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IdeaBulb: A Smart and Tangible User Interface for Monitoring Ideation During Creative Sessions

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Abstract—**In this paper, we propose a tangible user interface for the monitoring of new ideas generations (ideation phase) during creative sessions. Based on the analysis of different brainstorming, we highlight the dynamic of ideas production by different groups during ideation phase using electronic devices. We claim that this tangible user interface is designed in order to give live feedback concerning these dynamic of ideas production to the participants and the facilitator. Our work is the result of the interaction between two scientific approaches: the analysis of creative sessions and the design of tangible user interface. The result of our experiments show a creative cliff and propose a design concept for monitoring ideation phase.**

Keywords—creativity; ideation; tangible interface; idea generation.

I. INTRODUCTION

The use of creative processes is a factor increasingly recognized as essential in the emergence of new ideas or business opportunities [1]–[3]. These processes can be declined in a punctual way by involving groups of participants in a creative session, or a brainstorm session [4].

Open-Innovation oriented creative sessions gather participants from different backgrounds – services, companies - from clusters are more likely to be competitive domestically and globally when their business is competitive and collaborative at the same time [5]. These ambivalent aptitudes create a context of coopetition [6].

Creative sessions are day events led sometimes by a facilitator (internal or external) to help the generation and the evaluation of new ideas, also they follow a process characterized by a succession of convergent and divergent main phases according to the facilitation model proposed by Ambrosino et al. [7].

The generation of ideas called the ideation phase is a critical part of the innovation process [8] where participants are asked to produce as many ideas as possible in an allotted time. Time-constrained is thus important, because when deadline is fixed, it add an emotional power in the form of fear, lest participants may fall down [9].

In this article, we propose first to analyze the ideation phase of creative sessions in order to highlight the dynamic of ideas production within the group.

Second, we propose a tangible user interface for the monitoring of ideation phase in order to improve creative sessions by giving to the participants and the facilitator a live feedback concerning these dynamic of ideas production.

II. BRAINSTORMING TECHNIQUE AND SUPPORT TOOLS

Classic brainstorming usually causes blocking and slows down the generation of ideas in groups [10]. Galuppe et al. [11] show electronic brainstorming systems can improve creative sessions by acting on three classes of explanatory mechanisms which can cause productivity loss in brainstorming groups:

- Procedural mechanisms like production blocking [12], when just only a person can speak at a time.
- Social psychology mechanisms like drive-arousal [13] and self-attention [14], which is due to the presence of the other people and individual membership in the group.
- Economic mechanisms like social loafing [15] and free-riding [16], which correspond to an intentional withdrawal.

IdeaValuation [17] is a structured electronic brainstorming tool. It supports the ideation and evaluation through a discovering matrix [18]. The matrix is composed of needs (rows) and means (columns). As advised by [10], the facilitator using *IdeaValuation* invites participants first to generate their ideas in individually in the relevant cells of the matrix.

Then, these ideas are discussed and evaluated in a group session, following the instruction of the facilitator to evaluate each idea in turns. For each idea, the evaluation is done along four criteria and is followed by a short discussion between participants.

III. CHARACTERIZING THE IDEAS PRODUCTION

A. *Experimental setup and process*

Simultaneously, two creative sessions were performed in an event dedicated to Innovation in France. Groups are composed of participants who are members of the regional Agency of Development and Innovation in Nouvelle-Aquitaine (ADI-NA). There are located in two different rooms and the rooms do not interact together.

First participants are introduced to *IdeaValuation* tool and in particular the discovering matrix used for this event. Then, participants are then invited to generate as many ideas as possible, following one of the 4 fundamental rules of brainstorming [19]. They use a Samsung Galaxy Tab A tablet connected by WIFI.

Some characteristics of these ideation phases, which last 20 minutes, are described in the matrix, in TABLE I.

TABLE I. CHARACTERISTIC SETTINGS OF TWO WORKSHOPS

Information according phase concerned			**Workshop 1**	**Workshop 2**
Registrering	*Thematics adressed*		Marine Renewable Energies	Biomimicry for Sustainable Housing
	Number of participants registred		42	26
	Initial motivation	*"Expand my network"*	10	6
		"Generate ideas for collaborative innovation projects"	25	14
		"Other"	*7*	*12*
Discovering matrix	*Type of entries*		Needs vs Means	Needs vs Means
	Size		4 x 5	5 x 5
Results of ideation phase	***Number of participants who generate ideas***		**23**	**26**
	Total amount of ideas		**79**	**79**

While there were more participants registered to the workshop 1, only 23 of them submitted ideas through *IdeaValuation*, resulting in two groups of 23 and 26 idea producers.

B. *Observations and analyses*

The use of an electronic brainstorming tool such as *IdeaValuation* allows to monitor the production of ideas during the ideation phase. During 20 minutes of ideation phase, we compute every 2 min two metrics: the amount of ideas generated and the flow.

1) *Evolution of amount of ideas generated*

Figure 1 indicates the evolution of the amount of ideas generated during the ideation phase for both workshops.

Participants slowly start to produce ideas. Then, 10 minutes after the beginning, the group reaches a peak followed by a sharp drop: we observe it in the amount of ideas proposed after 12 minutes for group 1 and after 16 minutes for group 2. In the case of group 2, no idea was proposed during the last three minutes. This part of the curve can be called the creative cliff.

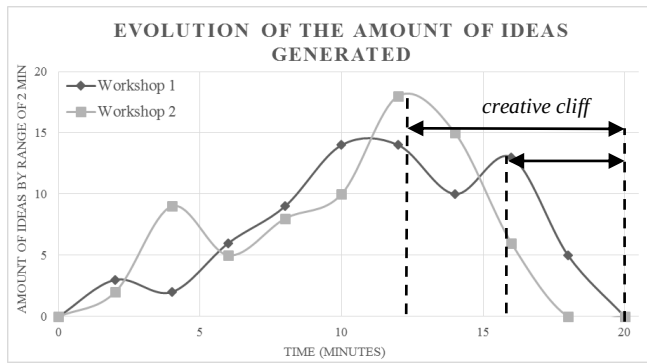

Figure 1. Highlighting the creative cliff

An ideal ideation phase could see all participants produce regularly until the end of the session. Without any external solicitation, the participants seem to be more limited by their ability to generate ideas than by time.

2) *Evolution of ideation flow*

Figure 2 indicates the evolution of ideation flow acceleration during ideation phase.

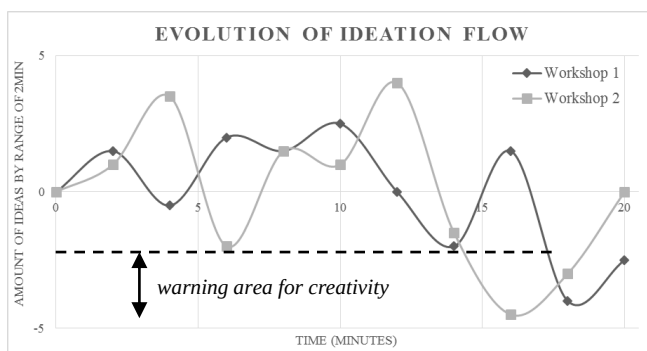

Figure 2. Highlighting of the warning area of creativity

There are some positive and negative variations of values which reflect the acceleration or deceleration flow of amount of ideas proposed. It seems to be a boundary beyond which the production of ideas tends to a zero value. When the curves tend to intersect this boundary, ideation flow is alarming. This part of the curve can be called the "*warning area for creativity*".

C. Opportunities for a tangible support tool

1) Lack of efficiency: boost productivy

As we have seen the time allocated to ideation phase is not fully used by all participant, the idea production cliff in the last quarter of the ideation phase. Individual generation lets them express and formulate ideas as they want, but the absence of external action, for example by giving to participants a live feedback about their progress may be a lever to increase their productivity.

In workshop 1, many participants do not generate any idea. Although, the absence of propositions by 19 participants in this workshop is notable, it is difficult to identify clearly the causes, but the use of a full digital solution may be at stake.

2) Lack of competition and collaboration

Despite the fact that competition benefits between intergroup are clearly highlighted as described in Introduction, participants need to have a live feedback of their progress. The only element which may be perceived as a competition one is the visualization of the other participants keyboarding during ideation phase. Currently, participants do not have any information about the real progress of the other participants.

Collaboration benefits are implied since participants accept to involve themselves in an open-innovation oriented creative session. However, they individually generate ideas and they cannot read the ideas of the others. So, collaboration may be perceived as limited during ideation phase.

In order to investigate these opportunities, we consider tangible user interfaces as a mean to give back control to participants on the productivity.

IV. IDEABULB: A TANGIBLE USER INTERFACE DESIGNED FOR IMPROVING CREATIVE SESSIONS

Tangible User Interfaces (TUIs) use physical objects to represent and/or manipulate digital information [20]. With the use of electronic brainstorming systems, we think TUIs to be adequate for enhancing collaboration and ideation in creative sessions thanks to a live feedback represented by a physical object, in order to make the ideation more tangible. They are known to support social interaction (e.g., collaboration) and to support thinking process (e.g., problem solving) through bodily actions, physical manipulation, and tangible representations [21].

A. Peripheral Interaction and Ambient Interfaces

Because ideation phase during a creative session is a cognitive process that requires central attention and a lot of mental resources, we wish to design an ambient TUI working with peripheral attention and requiring little mental resources to interact with.

Ambient awareness makes human beings aware of surrounding information [22]. Weiser and Brown [23] defined *calm technologies* as technologies able to move from the peripheral attention to the central attention of users, and backwards. They affirmed that calm technologies enhance ambient awareness by bringing more details into the periphery: it makes users aware of what is happening around them, what is going to happen, and what has just happened. In line with calm technologies, Ambient Interfaces use perceptible artefacts (e.g., shape, motion, sound, color, light, smell, air) to represent unobtrusively digital information. Bakker et al. [24] peripheral noted that recent studies have been conducted under the term *peripheral interaction*, aiming to broaden the scope of calm technology by designing not only for the *perceptual periphery* but also enabling users to physically interact with the digital world in their periphery.

B. Design concept: IdeaBulb

We think that giving live feedback to participants on their performance can mitigate ideation off-peaks. Therefore, we propose to design a smart interface to inform participants on the amount of idea they generated and their flow of ideation. Because we do not want to interrupt participants during their ideation process, we wish to design an ambient interface to subtly inform participant without being intrusive.

1) General design: metaphorical items

For designing *IdeaBulb*, we choose the metaphor of a bulb held by a hand, in Figure 3. Light bulb shape is part of the clichés to symbolize the ideation of an individual [25], while the hand holding it represents the group.

Figure 3. IdeaBulb's metaphorical design

2) Feedbacks

The smart interface *IdeaBulb* will give in real-time two types of feedback during ideation phase.

a) Cumulative feedback on the amount of ideas submitted

Using a led strip, *IdeaBulb* lights on its "belly" according to the amount of ideas submitted. For instance, *IdeaBulb* informs participants that there is a total of 3 ideas submitted by turning on 1 led over 30 leds maximum, as shown in Figure 4 (a).

b) Immediate feedback on the flow and the submission of ideas

Using a servomotor, *IdeaBulb* opens its "mouth" according to the flow of ideation. For instance, a flow of 0 ideas by minute is represented by a mechanical dome widely opened meaning that *IdeaBulb* is "hungry" for ideas. In contrary, a flow of 4 ideas by minute is represented by a "mechanical dome" completely closed meaning that *IdeaBulb* is "satisfied", in Figure 4 (b).

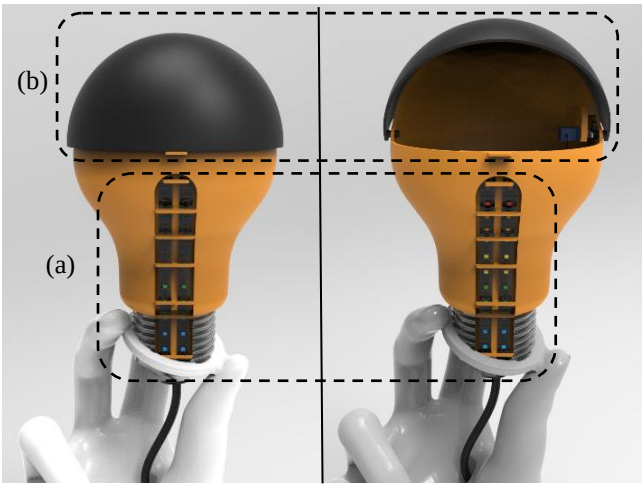

Figure 4. Opening mechanism (b) and lighting of leds (a)

Each time an idea is submitted, *IdeaBulb* quickly opens and closes its mechanical "mouth" meaning that an idea was eaten. Moreover, when *IdeaBulb* "eats" an idea, the led strip is animated informing participants that the idea is going down in the "belly" of *IdeaBulb*.

V. Conclusion and Perspectives

Our work presented here is the result of the interface between two main scientific fields: analysis of live facilitation during creative sessions and the design approach for a tangible user interface in a context of competition and collaboration. Based on the analysis of our many experimental results, including the two workshops presented here, the monitoring of ideation phase highlights a *creative cliff* and a *warning area for creativity*, when generation of ideas becomes low. Then, we present a smart and tangible user interface, *IdeaBulb*, which could counteract the off-peaks observed.

The prototyping and testing during creative sessions could validate our assertions. The total amount of ideas, ideation flow and participant experience should be monitored. The context of competition and so creative performance could be increased by dividing the group into many sub-groups in order to enhance group creativity [26]. An *IdeaBulb* could be assigned for each sub-group. The implementation of a physical interaction or rewarding in a non-game context, can also be a process to foster participant's performance, as gamification invite to in [27].

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