

Reviving the Innovative Process of Design Thinking

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Abstract—The application of weblogs in educational environments is enjoying an increasingly good reputation. In this paper, we describe our experiences with weblogs, supporting the innovation seeking process 'design thinking' that has recently received attention in various fields of interest. In face of this broad range of 'design thinking' usage, it was surprising to us, how little technology is employed in the corresponding teamwork processes. In this paper, we therefore stress the idea that weblogs may greatly support design thinking teams. Firstly, by enabling and supporting the formation of team communities across barriers of individual diversity, space and time, and secondly by supporting the process of design thinking itself.

Keywords-Web-based Collaboration; Management; Documentation; Performance; Design; Experimentation; Human Factors.

I. INTRODUCTION

Nowadays, no individual alone could ever know all that there is to know [1]. To remain competitive in the 21st- century global economy, knowledge worker must be increasingly specialized, and at the same time cooperate in diverse setup teams.

Diversity has been credited with myriad positive outcomes for team performance. Research, meanwhile has shown that the performance advantages of diverse setup teamwork are often found under very narrow conditions [2]. Both, experimental and field researches show that teams often do not reach their potential [3]. When groups collaborate there may be a tendency to loaf, to prematurely evaluate group products, or for some individuals to dominate the group process or distract the group from its goals.

This creates a demand for sophisticated coordination and management [4]. Techniques that assure efficient interaction, appropriate leadership, and motivating goals shall help groups overcome some of the negative forces. Design thinking offers such a broad set of techniques and opens up a space where creative teamwork can lead to innovation.

In this paper, we stress the idea that weblogs as such a technique among others may greatly support the innovative process of Design Thinking. Firstly, by enabling the formation of teams and communities across barriers of individual diversity, space and time, and secondly by supporting the process of design thinking itself. This paper underpins this

argumentation with the subsequent arrangement of sections: The subsequent section introduces the general concept of Design Thinking. Section three elaborates upon the question to what extent modern information and communication technology might enhance the process of Design Thinking. In doing so it delves into the question to what extend weblogs might be a general value-add in the teaching and learning environment and particularly in the process of Design Thinking. The following use case in section four is about the implementation of a weblog in a highly dynamic and innovative learning- and teaching- environment. It will indicate that weblogs - if implemented correctly in a specific context of application - can indeed greatly improve the process of Design Thinking. We finally discuss terms of success and give an outlook on further research questions.

II. WHAT IS DESIGN THINKING?

Recently, the term 'design thinking' has received attention in various fields of interest. The concept has its roots in research on how designers comprise wicked problems [5] and develop novel and viable solutions. Originally investigated in domains like architecture and industrial design, the initial research focuses on cognitive models supporting the generation, condensation, and creative transformation of design knowledge and concepts [6] [7] [8]. Building on that, design thinking was further developed and translated into metadisciplinary frameworks detached from designers' professional domains and was applied to various disciplines and fields of innovation. Design agencies such as IDEO promote working methods labelled with this term and inspire large scale companies like Procter & Gamble and SAP to design thinking' approaches to innovation [1]. As such, it supports the useful exchange of knowledge which has shown to be crucial for innovation processes. Nowadays, the term has therefore expanded into academic curricula beyond traditional design programs, as, for instance, at Rotman School of Management (Toronto) in the context of MBA education, and at the d.Schools in Stanford and Potsdam which offer design thinking education specifically to non-designers [9] [10]. Here, post-graduate students learn to work across their highly specialized particular disciplines in

diverse teams. This diversity includes cognitive, disciplinary and social diversity. To enable the analysis and processing of a wide scope of challenges and to deal with so-called "wicked problems" [11], teams comprising members with backgrounds in distinct disciplines are required. While the team setup is interdisciplinary, the participants interact in an open dialogue that transcends their respective disciplines, accepting each perspective as of equal importance and relating the different perspectives to each other. This necessitates exchange between domain languages and between everyday practices of different fields. In order to facilitate this approach, student teams are attended by teachers with the competence of moderation, mediation, association and transfer needed for this interdisciplinary mode of working [12].

One of the rather well proven success metrics of design thinking projects is the alternating use of divergent (where the questioner attempts to diverge from facts to the possibilities that can be created from them - concept domain) and convergent (where the questioner attempts to converge on and reveal "facts"- knowledge domain) thinking which is actively promoted through frequent feedback and testing. This change of thinking style results in a specific creative process, open to iteration. Song et al. [13] show that teams cycling between divergent and convergent patterns of thinking and questioning perform better than teams that have little variation over the design process. A frequent shift furthermore promotes the pooling of unshared information [14] [15], another established indicator for successful teamwork, which is the basis of what is often described by 'creating something larger than the sum of the individual input'.

The optimal team setup for Design Thinking teamwork projects is diverse: interdisciplinarity, mixed social backgrounds and cognitive diversity are some of the keywords here. Design thinking allows these diverse setup teams to develop a mutual understanding due to its strong emphasis on team-based learning regarding both the problem and its potential solutions.

Therefore, design thinking uses a broad variety of instruments. In addition to the predominant use of whiteboards, post-its and simple pens, digital documentation and communication applications are employed as well. Most of the time, a combination of analogue and digital instruments will be reality.

III. SUPPORTING HIGH DIVERSITY TEAMWORK

Until this decade, the ability to use technology to enable networked innovation was very limited. The primary technologies used to facilitate group innovation were paper and, more recently, the whiteboard and dry erase marker. Since then, a great deal has happened in the past decade that is revolutionizing collaborative innovation. New communication and collaboration platforms, media, and tools now allow many-to-many collaboration at a scale and cost that

could never have been achieved in the past. The Internet, an overnight success three decades in the making, along with its younger cousin the Web, really does change everything. For the first time, we now have tools that enable the free exchange of information across many individuals with remarkably low friction. Unfortunately, by seeking the rare brilliance of a limited few instead of the statistically likely success of the connected many, the "lone genius" worldview has limited our ability to make meaningful progress in everything from technology, to organizations, to education, and all the way to society [16]. We have done very little to systematically develop technology to support the innovation process. Overall, we are still in the "horseless carriage" days of living in a truly networked world. We can do better, but how do we begin to engage this new way of being? We believe a path to the future can be found by paying conscious attention to evidence of what works in the world today, and by asking: What are some of the enabling collaborative tools available today? There are many web-enabled collaborative tools that can be used for innovation seeking teamwork:

- *Instant messaging*: The ability to easily send short messages back and forth to others who are present using computers and mobile devices.
- *Conference calling*: Previously only available to corporate entities, now virtually anyone with a connected computer can initiate and participate in a conference call with others worldwide.
- *Video conferencing*: This is the addition of live video to conference calls or one-to-one messaging.
- *Shared whiteboards and documents*: These allow people to interact in real time and share documents, photos, drawings or presentations where anyone can edit or annotate the shared media. It reinforces collaboration and iteration.
- *Virtual spaces*: Web offerings to interact in real time within a virtual three-dimensional world.
- *Question and answer sites / Portals*: Many websites allow groups of people to easily share their knowledge and create new value.
- *Wikis and weblogs*: Web tools that have become widely available in recent years, making publishing quick and easy. They encourage dialogue and sharing, via asynchronous posting of comments, documents, discussions, and editing of shared media. Blog search engines, such as Google Blog Search and Technorati, BlogPulse or BlogIntelligence [17], allow people to easily search a huge quantity of very dynamic information. By transcending time, space and language barriers, blogs thus enable the exchange of knowledge across conventional borders [18] [19] [20].

A. Weblogs in creative teaching and learning environment

The focus of this paper is on this last group of web-enabled tools, since we believe that weblogs can spur the

process of Design Thinking most [21]. Technically, weblogs are an easy-to-use, web-enabled Content Management System (CMS), in which dated articles ("postings") as well as comments on these posts are displayed in reverse chronological order. Stephen Downes for instance postulates to define weblogs independently of their content: "Blogging is something defined by format and process, not by content" [22]. Blogs are therefore a form of micropublishing that are at first undefined regarding their field of application [23]. This undefined point of origin makes them so flexible for numerous other potential purposes, beginning with personal diaries, reaching over to knowledge- and activity management platforms, and finally to content-related and journalistic web offerings. Weblogs belong to the group of "social software": simple, easy-to-use, and flexible applications that not just enable, but also facilitate cooperative gathering of content. The consent among all currently existing social software tools next to weblogs, is that the surplus value is generated out of collaborative (social) activity. Social software therefore enables affiliation to (social) networks, as well as structuring and channeling of attention towards a certain field of interest [21].

Research on computer-based or electronic brainstorming has found that electronic groups can perform about as well as or better than nominal groups [24]. With the electronic technology, group members can share ideas simultaneously, be anonymous to other group members (low evaluation apprehension), and be accountable for their individual performance on their station (low social loafing). On top of that, insuring individual accountability can enhance performance in groups [25]. Kayser [26] stresses the similar experimental finding, that the use of a written or electronic exchange process is one important factor to enable groups to reach a high level of creativity. This is due to the fact that team sessions should be followed by individual idea-generation sessions to fully tap the cognitive benefits of an exchange process. The individual part structures the process to minimize production blocking, evaluation apprehension and social loafing.

The application of weblogs in teaching or learning environments is as a consequence enjoying an increasingly good reputation. Diverse authors attribute blogs the potential to be a transformational and innovation-enhancing technology in this regard [23]. Summarizing the findings of their qualitative study, Efimova and Fiedler [27], for instance, pool the benefits of the technology through the following characteristics:

- The representation of multiple perspectives
- Revelation of synergies of individual and collaborative learning,
- The acquisition of meta-learning-strategies as well as
- The facilitation of access to experts.

It seems to be a competitive advantage when students prepare, document and allocate their work, questions, sug-

gestions or recommendations in form of postings in a quick and easy to handle ready-made manner [21]. Highly ranked institutions such as the Harvard Law School start to strategically implement weblogs as digital portfolios for their student- and teaching body [23].

The core of a blog is a so-called 'personal learning space' in which personal artifacts are largely shared with a non-uniform group of audiences. The individual process of students is hereby documented and can at all times be reflected and reused by themselves and all other potential stakeholder. This space quickly becomes a complex ePortfolio [28], defined as "[...] a Web-based information management system that uses electronic media and services to enable learners to build and maintain a digital repository of artifacts for demonstration of competence and reflection on their learning" [29].

B. Weblogs – a Design Thinking supporting technology

The usage of a weblog as central and strategic point of information and communication within a design thinking process offers not only the integration of all information collected via these tools, it supports furthermore an active division between collaborative and individual working phases. This is crucial for a successful integration of as diverse knowledge and ideas as possible. There is a misbelief, that teamwork means working in a group at all times of a project. It has been proven to be wrong [30]. Instead, it is crucial for the success of teamwork, to shift between face to face group interaction and individual action. This allows all team members to work at their speed and to put forward their ideas without being interrupted or rated before an idea is fully elaborated. It also helps the team to grow together and to value each member as an individual, if they have the chance to put forward their knowledge, ideas and remarks in individual sessions.

This moment of true teambuilding is what most design thinking methods are designed for: brainstorming, storytelling, user research, prototyping and many more are neither new nor unique. Their power lies in the right combination and application over a creative thinking process. All these methods support the active solidarization of the individuals into one team, following the similarity-attraction paradigm. According to Mannix and Neale [31], the predictions of this paradigm are straightforward: Similarity on attributes such as attitudes, values and beliefs and behavior facilitate interpersonal attraction and liking - basic needs for a trust- and successful collaboration.

IV. USE-CASE D-SCHOOL BLOG

The following use case is about the implementation of a weblog in a highly dynamic, modern and innovative learning- and teaching- environment that focuses on the innovational culture of "Design Thinking". It will indicate that weblogs - if implemented correctly in a specific context

of application - can indeed improve the traditional and conservative way of education [21]. Our use case supports Ojala's reasoning that blogs give room to alternative views and opinions and inaugurate a distinct culture of thinking outside the mainstream [18].

A. Motivation and Background

The initial motivation to start the D-School-blog-project was to support the so-called "Innovation Lab", set up by the Hasso Plattner Design Institutes of Potsdam (Germany) and Stanford (USA) at the world's biggest IT fair CeBIT in Hannover in 2009 [32].

On each of the seven fair days, the lab used a predefined design thinking process, to develop original ideas for daily challenges with the overall goal to 'humanize' IT. CeBIT visitors, as well as the American and German students and professors from their respective locations in Stanford and at the fairground were joining forces in big, creative and interdisciplinary team in these 24-hour projects to develop fresh ideas for user-friendly products and services. The overall goal of the 'Innovation Lab' was to turn CeBIT into an opportunity for every fair visitor to experience innovation first-hand and to show that innovation can be taught and learned.

Communication of preliminary results within the distributed team was supported by the employment of free tools and web services such as SKYPE, YOUTUBE, PICASA WEB GALLERIES and more. Anyone with Internet access was able to follow, comment and contribute to the progress of the Innovation Lab through the 'D-School-Blog'.

B. Design, Structure and Content

For creative endeavours that require composition of novel artifacts, enhanced interfaces shall facilitate the exploration of alternatives, prevent unproductive choices, and enable easy backtracking. Therefore the interface is of crucial importance. Another requirement is to find acceptance among a very broad user range, as this is a crucial aspect of design thinking teams. Wide spreads of technology and premature knowledge and willingness to explore the digital space is one of the difficulties one faces when building a weblog.

To facilitate the blog's acceptance inside the DT community, its graphical presentation was realized along the Corporate Design of the D-School in Potsdam. It displays a sense of playfulness as well as an uncommon, creative character that is well-known and closely associated with Design Thinking. The starting page of the D-School-Blog was therefore subdivided into five major areas:

Area "A" is comparable to the typical header of any weblog, including search functionality, multi-language support, information on why the blog was initiated and most notably the blog's navigational area that links to the following four main categories:

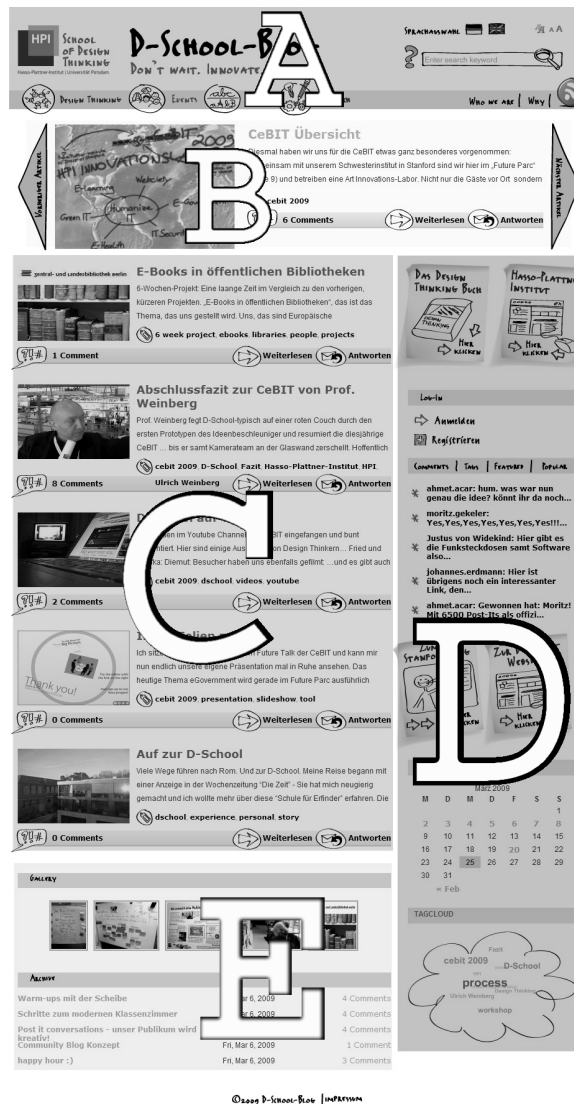


Figure 1. D-School Blog Starting Page - accessible via <https://d-school-blog.hpi-web.de/>

- The 'Design Thinking' category includes all kinds of posts that generally describe the innovational process of Design Thinking and that cannot be included in the following more specific categories.
- "Events" comprise postings that link Design Thinking with specific events like the above-mentioned innovation lab at the CeBIT, the presentation of the first Design Thinking book and others.
- "Classes" specifically focuses on the Design projects undertaken in the Design School of the HPI in Potsdam.
- The "Research" category is exclusively reserved for all work related to the bilateral Design Thinking Research program of the HPI and the Stanford University.

Label "B" in Figure 1 displays the featured articles in the D-Blog. This plugin-enabled functionality adds a number of

features to the standard blogging software of WORDPRESS that allow moderators to easily write and organize series of posts and display that series dynamically in the blog. This feature allows drawing extra attention towards a specific event, project or topic regarding Design Thinking that is being covered by multiple posts. In the case at hand, we used this area within the blog to display the different Design Challenges called out during our "innovation Lab" at the CeBIT in the most prominent way possible.

Any article posted in the D-blog finds its way into the main content area labeled "C". Usually, the posts are displayed in reverse chronological order, typical for weblogs. The sidebar of the D-blog is presented in a weblog-common way in the area labeled "D". Here, the blog visitors find important Design Thinking-related links, fields for registration and log-on, as well as a mask displaying the latest comments posted and the most popular posts written, as well as a list of the featured articles as also displayed in area "B". Here, you also find the list of tags assigned to the single posts, also displayed in the "tagcloud" at the bottom of the sidebar.

Area "E" is the last major division of the blog's starting page. Since multimedia content is generated in masses within the DT-process, a corresponding preview-gallery also needed to be placed on the starting page. The archive with "out-dated" posts finds its place at the very end of "area" E, only followed by copyright information and imprint.

Bross et al. [21] subdivide the D-School-Blog's community into the following user groups:

- Scientific staff, students and alumni of the D-School in Potsdam and in Stanford,
- the editorial staff of the D-blog that was also responsible for its technical realization,
- people that are interested in the Topic of Design Thinking and that are willing to contributing to the process by writing their own articles or commenting on the content of user-groups one till three.

The diverse background of those involved in this project obliged the editorial staff to provide technical support to parts of the community by giving continuous support of how to use a medium such as weblogs.

C. Proof of concept

The success of the community blogging concept is indicated by the usage statistics of the D-School-Blog. The initial pool of users consisted of students and alumni taking part in the 24h challenge and of design thinking researchers interested in participation at the CeBIT in 2009. A total of 55 user accounts have been set up for the launch of the blog, of which 39 have logged in within the first three days. Nearly 2 years later, the blog matured from a single-event documentation tool to a Design Thinking community platform that is fully integrated into the curriculum of the D-School in Potsdam. It is also prominently linked from the D-School's homepage (see [33]). 140 different authors

are by now regularly publishing new posting on the weblog. In total, the D-School-Blog so far welcomed in excess of 27.000 different users on its pages, who generated more than 100.000 hits. We also believe that the D-School-Blog is increasingly attracting interest in and outside the virtual borders of Germany. Indicators for this assumption are close to 25.000 referrers regarding the d-school-blog from external web pages, as well as the rising number of more than 300 followers on the accompanying twitter feed (twitter.com/dschool_potsdam). More to the point, selected projects of the D-School that have been documented in its blog, such as BRING.BUDDY (see [34]), have made it into a German newspaper with a wide circulation [35] and even into a popular German television show [36].

D. Critical success factors

Blogs may support the team building process but meanwhile need to find acceptance among all stakeholder. This is a tough task, due to the diverse setup that we have described earlier on. None of the less, we believe that if the following rules are abided, a blog should not be a source of friction. The user should therefore be allowed

- to take an holistic view of the source data or raw material with which they work
- to suspend judgment on any matter at any time and be able to return to that suspended state easily
- to be able to make unplanned deviations; return to old ideas and goals, formulate, as well as solve, problems and
- to re-formulate the problem space as their understanding of the domain or state of the problem changes.

Despite of the numerous advantages weblogs might incorporate for an innovative environment such as the Idea of Design Thinking, there is a downside in their application as well. Several experiments show, that acquiring knowledge of others through social software (e.g. weblogs) without personal interaction cannot fully replace the depth of understanding of face-to-face interaction (e.g. through non-verbal communication like mimic or gesture) [37]. We therefore strongly support the combination of real "physical" networking and virtual networking in order to leverage social software to the maximum.

Nardi et al. [38] state on this behalf that it is not what you know - it is who you know in the modern world that is most important in helping you getting a job or task done satisfactorily.

In other words, social networking increases the resources that can be leveraged through interpersonal relationships - thus social capital [37] [39]. Scholars transcribe professional networking with maintaining contacts, socializing, engaging in professional activities such as attending conferences, participating in community groups, and increasing visibility to others [40]. It thus equally includes emailing, participating

in social networks such as FACEBOOK and using weblogs in the modern era of social media [29].

V. SUGGESTIONS FOR FURTHER RESEARCH

Creativity is a socially defined activity. As such, measures of a creativity support tool's success are partially dependent on how success is defined and evaluated within a specific community of practice. Consequently, traditional measures such as performance or efficiency, while still important, are only one lens with which to view the value of a creativity support tool. To gain a more holistic perspective of how a tool influences the creative process, one may find it necessary to define new ways of measuring the impact of a creativity support tool on the problem solving process, where these metrics are derived from practices deemed important by the community under investigation. The following types of research questions that should be asked in evaluation studies of blogs supporting design thinking teams:

- Is this technique better than existing practice (Post-Its, Whiteboard, etc.)?
- Does it expand its use to other contexts?
- Have you learned how to improve this tool based on this evaluation?
- How does the tool/technique influence the creative process?
- What facets of creativity are affected and to what degree?
- How brittle is the tool/technique?
- How accepted is it by the users over the long term?
- Does it celebrate diversity?
- How does this method complement others in the family of tools/techniques?
- What is the task-to-technology "fit"?

VI. CONCLUSION

On top of the general advantages that weblogs might have in a teaching or learning environment (refer to section 3.1), we identified several characteristics that are specifically useful when deployed in the context of Design Thinking. One crucial success factor is their ability to actively promote and support frequent feedback and testing of their rationale. This allows users to fundamentally change their style of thinking and make room for specific creative processes that are open to iteration and central for the concept of Design Thinking. Weblogs also have the ability to pool information that was so far unshared - another established indicator for successful teamwork, which is the basis of what is often described by creating something larger than the sum of the individual input. We also argued that weblogs support the active solidarization of the individuals into one team, following the similarity-attraction paradigm. Next to the benefit of understanding why and how blogs can support better design thinking teamwork results, one may also retrieve extensive process and decision documentation of rather poorly

investigated design thinking projects. Especially researchers can profit from the possibilities for convenient retrieval of stored expertise. Additionally, the information can support and speed up coaching and learning - new students can in fact build on the research and ideas of others. We thus argue that weblogs - if implemented correctly in a specific context of application - can indeed improve the innovative process of Design Thinking greatly.

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