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MuPeT: A Framework for Enabling Multi-Perspective Problem Elaboration

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Abstract: Creativity techniques gain importance in education and business areas day by day. Beyond the well-known brainstorming, which focuses on divergent thinking, lateral thinking will encourage the individual to regard the situation from a variety of perspectives by breaking old mind patterns and forming new connections and perceptions. Examples like „Six Thinking Hats“ or „(Walt) Disney Method“ consist of group discussions, where specific roles are assigned to the participants to enforce a discourse with different perspectives. Electronic group discussion systems can compensate the deficits of verbal (face-to-face) discussions through motivating passive discussants to participate. Furthermore, a system can provide a persistent logging of contributions and an explicit representation of a contribution according to the perspective of the participant. We present a novel approach, which allows both authoring and performing such multi-perspective creativity methods. In addition, the participant's user interface is optimized for mobile devices. Finally we show first results of usability evaluations covering authoring and performing of a created method.

Keywords: Creativity techniques, group discussions, critical thinking, web-based learning

1. Introduction

Nowadays, internet and communication technologies (ICT) are present in nearly all areas of life in our society. The easy access to digital libraries and a variety of sources of information leads to a higher complexity, as the use of these knowledge sources turns into a requirement for individuals. The increasing complexity of this information and knowledge society inhibits the risk of uncertainty and personal overload as a consequence.

To accommodate to this knowledge society, there is a need to foster so-called 21st century skills. Abilities for problem-identification and problem-solving become more and more important in our daily life. This encompasses both the educational sector and business areas. Especially the movement from instructional to constructivist teaching methods demands critical thinking and active construction of knowledge from the students.

A solution to this dilemma will be the reduction of the information and knowledge society's complexity. This can be achieved through abstraction, modelling, the use of tools and cognitive scaffolds. A key to problem-identification, problem-solving and decision-making is critical thinking, which elicits metacognitive skills to establish evidence on observation in order to judge on a specific problem. When performed in groups, such tasks include discussion and evaluation of others' ideas. Former research has shown that collaborative learning enhances critical thinking (Gokhale, 1995, Johnson, Johnson, & Smith, 1991) and planning skills (Gauvain & Rogoff, 1989).

Electronic meeting systems can compensate some of the deficits of verbal (face-to-face) discussions (Nunamaker, Dennis, Valacich, Vogel, & George, 1991). In virtual teams it is easier to motivate passive discussants to participate, because the given anonymity reduces the barrier to contribute. Beyond that, such systems could provide moderation support and explicit representations of contributions according to the context and perspective of the participants.

We propose a framework system for the authoring of creativity methods in the notion of multi-perspective problem-elaboration called MuPeT ("Multi-Perspective Thinking"). Prominent examples of methods applying to this category are the "Disney Method" (Dilts, Epstein, & Dilts, 1991) and De Bono's "Six Thinking Hats" (De Bono, 1985). These methods are two examples, which can be applied in groups using MuPeT. The system provides means to add new creativity methods by *authors*. A dedicated interface for *moderators* allows for orchestrating a collaborative session. Finally, *participants* contribute in a collaborative session by adding cards to a shared space. A card represents ideas and concepts, and can relate to other cards. This relation is expressed by attaching a card to another, forming a pile of cards. The result will be a semi-structured space, reflecting the whole group discussion.

The structure of this paper is as follows: Section 2 provides a short overview about the background and related work. In section 3, an overview of the framework and implementation is given, emphasizing the three different roles in using the system Section 4 summarizes two usability evaluation pilots focusing on the *author's* interface. Finally, section 5 summarizes our findings and presents our future work concerning the MuPeT system.

2. Background and Related Work

The MuPeT system can be used to create methods for multi-perspective group discussions. There is a strong intersection between these kinds of group discussion and creativity-techniques, which can be applied to groups. A very prominent creativity technique is De Bono's "Six Thinking Hats" (De Bono, 1985) in which participants wear hats in different colors representing different perspectives or ways of thinking in a group discussion. The goal is to foster a more efficient discourse about a topic without missing important viewpoints. A second prominent creativity technique is the "Disney Method". The Disney method has been developed by (Dilts, Epstein, & Dilts, 1991). It is similar to the Six Thinking Hats and can be seen as a simpler version of it, consisting of three perspectives (*Dreamer, Realist, and Critic)* in a parallel thinking setting.

MuPeT supports both creativity techniques and is designed to foster collaborative and metacognitive skills. Former research has shown that collaborative learning enhances critical thinking (Gokhale, 1995). MuPeT furthermore follows a specific type of collaborative activities, namely Think-Pair-Share. This process has some benefits on the learning of the participants: In sharing their ideas, students take responsibility of their own learning. They negotiate meanings, discuss ideas, and do not rely solely on the teacher's authority, which forces critical thinking (Cobb, et al., 1991). Although this learning strategy has its foundations in non-electronic collaborative learning, it can also be applied to CSCL (Gallupe, Dennis & Cooper, 1992, Aiken, 1992). In MuPeT, cards represent ideas or concepts, the pairing appears in the system's shared space and in a follow-up discussion, and participants share their ideas and solutions. The novelty of the presented approach is in the flexibility of the framework, which enables to author the underlying methods for group-discussions and the creativity techniques. In contrast to this, several systems exists, which focus on very specific creativity methods (Six Thinking Hats in *De Bono Thinking 24x7*[1]) or very general supporting group discussion or idea generation without putting emphasis on preserving or highlighting different perspectives (*MindMeister*[2] or *Daedalus InterChange*[3]).

[1] De Bono Thinking 24x7: http://www.debonoconsulting.com/de_Bono_Thinking_24x7_Software.asp, retrieved May, 26th 2014.
[2] MindMeister, MeisterLabs GmbH: http://www.mindmeister.com/, retrieved May, 26th 2014.
[3] Daedalus InterChange, The Daedalus Group: http://www.daedalus.com/products_diwe_overview.asp, retrieved May, 26th 2014.

3. MuPeT System

With the goal of fostering critical, lateral and divergent thinking, we apply a modified Think-Pair-Share approach to create such system. We developed a framework to create methods for problem elaboration and group discussion with some degrees of freedom: Groups, parallel or non-parallel thinking, the number of perspectives and participants and possible recurrences and multiple iterations of the processes. To achieve this, we syndicate the requirements that come from related work and similar systems. This has been implemented in a web-based system, which will be presented in this section. After an overview of the system, technical details concerning the architecture will be shown briefly.

3.1 Multi-Perspective Group Discussions

An example for a creativity technique that is usually applied in a group is the well-known brainstorming. The participants collaboratively produce ideas, which are not only built on their own thinking. They also reflect on others' ideas and rephrase, abstract or mash-up concepts to create more ideas. Such techniques and tools only cover the divergent phase of a problem-solving process, masking emotions, positive and negative aspects. Other techniques incorporate multiple perspectives and more structured information spaces, extending this minimalistic approach to enable group-discussions.

3.2 Requirements

Considering the mentioned creativity methods and the related work, we derive the following requirements for such a system for authoring and performing multi-perspective group discussions:

- Method management: Allow for creating, removing and selecting methods.
- Session management: Sessions need to be recorded to enable persistence of the information, and also to pause them and continue later.
- Multiple perspectives: Following the mentioned creativity techniques, handling of different perspectives is needed.
- Perspective sequences: Methods consist of a queue of perspectives with a dedicated order.
- User management: More general than in the described methods, discussion can also benefit from different perspectives at the same time. Therefore, sequences need to be assigned to different users.
- Roles: Besides the participants, there is the need for a moderator with specific needs.
- Concurrency: Multiple users access the system concurrently when creating concepts and ideas, requiring data consistency.
- Idea representation: A potentially great amount of incoming ideas need to be represented adequately in the system. These ideas might be related and come from different perspectives. This requires a clear and functional visualization.

3.3 Overview of the System

Derived from the requirements, we give a brief overview of the system. Mainly it consists of two different user interfaces, one for the moderator (and author) of methods, another one for the participants. When creating a new method, initially all perspectives need to be created. As a next step, the author can define a sequence of perspective (queue). By default, a queue of all previously defined perspectives is being created. Custom sequences might be useful to create multiple iterations or custom schemes, as demonstrated in Figure 3. A use case for having more than one queue could be if a custom method consists of different groups of participants, where each group has its own set of perspectives. This can be applied in more controversy group-discussions, e.g. when learning to debate in schools. Such examples would not count as parallel thinking.

In order to facilitate the method, the moderator has to create a session. A session consists of a method on which it is based on and groups of participants. To these groups, queues of perspectives need to be assigned. Having one group for all participants will enable parallel thinking, while several groups can be used for the *n*on-parallel version. After these assignments, the session is ready to accept connections from participants.

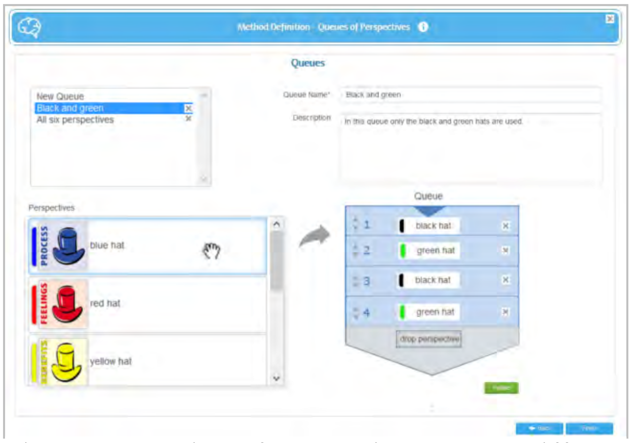

Figure 3. Creation of perspective queues. Different queues consisting of any order of perspectives can be defined for each method. This enables a flexible moderation and adaptation of methods.

The participation mode gives the users the possibility to facilitate a created technique. The participants' interface is gives an overview about the current perspectives including the instructions, e.g. the description of the worn hat in terms of Six Thinking Hats. The interface provides the possibility to attach cards to a shared view, and to contribute to the discussion. It supports different representations of cards and reflects which participant created the card from which perspective. The card content can be text entered with a keyboard, or freehand text from a stylus. This can provide an additional benefit of natural input, especially when working on tablet PCs with such digitizer devices. Figure 5 demonstrates the whiteboard mode of the system, which could be easily used to provide a better overview of the current discussion, and to support the convergent or reflection phases at the end of a session.

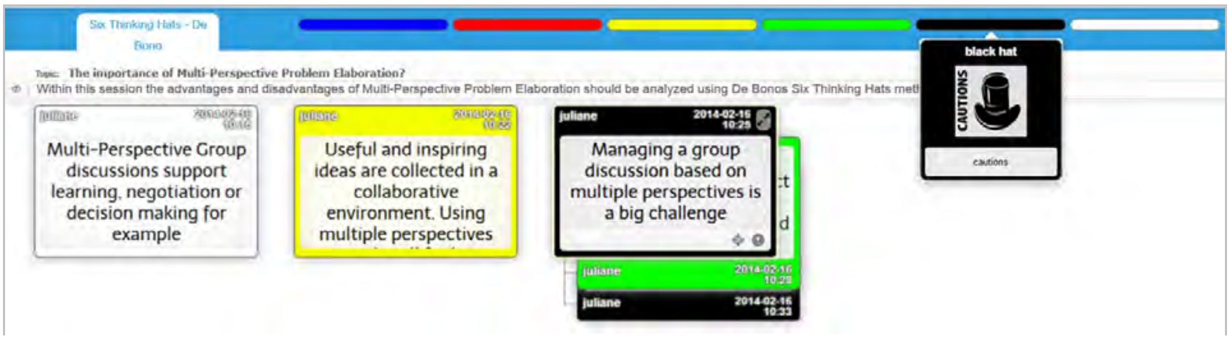

Figure 4. The whiteboard mode of MuPeT. In the top bar, the queue of perspectives is displayed highlighting the current one. The canvas contains all cards (color from the perspectives) that have been added to the shared space. A pile of cards visualizes the relation between ideas.

4. Evaluation

The system has been evaluated with focus on the authoring of creativity techniques as first trials indicated that the system is relatively simple for executing the methods in groups. However authoring in general is a complex task and the development of own creativity techniques is quite unnatural and uncommon. Therefore we will describe three evaluation studies that focused on the authoring part of the system.

In the first evaluation, a group of five experts discussed a real world topic ("extending the university with a new building"). Before the actual discussion, the participants had to create a method for the problem elaboration. The experts evaluated most of the functionalities of the system *for authors and participants*. The results are based on Jakob Nielsen's ten heuristics for user interface design (Nielsen, 1994), performed with a think-aloud protocol. The overall impression of the experts was quite good. However, there were some aspects of the system that can be improved. Most of the usability problems concerning user control, freedom, and error prevention were encountered in the authoring process, when creating new methods. The suggestions have been used as an input for the first redesign iteration, shifting the focus for further evaluations to the moderators view.

The next iteration consisted of two studies. The usability improvement of the interface was further evaluated, focusing on the authoring of methods and orchestration of groups. The Ergonomics of Human System Interaction formed the basis of the evaluation criteria (ISO 9241-110 for dialogue principles and ISO 9241-210 for user experience). Two questionnaires have been used to evaluate these criteria: The User Experience Questionnaire (UEQ) (Laugwitz, Held, & Schrepp, 2008) is used to measure the perceived user experience and the dialogue principles are tested through the ISONORM 9241/110 (Pataki, Sachse, Prümper, & Thüring, 2006) survey. A protocol for the evaluation has been developed to check the user workflow for the authoring and moderation. Initially, 16 users tested the version of the system. Afterwards, the participants were asked to fill out the questionnaires. This output regarding ideas from the think-aloud technique has been used to create further improvements, later evaluated by another 16 participants. Table 1 shows the results of the UEQ questionnaire. The ratings range on a 7-point Likert-scale (-3 , +3).

Table 1: Average and standard deviation of the UEQ evaluation. Group 1 tested the previous version (iteration 1) and group 2 the improved version of iteration 2.

Dimension	Group	AVG	SD
Attractiveness	1 2	0.78 1.11	1.20 0.77
Perspicuity	1 2	0.11 1.14	1.56 1.12
Efficiency	1 2	1.05 1.34	0.71 0.81
Dependability	1 2	0.50 1.17	1.10 0.95
Stimulation	1 2	0.98 1.08	0.88 0.86
Novelty	1 2	0.98 1.28	1.01 0.64

Table 2: Results of the IsoNorm questionnaire for both groups. The values have a range from -3 to +3 on a 7-point Likert-scale.

Dimension	Group	AVG	SD
suitability for the task	1 2	1.23 1.54	1.11 1.33
self-descriptiveness	1 2	-0.90 0.90	1.33 1.17
conformity with user expectations	1 2	0.98 1.42	1.31 1.29
suitability for learning	1 2	0.77 1.44	1.32 1.53
Controllability	1 2	0.69 1.06	1.11 1.17
error tolerance	1 2	0.48 0.98	0.85 1.06
suitability for individualization	1 2	0.13 0.63	1.16 0.82

In all dimensions of the questionnaire, an improvement can be measured. The evaluation of the IsoNorm questionnaire (cf. Table 2) has proven the positive effect of the usability engineering. The most significant improvements are made on the UEQ Perspicuity and the IsoNorm self-descriptiveness. The results of the second group show that the overall perception of the systems usability is very good, though there is still space for improvement. Future studies will envisage a larger-scale use of the participant's interface.

5. Conclusions and Future Work

In this paper, we presented a framework for enabling multi-perspective problem elaboration. The implemented system is capable of authoring of new creativity methods and their facilitation in a web-based application. The evaluations showed that the system is well received. For the future, additional experiments are planned to evaluate the participation interface in online-learning scenarios. It will be interesting to see, if such tools can be used to support inquiry-based learning, especially in the context of online labs in the STEM fields ("Science, Technology, Engineering, Mathematics"). Such learning scenarios usually demand activating and supportive teaching techniques. Moreover, the analysis of learning traces and the application of methods of learning analytics can be of interest. How do students create hypotheses, construct their knowledge or reflect on their learning process in discussion phases?

A typical weak aspect of such tools for idea generation is the lack of support for the convergent phase, where the concepts, ideas and solutions are evaluated. A borderline example is the brainstorming, where the result is a collection of unrelated ideas. For such tools, a "post-processing" phase that provides both visual support and also content-analysis would be of interest. This can be a timeline visualization of the idea generation, but also a network built from relations that are extracted on a semantic level.

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