWiki, with which designers drafted the Creativity Barometer user-interface for Android phones.
- Designers and users employ the environment to design the interface. Designers are participants who have designed applications, while users are participants who do not have design experiences, but have used the desktop version of the Creativity Barometer.
- Afterwards, meta-designers observe and interview designers and users to collect feedback on how to improve the design environment. Furthermore, the interviews trigger the reflection among the participants and help the meta-designer to understand how the participants have perceived the design process.
- Based on the empirical data, meta-designers refine the design environment for improving the next design cycle.

Semi-structured Interviews: After each design session, the meta-designer conducts follow-up semi structured interviews, for a total of 13 interviews. Open-ended questions are used in qualitative research rather than to quantify the answers. We aim to find out what participants think about MikiWiki, their design experiences and the rationale behind their opinions (Dawson 2002).

These are the guiding questions for the interviews:

• How does MikiWiki support participants in generating, expressing, structuring and connecting their ideas with respect to different design phases?

• What is the level of the satisfaction with their design results? How does MikiWiki support participants' creativity on an individual level and on a collaborative level?

• Do participants have any difficulties in using MikiWiki, how do they cope with them and what can be improved for the next design sessions?

• How do participants reach final agreement on design decisions?

• What are the important differences between MikiWiki and other groupware and what are the best parts of using MikiWiki?

[In01] to [In13] are used in the text to identify the 13 interviews.

Observation: Furthermore, we focus on observing and reflecting upon situations related to meta-design principles. Therefore the meta-designer took notes during the sessions with respect to the following questions.

1) How do participants and the meta-designers cope with the transition between meta-design, design and use?

2) Do nuggets encourage participants' appropriation with respect to underdesign?

3) How do participants with different perspectives exchange their ideas and find a balance between individual preferences and collective decisions?

4) How do participants shape their design space?

5) How do participants brainstorm, articulate and finalize their creative ideas via different nuggets at different design phases with respect to divergence and convergence of ideas?

It was possible to refine these notes by employing the video recordings afterwards.

3.3 Participants

The design sessions involved 11 participants (P), all with the following characteristics (Table 2):

Table 2. Participants Profile Information

Education and Expertise (Age)
Master in Sociology and Historical Science; Organizational and Migration Research, Urban Planning, Qualitative Research Methods (26-30)
Master in Political Science & Oriental Science; German Policy Development; Cooperation Development in the Middle East/ North Africa (26-30)
Master in Computer Science (CS); Privacy, CSCW, CSCL (26-30)
Master in CS; Creativity, User-Experience Design, Ubiquitous Computing (26-30)
Bachelor in CS; Video Analysis, Interaction and Experimental Design with Groups (26-30)
Master in CS; CSCW, Collaborative modeling, End-user Participation (31-35)
Master in CS; CSCW, Creativity, Collaborative Modeling (31-35)
Master in Social Science; Storytelling; Ambient Assisted Living (36-40)
Master in Engineering; Communication Technologies, Computer Sciences and Business Administration, CSCL, New Media (41-45)
Master in Computer Science; Interfaces, Interaction, Usability, Cognition, CSCW (41-45)
PhD in Engineering; Applied Work Science, Innovation and Process Modeling (50-)

1) Researchers who are involved in innovation, creativity, CSCW and CSCL related research and are willing to try out new technology

2) All participants have some experience with interdisciplinary creative collaborations, and are used to use different groupware systems

3) Some participants are directly involved in creativity related research.

4) Every participant has interdisciplinary focus, ranging from computer science, usability engineering to social, history and political science.

Design sessions were organized to involve different types of participants. Group 1 and 2 consisted of designers; group 3 consisted of users and designers from the previous design session; group 4 was made purely of users; group 5 consists of one designer and two users.

The meta-designer introduced participants the use of MikiWiki to participants and answered any usage question during the design process. Between design sessions, the meta-designer improved the design environment according to feedback given by the latest group.

Two participants from group 1 also attended the third design session in order to validate the previous experience and evaluate improvements of the mockup design environment.

Table 3 lists the main initial nuggets used to create the design environment for design session 1 (DS1).

Table 3. Initial nuggets

Design phases	Nuggets	Usage
Collaborative Writing	note	Creates PostIt notes
	sync-imagenote	Translate text into images
Collaborative Sketching	doodle	A sketch canvas for users to sketch
Collaborative Design	toolbox	Contain Android design elements
	canvas	Android phone canvas
	trash	Deletes design elements
	iconsearch	Searches for icons from the web

3.4 Design Phases

Each design session lasted approximately 60 minutes and it was divided into three phases.

Phase 1: Brainstorming and Collaborative Writing (15 minutes)

1) Define the design needs and goals of the design of Creativity Barometer for mobiles

2) Agree on suitable categories to describe design elements, structure, requirements, and pages

3) Create a mood-board and agree on the proposed "look and feel"

Phase 2: Sketching Ideas and Collaborative Drawing (15 minutes)
1) Basic illustrations of the structure and components of web pages
2) Focus on the interaction and navigation structure

Phase 3: Designing with the Mockup Environment and Collaborative Design (30 minutes)
1) Use the mockup environment to design the creativity barometer interfaces
2) Final wrap up: suggest possible elements for improving the design process

4 Selected Findings: Creative Interaction

This section describes some of our findings with respect to participants' creative interaction with MikiWiki.

Interplay between Artifacts and Communication: We observed that using MikiWiki leaves continuous traces of the participants' interaction to support their knowledge sharing. The nuggets offered various modes of externalizing and documenting their ideas. Referring to these externalizations on the large screen allowed them to explain their design rationale and to intertwine their perspectives and foster synergy building. Furthermore, the documented ideas were a continuous basis for refining and extending them.

However, starting to work with the interactive wall and the MikiWiki-environment presented some barriers: at the beginning, designers were mostly talking rather than interacting with the wall, not leaving a trace of their thoughts and discussion on the system. After a while they forgot what they had said or had in mind previously. Others (e.g. designer 2) were goal oriented and questioned the benefits of creating something such as a moodboard for their mobile application design. In these situations, it became obvious that the meta-designer has an influential role as a facilitator since her interventions helped the participants starting to use the environment. After this initial phase, no further intervention was necessary – the participants continued to use the wall.

The sharing of perspectives led to negotiations and to creative proposals. For example, the participants had different opinions about the "look and feel" of the barometer interface. Eventually they designed two different mockup styles: a *robotic* style

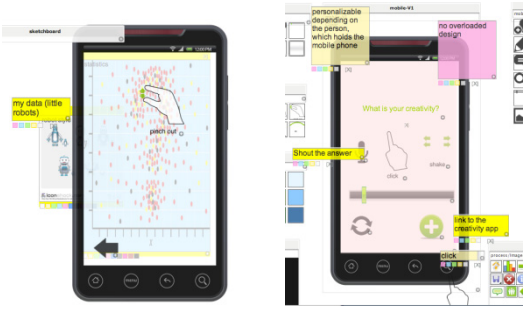

Fig. 4. Two different perspectives

Fig. 5. Repurposing color icons

and a *hello kitty* pink style (Figure 4). The difference between these two styles also demonstrates that the participants were encouraged to transfer their moods, and their emotional attitudes towards the interface, as well as their feelings about the expected context of use to the design.

Another example demonstrates the wide range of possibilities for externalizing ideas: In DS2, designers wanted to use a vertical slider to symbolize the barometer. However, the existing toolbox only provided a horizontal slider. P3 proposed that "*maybe it would be easier to just try to draw something like a box, just tell that it's a vertical slider...*" He then used colored box icons (Figure 5) to create a vertical graduated slider.

This case demonstrates the advantage of meta-design. On the one hand a wide range of features and materials is offered to inspire the participants and to promote the expressing of ideas. For example, the meta-designer intended the color toolbox to provide simple and more generalized design elements. On the other hand she meta-designed them to be easily appropriated and to be used in many different situations, so that the initial set of design elements could be spontaneously extended.

Meta-design before and in between: The interplay between meta-designers, designers and users also which benefitted from the MikiWiki approach: after each design cycle, in accordance with the participants' feedback and the meta-designer's observations, nuggets were modified and evolved for the next cycle to better support the collaborative design process. As such the nuggets were constantly evolving and improving, which also demonstrates how the meta-designer coped with the emerging socio-technical issues via bricolage (Lévi-Strauss 1968) and opportunistic programming (Brandt et al. 2008).

As an example Figure 6 illustrates from the meta-design level how a doodle nugget was evolved in-between each design session based on the meta-designer's observations as well as the feedback given by participants, e.g. adding the auto-saving function in DS2, combining the *page* nugget and the *doodle* nugget to provide better

dragging, and hiding and expanding interaction in DS3. Figure 6 also presents the progression of design sessions and the co-evolution that took place between users, designers and meta-designers.

The evolution of the meta-design environment took place iteratively, and was also re-enforced and perpetuated by designers' and users' creative contributions. For the meta-designer, MikiWiki strongly supported a design-in-use option making it both possible and easy to adapt the design space from session to session. It is through this cyclical process that meta-designers, designers and users enhanced their mutual understanding by interacting with the concretely available tools and materials.

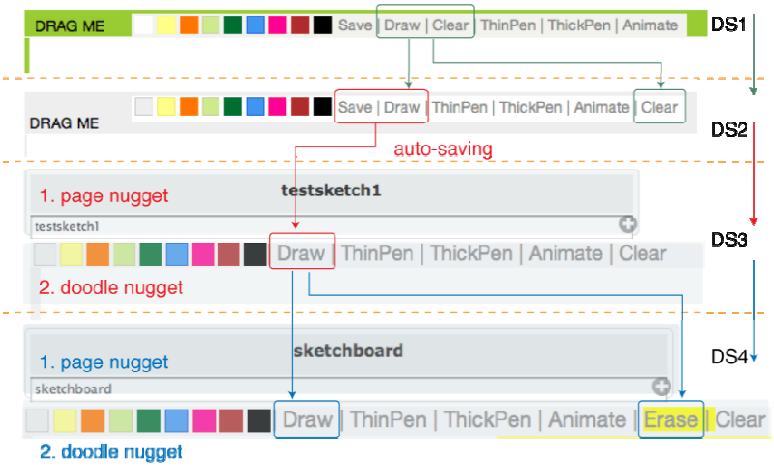

Fig. 6. Evolving the doodle nugget in between sessions

Tools for Creativity Support: An essential aspect of meta-design is to continuously support creativity throughout the whole span between design-for-use and design-in-use to fill the gaps being left by underdesign. During the sessions, it became apparent that MikiWiki provided various features, which supported creativity in design. The combination of MikiWiki with an interactive large wall meets several published creativity criteria (Herrmann 2010; Hailpern et al. 2007; Resnick et al. 2005). The interactive screen is especially useful to provide an overall picture of what has been proposed so that nothing is lost and the various ideas can be flexibly grabbed to generate variations, played around with or become the basis for following ideas. The following features were identified as creativity support:

Simple Tools: a whole palette of tools is offered [In02, In07, In13]; they are small enough to foster appropriation (Pipek 2005) and adaptation; and different tools can be used together to achieve new behaviors [In04, In11].

Ease of use: low threshold of use, simple interactions, system trust (e.g. given by the auto-saving feature meta-designed in DS3) [In05] and perceived feasibility breed satisfaction [In01, In07, In13]. The appropriate tools can also greatly reduce the risk

of misunderstanding, and unproductive discussions (Mamykina et al. 2002) as well as provide each individual with suitable means to be creative [In01, In07, In08, In09].

Reconfigurable spaces: restructuring personal workflow [In04], coping with and exploiting the initial lack of structure. As nuggets are independent and loosely coupled, participants can recombine them to create either a structured design space [In01] or a more chaotic space on the canvas [In03].

Adding structure: users can structure and transform ideas by connecting them and indicating their relationships (Figure 1)[In10]. This process also supports reflection and the articulation of previous creative ideas towards a convergent design result [In04].

Perceptibility: providing an overview of all ideas and the big picture they compose [In01, In06, In11]; inspection of details is possible and process history can be reconstructed from the traces left in the design environment [In04].

Quick experimentation: it is possible to explore what-if scenarios with easy drag-and-drop actions (Figure 2)[In01, In11]. As undo is also available, both creating and erasing content could be safely conducted [In09, In12].

One shortcoming of the environment that emerged from the interviews is that there was no private space where participants could draft ideas in isolation, without being observed by others – as required by Lu and Mantei (Lu and Mantei 1991). Currently MikiWiki does not support the differentiation between various layers which can be assigned to certain participants of design aspects and can be easily hidden or shown, although it could be extended on the client side to do so.

A Sandbox for Tinkering: One shared reason for appreciation was that MikiWiki acted as a sandbox that the users could play with, tinker and try things out. It is important to support participants to explore solutions and "what-if" scenarios (Shneiderman 2000; Mamykina et al. 2002) scenarios, trying out assumptions to assess design proposals. One participant [In02] stated: "*It was quite nice that we didn't jump from tool to tool to do different things. Brainstorming feels more like a different tool, starting from simple GUI. We just tried what we had there to achieve what we want. It really felt like a little playground, when you had quite many possibilities. […]*" Therefore, using MikiWiki with an interactive large screen can be characterized as a 'sandbox for tinkering' which allows the participants to collaboratively prototype design proposals, try out, evaluate, and eventually discard or use them as a basis for ongoing work. We believe that the perception of the sandbox is supported by the easy reach and availability of a range of small tools and the easiness of designing by selecting, dragging and dropping ready-made design elements.

From Reciprocal Inspiration to Convergence: When participants were seeing the wealth of icons made available by the meta-designer, they were inspired even if the icons were not related to their actual ideas. Those items that were not in the initial center of the participants' interest yet acted as a stimulus for creative thought and enriched participants' design ideas. For instance, in DS3 they noticed the audio icon, and subsequently had the idea to use audio input. The possibility to visualize abstract

concepts helped them to detect similarities between their design approaches and to refine them thus supporting a process of convergence. It could be observed that MikiWiki promoted the building of relations between design ideas and the merging of individual approaches. Therefore, in MikiWiki it is not only feasible to support divergent phases of brainstorming but also building synergy in a later phase by using the initial results from the brainstorming process.

Appropriation Kits: Not only were designers and end-users inspired but also the creativity of meta-designers was stimulated. By observing how nuggets were appropriated by participants, what they tried to do with them and which expectations came up, the meta-designer developed new ideas on how to enhance or modify the nuggets. Nugget pages act as a mechanism and interface for supporting the creation and evolution of software artifacts and are themselves subject to creative redesign. Moreover, nuggets capture and embody knowledge via their continuous adaptation process. In a reflexive process, this knowledge affects the medium itself by triggering its adaptation. Participants can incrementally construct knowledge via nuggets during collaboration and communication between themselves and with the meta-designer.

5 Summary and Implications for Design

The empirical evaluation of co-located MikiWiki sessions and of the underlying HMS reveals that meta-design is not only an abstract concept but can be instantiated in real settings. The instantiation is not only a technically issue (MikiWiki, large screen etc.) but also relies on the whole socio-technical context - e.g.: the influence of a facilitator, who has to encourage the participants to sketch their ideas, and to get them initially used to employing the variety of the meta-design features available. Further influential factors are the duration of sessions, their cyclical repetition, the appropriate mixture of the participants with respect to their abilities and experiences, and the characteristics of the design task. The facilitator must be able to act as a meta-designer who can instantaneously add new features to the design-environment or modify its features. If the meta-designer's activities do not only include bug fixes or simple adaptations but are the result of a more substantial reflection, they can be considered as re-seeding in terms of the SER-model. The adaptability of the design-environment is the most central characteristic of meta-design and can be achieved by flexibly combining small components. This is exemplarily demonstrated with the MikiWiki nuggets. Each of them represents an independent aspect of the design process and they can be closely related to each other and easily connected to a network.

The way MikiWiki instantiates meta-design does not only support rational problem solving, but also takes emotions and moods into account. It offers participants an asset to transfer their mood and emotional approach to the product being under design – and therefore supports a design outcome that is highly compliant with cultural issues or aspects of experience. This is a relevant aspect for further research.

MikiWiki provides a collaborative design environment for a broad spectrum of application areas, for instance iteratively prototyping interactive system design with a focus on evolutionary participatory design. MikiWiki could be used to rapidly prototype new UI designs and bring different design teams together. It is a web-based

platform, allowing design results to be easily stored and shared by communities. The wide design corridor, which is opened by MikiWiki, became obvious by the way participants used it and how their design focus was broadened and enriched.

The validity of the empirical findings is limited since meta-design usually covers a much longer period than was observable within the case study. Ongoing empirical investigation and clarification of the meta-design concept should take a whole series of design cycles into account, and also include phases of asynchronous and dislocated collaboration. Furthermore, a longer time period can be taken into account where design outcomes are used and adapted during use. However, it appeared reasonable to start with short cycle experiments to get an immediate feedback on:

- The needs for adapting the MikiWiki environment or increasing its adaptability.
- The characteristics of the socio-technical context into which MikiWiki has to be embedded.
- The kinds of explanations and interventions that have to be provided by the meta-designer.
- The characteristics of the design task and of the involved participants.

The chosen setting is a reasonable basis to proceed with the empirical investigation of meta-design. Further design studies can help in concretizing and exploring meta-design principles and their interplay with collaborative creativity in participatory design processes.

References

Amabile, T.M., Conti, R.: Changes in the work environment for creativity during downsizing. Academy of Management Journal, 630–640 (1999)

Ardito, C., Barricelli, B.R., Buono, P., Costabile, M.F., Piccinno, A., Valtolina, S., Zhu, L.: Visual mediation mechanisms for collaborative design and development. In: Stephanidis, C. (ed.) Universal Access in HCI, Part I, HCII 2011. LNCS, vol. 6765, pp. 3–11. Springer, Heidelberg (2011)

Brandt, J., Guo, P.J., Lewenstein, J., Klemmer, S.R.: Opportunistic programming: how rapid ideation and prototyping occur in practice. Paper Presented at the Proceedings of the 4th International Workshop on End-User Software Engineering, Leipzig, Germany (2008)

Costabile, M.F., Fogli, D., Mussio, P., Piccinno, A.: Visual Interactive Systems for End-User Development: A Model-Based Design Methodology. IEEE Transactions on Systems, Man and Cybernetics, Part A: Systems and Humans 37, 1029–1046 (2007), doi:10.1109/TSMCA.2007.904776

Dawson, C.: Practical Research Methods: A User-Friendly Guide to Mastering Research Techniques and Projects. How to Books Ltd. (2002)

Fischer, G., Giaccardi, E.: Meta-Design: A Framework for the Future of End User Development. In: Lieberman, H., Paternò, F., Wulf, V. (eds.) End User Development, pp. 427–457. Kluwer Academic Publishers, Dordrecht (2006)

Fischer, G., Herrmann, T.: Socio-Technical Systems: A Meta-Design Pers-pective. International Journal of Sociotechnology and Knowledge Development (IJSKD) 3(1), 1–33 (2011)

Fischer, G., McCall, R., Ostwald, J., Reeves, B., Shipman, F.: Seeding, Evolutionary Growth and Reseeding: Supporting Incremental Development of Design Environments. In: Adelson, B., Dumais, S., Olson, J. (eds.) Proceedings of ACM Conference on Human Factors in Computing Systems (CHI 1994), vol. 1, pp. 292–298. ACM, New York (1994)

Guilford, J.P.: Creativity. American Psychologist 5, 444–454 (1950)

Hailpern, J., Hinterbichler, E., Leppert, C., Cook, D., Bailey, B.P.: TEAM STORM: demonstrating an interaction model for working with multiple ideas during creative group work. Paper Presented at the Proceedings of the 6th ACM SIGCHI Conference on Creativity & Cognition, Washington, DC, USA (2007)

Herrmann, T.: Support of Collaborative Creativity for co-located Meetings. In: Randall, D.S., Pascal (eds.) From CSCW to Web 2.0: European Developments in Collaborative Design. Computer Supported Cooperative Work, pp. 65–95. Springer, London (2010), doi:10.1007/978-1-84882-965-7_4

Herrmann, T., Carell, A., Nierhoff, J.: Creativity barometer: an approach for continuing micro surveys to explore the dynamics of organization's creativity climates. Paper Presented at the Proceedings of the 8th ACM Conference on Creativity and Cognition, Atlanta, Georgia, USA (2011)

Hutchins, E.: Cognition in the Wild. The MIT Press, Cambridge (1995)

Konkola, R.: Harjoittelun kehittämisprosessi ammattikorkeakoulussa ja rajavyöhyketoiminta uudenlaisena toimintamallina. In: Tuomi-Gröhn, T., Engeström, Y., Young, M. (eds.) Koulun ja Työn Rajavyöhykkeellä. Uusia Työssäoppimisen Mahdollisuuksia, pp. 148–186. University Press, Helsiniki (2001)

Lévi-Strauss, C.: The Savage Mind. University of Chicago Press (1968)

Lu, I.M., Mantei, M.M.: Idea management in a shared drawing tool. Paper Presented at the Proceedings of the Second Conference on European Conference on Computer-Supported Cooperative Work, Amsterdam, The Netherlands (1991)

Mamykina, L., Candy, L., Edmonds, E.: Collaborative creativity. Commun. ACM 45(10), 96–99 (2002)

Mørch, A.: Three Levels of End-User Tailoring: Customization, Integration, and Extension. In: Kyng, M., Mathiassen, L. (eds.) Computers and Design in Context, pp. 51–76. MIT Press, Cambridge (1997)

Pipek, V.: From tailoring to appropriation support: Negotiating groupware usage. University of Oulu, Oulu (2005)

Resnick, M., Myers, B., Nakakoji, K., Shneiderman, B., Pausch, R., Selker, T., Eisenberg, M.: Design Principles for Tools to Support Creative Thinking. In: IJHCI, 36th edn.

Schön, D.A.: The Reflective Practitioner: How Professionals Think in Action. Basic Books, New York (1983)

Shneiderman, B.: Creating creativity: user interfaces for supporting innovation. ACM Transactions on Computer Human interaction 7(1), 114–138 (2000)

Star, S.L., Griesemer, J.R.: Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-1939. Social Studies of Science 19(3), 387–420 (1989)

Zhu, L.: Cultivating collaborative design: design for evolution. Paper Presented at the Proceedings of the Second Conference on Creativity and Innovation in Design, Eindhoven, Netherlands (2011)

Zhu, L.: Hive-Mind Space: A Meta-Design Approach for Cultivating and Supporting Collaborative Design. Università degli Studi di Milano, Milano (2012)