Technology for Creativity and Innovation:

Tools, Techniques and Applications

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Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Library of Congress Cataloging-in-Publication Data

Technology for creativity and innovation : tools, techniques and applications
/ Anabela Mesquita, editor.
p. cm.
Includes bibliographical references and index.
Summary: "This book provides empirical research findings and best practices on creativity and innovation in business, organizational, and social environments"--Provided by publisher.
ISBN 978-1-60960-519-3 (hbk.) -- ISBN 978-1-60960-520-9 (ebook) 1. Creative ability in business. 2. Creative thinking. 3. Diffusion of innovations. 4. Technological innovations. I. Sarmento, Anabela.
HD53.T434 2011
658.4'063--dc22
2010051811

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Chapter 10
Experience with Self-Guiding Group Support Systems for Creative Problem Solving Tasks

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ABSTRACT

Many teams and groups use brainstorming to improve their creativity. Brainstorming can be supported with Group Support Systems (GSS). However, GSS are most successful when offered in combination with facilitation or at least training. Unfortunately, facilitation or training will impose a barrier to use such systems. In this chapter the use of a GSS for a multi-step creative problem solving task was evaluated. The groups using this GSS got no training, had no GSS experience and got no support, other than a 1 page log-in instruction. With this limited instruction and no training all participating groups handed in a report with the results of their brainstorm, using the tool. This chapter will report the process, the way it is embedded in the tool, and the results of our exploratory questionnaire among the participants.

INTRODUCTION

Creativity is a critical competence in organizations. Organizations need to improve their services and products continuously in order to remain competitive. To foster creativity, it is important that people in organizations collaborate, as creative solutions often are the result of multiple perspectives and interdisciplinary problem solving. Frost and Sullivan surveyed 946 decisions makers globally, using a collaboration index, and found that collabora-

DOI: 10.4018/978-1-60960-519-3.ch010

tion is a key driver of performance in organizations, its impact is twice the impact of strategic orientation, and five times the impact of market and technological turbulence (Frost & Sullivan, 2007). Given the importance of collaboration and creativity it is important to develop and support these competences in organizations.

A well known technique for creativity is brainstorming. Brainstorming is a method in which a group collectively shares ideas to resolve a problem. Originally brainstorming was developed as a face to face group process, where participants share ideas and write them on a flipchart. Osborn (1953) set four key rules to further stimulate creativity: (1) don't criticize, (2) freewheel, (3) combine and improve, and 4) the wilder the better. These rules are intended to prevent the individual participant from withholding specific ideas for fear of being chastised by other group members. To further support creativity, electronic brainstorming with GSS has been introduced. GSS enable parallel input which increases the efficiency of a collaborative creativity or brainstorming. Furthermore, they offer tools to reduce information overload and, through anonymity of participants, dominance and fear of contributing is diminished (Nunamaker, Briggs, Mittleman, Vogel, & Balthazard, 1997). Santanen et al (Santanen & Vreede, 2004) found that using GSS, the need for some of Osborn's rules is reduced, for instance, the rule 'don't criticize.' Since GSS are anonymous, the negative (blocking) effects of criticizing are reduced, and critique can even motivate participants to sharpen their ideas in this context (Santanen & Vreede, 2004). Further, creativity can be stimulated giving the group directions and triggering different perspectives (Knoll & Horton, 2010).

GSS therefore could potentially help organizations to increase their creative capacities. However, collaboration is also challenging, and the use of GSS requires additional procedural support from experts such a facilitators, trainers or at least technical assistants (Dennis & Wixom, 2001; Kolfschoten, Niederman, Vreede, & Briggs, 2008; Nunamaker, et al., 1997). This creates a significant barrier to sustainably implement collaboration support in organizations (Briggs, Vreede, & Nunamaker, 2003). We therefore looked for a way to guide groups through a brainstorming process without the need for procedural support. This resulted in the development of a GSS that does not require any additional support. In this chapter we will discuss the role and purpose of collaboration support, and its challenges. Next we will present the tool developed, called TeamSupport. Finally we will present an experiment with the tool to evaluate its role in creativity, and the extent to which the tool is self-guiding, enabling its use without additional support.

BACKGROUND

Collaboration support can in some circumstances enable groups to accomplish their goals more efficient and effective (Fjermestad & Hiltz, 2001; Vreede, Vogel, Kolfschoten, & Wien, 2003b). Collaboration support technology offers mostly tools to collect and combine input from participants in activities such as brainstorming and voting (Nunamaker, et al., 1997). However, collaboration support is often used in combination with training or facilitation, which poses an additional barrier to its use and implementation.

While collaboration support such as GSS has proven to increase efficiency and effectiveness of groups, it is challenging to implement such collaboration support in organizations (Vreede & Briggs, 2005; Vreede & Bruijn, 1999; Vreede, Davison, & Briggs, 2003a; Vreede, et al., 2003b). Lab and field studies in collaboration support show conflicting results (Fjermestad & Hiltz, 1999, 2001; Santanen, 2005) with respect to the effectiveness and efficiency of GSS. Research has indicated that collaboration support often depends on a single champion, and when this person leaves the facilities are abandoned (Munkvold & Anson, 2001). Further the training of a facilitator

can take a significant amount of time and effort, and is often offered in a master-apprentice style (Ackermann, 1996). Finally, it can be challenging to create a business case for collaboration support (Agres, Vreede, & Briggs, 2005; Post, 1993), especially because of the costs of hardware and human resources.

Fjermestad and Hiltz (Fjermestad & Hiltz, 1999, 2001) found (see Table 1) that in 200 experimental studies with GSS, 63% of the studies reported their subjects received training. In the field, only 37% got training however, 63% was supported by a facilitator, and another 17% got support from a "chauffeur" (a technical facilitator). In the experimental studies, this was very different. Only 30% of the studies in experimental setting reported offering facilitation support. While the difference between sessions in the context of research experiments and field studies are fairly large, both seem to generally offer their groups support or guidance in using the technology. Tasks in experimental setting are often more simple and take less time, and thus do not need facilitation support. However, apparently they do need training to operate the technology for the specific task, as 63% reported this. A significant amount of studies did not report at all on the use of training, and therefore we cannot infer the percentage that got neither training nor facilitation support, but we expect that this is small, as the use of these tools is not very intuitive.

To overcome the need for training, researchers have collected scripts for the use of GSS called thinkLets (Briggs, et al., 2003). Originally, thinkLets described a script for a specific tool, and its precise configuration. In this way a clear instruction on how to use GSS was created. Nowadays we conceptualized thinkLets more tool-independent. For this purpose, we describe for each thinkLet the rules and capabilities that need to be afforded to the group using technology (Kolfschoten, Briggs, Vreede, Jacobs, & Appelman, 2006). This increases the applicability of thinkLets, as they can be instantiated with different tools. However, it also makes the translation from thinkLets to tool instruction more challenging, as thinkLets now needed to be instantiated for the specific tool with which they are used. This again requires a group in need of GSS support to receive training or process support.

Table 1. Training and facilitation support in GSS sessions

	Experiment	Field
training reported	63,50%	37,04%
no training	3,00%	5,56%
not reported	33,50%	57,41%
facilitator	30,00%	62,96%
no facilitator	70,00%	20,37%
chauffeur	not mentioned	16,67%

Researchers have been exploring possibilities to support facilitation and the appropriation of GSS technology (Antunes, Ho, & Carriço, 1999; Kolfschoten, Briggs, & Vreede, 2009; Kolfschoten & Veen, 2005). Further, it is reported that restriction of functionality to only the tools that are used for the specific task might be a way to offer guidance in the use of GSS (Dennis, Wixom, & Vandenberg, 2001). Also, a large project by Briggs et al. is aiming to create a suite in which thinkLet based custom made collaboration processes can be developed to support specific tasks, which can be guided by non-experts (Briggs, Kolfschoten, Lukosch, Vreede, & Dean, 2010). In this chapter we report on an experiment with a GSS to support a 4 step creativity task, which offers only functionality for the task, and offers build-in guidance for both the group and the person initiating the session.

THE TEAM SUPPORT GSS

To support our brainstorming task a GSS named TeamSupport (www.teamsupport.net) was used. The tool offers an online anonymous GSS envi-

ronment for creativity tasks. Anonymity helps to reduce barriers for participation and removes the need for Osborns rule on judgment (Santanen & Vreede, 2004). When people are anonymous, ideas are judged on content, not on author, and people are less reluctant to share wild ideas. To support the group in sharpening their ideas, the GSS offers not only a brainstorming step, but also several steps to converge the set of ideas in a more concise set. For this purpose the tool has a build in process of four steps; brainstorming, clustering, grouping (within clusters) and discussion of the resulting ideas. The process is build with four thinkLets. First an OnePage brainstorm is performed. Participants can add ideas to a shared page. Next, a ChauffeurSort is done, where the appointed group leader has to cluster the ideas, based on a discussion with the group. Next, the Concentration thinkLet is performed to merge double ideas in the clusters. Finally a LeafHopper thinkLet is used to add comments to the final set of ideas, and these are discussed in the group. The Facilitation process model of this collaboration process can be found in Figure 1.

This process thus helps the group not only to share creative ideas, but also to converge these ideas to a small set for further consideration. It is therefore a very effective problem solving process. The tool requires the group to appoint a "leader" who is afforded more capabilities than the other group members by the tool, and has a coordinating role. This leader has however, no experience, no facilitation skills, and no support from professional facilitators, and thus in no way needs the training or skills of a professional facilitator as described in the literature (Clawson, Bostrom, & Anson, 1993; Kolfschoten, et al., 2008). The person fulfilling the leader role is thus a complete novice. The leader sets up the brainstorm session, invites the other participants (verbal, through chat or e-mail, by giving them a URL and code) and enters the brainstorm topic or question. Participants can add ideas. The leader can move the group to the next step in which they discuss the ideas and cluster them. There is a next step button, and the leader can close the previous activity entirely when finished. The leader has the ability to clusters ideas while the participants can follow along and give suggestions. In the next phase the group combines ideas in each cluster that are the same or similar into so called groups. These ideas are grouped and re-labeled to rephrase them in a way that is more precise in capturing the key idea of the group. In the last step, these groups of ideas can be discussed and comments can be added, to capture the discussion. In Figure 2a-d, several screenshots of the tool are visible. As shown, the

Figure 1. Creative collaboration process

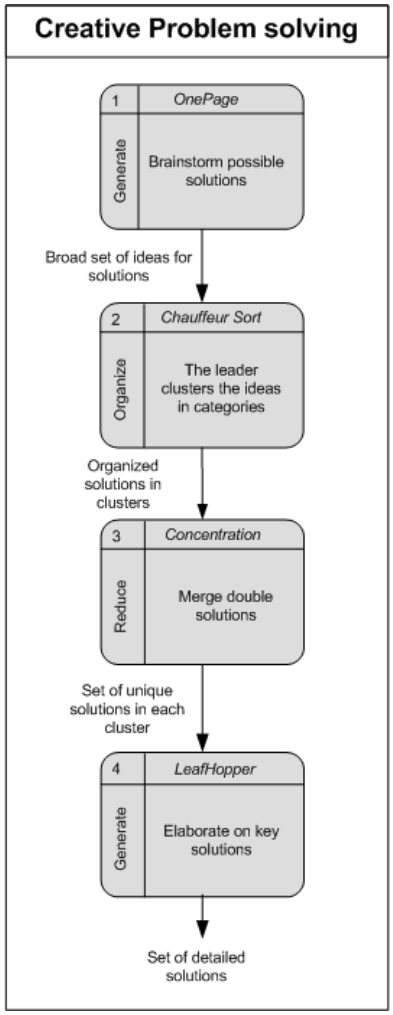
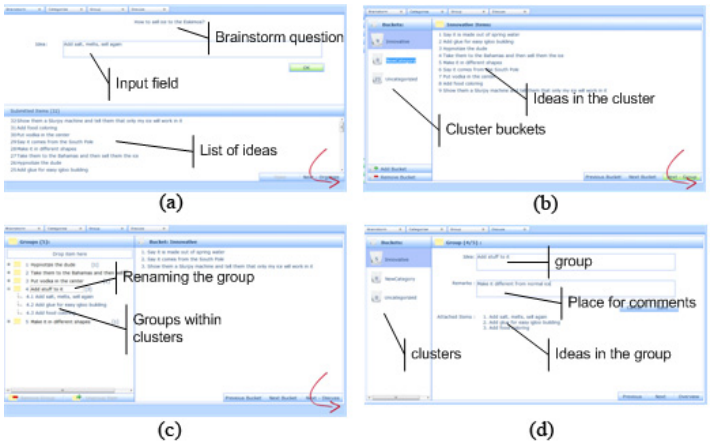


Figure 2. a) Brainstorm; b) Clustering in buckets; c) Grouping within a cluster; d) Adding remarks



participants see only the brainstorm question and a field where they can enter their ideas. This makes the step very intuitive, and restricts functionalities to only the functions required for the task. The leader also has a button "next" which will move the group to the next step.

Experiment

To see if this way of restriction enables groups to use the GSS without training or the support of a professional or experienced facilitator, we did an experiment in educational setting.

Method

We asked student groups to use the GSS tool to see if they could use it without facilitation or training. In 2008 and 2009 first year students of a bachelor program in 'policy making in engineering' participated in a project course. The students had to analyze a problem case presented by a problem owner from business. In 2008 this was a hospital department manager who presented a problem in effectively using the Deming cycle for business process improvements, 98 students participated. In 2009 this was a consultant/accountant presenting a problem of improving the financial administration of a ministry in a developing country, 119 students participated. Students worked for 8 weeks on the project going through a process of problem analysis, modeling, solution finding, evaluation and reflection. Half way in the project they are instructed to brainstorm with their group of 4-6 students to identify solutions for the problem case.

Their assignment was to use the Team Support tool and to brainstorm at least 30 ideas. They got a 1 page instruction on how to acquire an account for the tool, how to log in and how to start the session. No instructions were provided on how to go through the creative problem solving process. In the second year the vendor offered a video on their website with instruction on how to use the tool. One student indicated that one of them watched the video. We do not expect that many students used this video, and it was not referred to in the instruction.

To explore the feasibility of GSS without facilitation or training, we asked all students to fill out an exploratory evaluation questionnaire. A limitation is that some students filled this out alone, while others filled it out with their group. The questionnaire contained questions about the process, the ideas generated, and the way in which they used the tool. The questionnaire also

enabled students to give feedback on the tool. The questionnaire was in Dutch.

In the questionnaire we asked the students if the tool was easy or difficult to use and how this was for the leader. We used a five point scale: very easy, a little easy, easy, a little difficult, very difficult. Next, we asked if the tool supported the task, and whether it was useful (yes/no and open answer). We also asked if the students considered their ideas as creative, we used a four point scale: very creative, creative, a little creative, not creative. Further, we asked the students how they used the tool, the time they spent, whether it helped them, and if they had suggestions for improvement. These questions were open questions.

The questionnaire is exploratory and was not validated. The objective was to see if students could use the tool without support. Therefore we wanted to see how they would appropriate the tool. For this reason, we did not design the study as an experiment, and thus did not set strict guidelines on how the students should use the tool. While this introduced some limitations as indicated above, it also revealed some interesting patterns in how students used the tool, which might not have emerged in a controlled experiment. The results of the evaluation are discussed in the next section.

Results

We received 53 questionnaires in total. All student groups used the tool successfully and handed in the brainstorming report, 42 groups, and 217 students used the tool in total.

The results for ease of use are listed in table 2. The score for the leader was not always filled out as some participants did not fulfill this role. The scores for the leader are somewhat lower than for the participants. This is not surprising, as the leader had more tasks, and needed to learn to understand more functionalities of the system. However, most leaders (22) scored the tool as a little easy, and some even scored it very easy, which seems to indicate that the difficulty was acceptable.

Next, we asked if the tool supported the task. 73% reported that the tool was supporting their task. We consider this high, given that students are generally critical about the tools they are offered. We also asked if the students considered their ideas as creative. 4% evaluated their ideas very creative, 52% evaluated their ideas as creative, 40% considered them a little creative and 4% considered them not creative. This indicates again that the tool has supported the students in identifying creative ideas. On average the groups brainstormed 38 ideas (30 was asked in the assignment), from those they created on average 5 clusters, and 11 groups representing converged ideas. Note that we removed 4 outliers who brainstormed less than 30 ideas and probably interpreted the question as the number of ideas they eventually had after grouping the ideas, as an end result.

Table 2. Ease of use for participants and leaders

	For participants n=52		**For leader n=41**	
Very difficult	1	1,92%	1	2,38%
A little difficult	8	15,38%	6	14,29%
A little easy	19	36,54%	22	52,38%
Easy	1	1,92%	0	0%
Very easy	23	44,23%	12	30,95%

We did not instruct the groups on how to use the tool. 55% of the respondents decided to use it in a face to face setting, usually sitting co-located in the computer room at the university. 28% reported that they used msn or another chat tool and worked distributed. 7% reported a combination of these and 6 percent used no additional communication tools. One group used Skype. We found it very remarkable that groups used the tool distributed, and combined it with a chat tool. Research indicates various additional challenges of online facilitation (Macaulay, Alabdulkarim, & Kolfschoten, 2006; Romano, Nunamaker, Briggs, & Mittleman, 1999). The number of students using it in a distributed setting indicates that the tool has overcome several of these challenges. The groups spend on average 2 hours on the task and some reported the time for the leader which was usually the same, but sometimes slightly longer, on average 30 min longer.

We finally compared the groups working face to face with those working through chat. We found that the average time spend when working through chat was longer, (chat 2 hours and 36 min, face to face 2 hours), the groups working with chat however ended up with on average 13 grouped ideas, while the face to face group ended up with only 10. Face to face 17% scored the use of the tool as participant to be difficult, for leaders this was 8%. Others scored a little easy to very easy. For the chat group, 14% of the participants scored difficult or very difficult and 30% of the leaders indicated this score. Leading the group process in a distributed way, thus was more difficult. However, these groups also handed in their reports, and managed to go through the entire process. Last, we asked about the anonymity of the activity. Some reported that they discussed ideas and therefore anonymity was reduced or removed. This occurred more in the face to face setting than in the chat setting. For small groups, a distributed session thus improves anonymity, which as discussed earlier, can improve creativity.

Tool Suggestions and Improvements

Besides the quantitative evaluation we also asked the respondents to reflect on the tool and to offer suggestions for improvement.

The most prominent feedback was that the tool was very easy to use. One student mentioned "the tool forced us to really think our solutions through." Some students indicated that they struggled to understand the tool in the beginning and that the tool did not offer enough 'overview.' However, most groups indicated that they understood it after a while. Some indicated that it would be much easier to use a second time. Also the students mentioned the characteristics of GSS (anonymity, parallel communication, automatic minutes) to be supportive. Several requested to add a manual or tutorial with more instruction on how to use the tool. Some students indicated that they did not see the added value of the exercise. In some occasions this was because they had already identified solutions with their group. A final difficulty was in the discussion phase. Some groups did not succeed in this phase. The reason for this is not entirely clear.

Several improvement suggestions were made. A suggestion has been made about the fact that currently only the leader can categorize while group members cannot move ideas into the categories, and instead have to instruct the leader to do this. It would make the process even more efficient and faster if the participants could also do this task. It is also suggested that drag & dropping multiple items into a bucket would be appreciated. Other suggestions for improvement include the ability to comment on the ideas from others in the brainstorm phase, a more intuitive submission interface, and to incorporate chat functionality in the TeamSupport tool to eliminate the need to work in two applications. Further the tool needs a help button and an overview of the rights of the participants and the leader. One person suggested building in a voting functionality. An overall suggestion on the tool is to make it look more

attractive and to provide more of a structure and overview. The developer implemented some of these features, and accommodated the suggestions of the students in a new release of TeamSupport, presented in the next section.

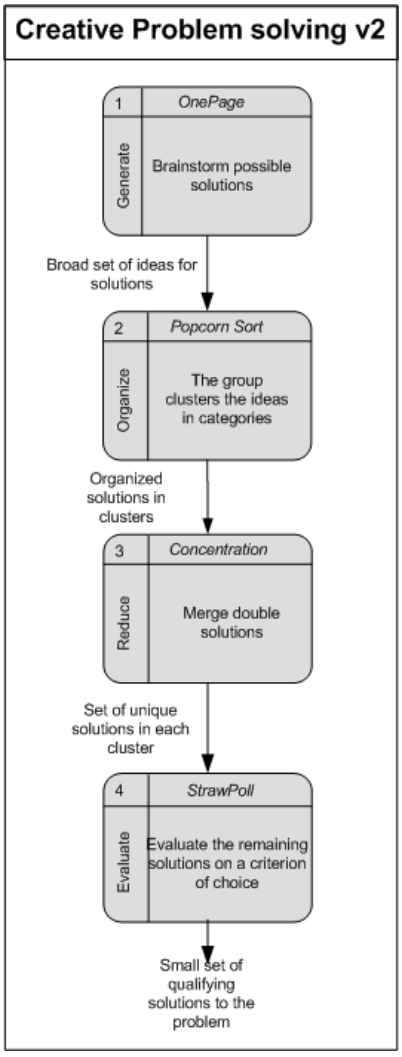
Revised Self-Guiding GSS

Based on the suggestions and the outcomes of the evaluation the following modifications were made to the tool:

1. A voting functionality has been added to rate ideas.
2. A new layout with a better overview and structure has been realized by implementing a navigation panel at the top, removing the old ability to navigate to the next step in three different ways.
3. To improve the intuitiveness of the interface, the ability to select multiple ideas for categorizing and grouping, by holding the CTR-button has been implemented, and the submission of ideas by pressing ENTER has been implemented.
4. The session leader can send messages/instructions to all participants, to partly replace separate chat tools
5. Template management functionality has been added that enables the session leader to (re-)order the process steps to his liking, for more advanced users.

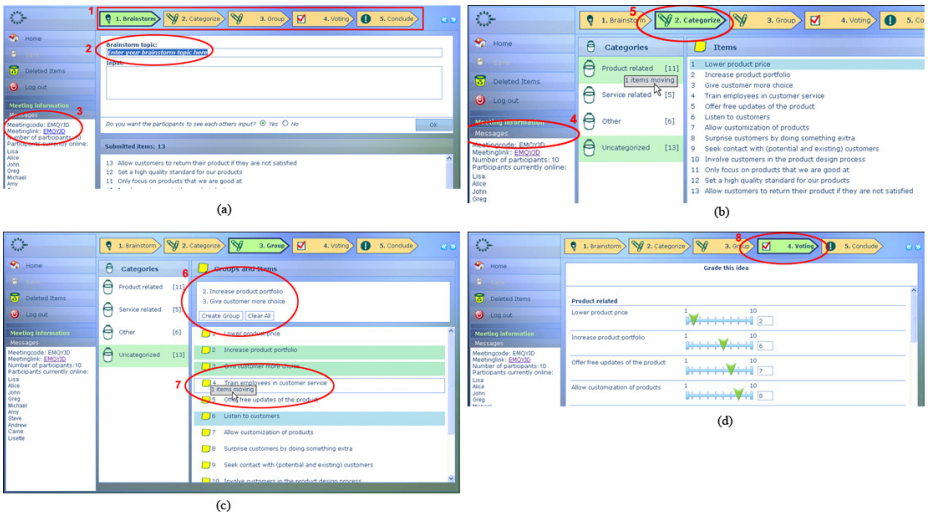
The new process also slightly changed the sequence in the collaboration process and the thinkLets used. In this process, again the group starts with an OnePage to brainstorm ideas, next a ChauffeurSort to sort ideas in categories. After the ChauffeurSort, again Concentration is used and next instead of LeafHopper, the group performs a StrawPoll. (The LeafHopper can be inserted as an extra step in the process via the Template Management functionality.) In this way the group has a clearer basis to select a final set of ideas to consider further in their problem solving process. The facilitation process model of the revised process is shown in Figure 3.

Figure 3. Creative problem solving process



The session flow navigation pane (1) in Figure 4a shown below is the main mechanic the group leader has in order to guide the participants through the process. It is located prominently at the top of every window. When you start the session, the text field for the brainstorm topic will be highlighted (2) so the group leader knows to enter the brainstorm topic or question first.

Figure 4. a) Brainstorm; b) Clustering in buckets; c) Merging similar ideas together; d) Rate the ideas in the Voting step



The group leader invites the participants to the session by providing them with the meeting link (3) through for example e-mail or another digital medium. Participants get into the session through the meeting link. When entering the meeting, participants will see the brainstorming topic, and will start generating ideas.

In the messages tab (Figure 4b), the group leader can send instructions to the participants whenever necessary to guide them through the process. (4) Together with the participants the group leader can categorize the generated ideas by navigating to the "Categorize" (5) step and drag and drop the items into buckets.

The next step is to group the items together that are similar or related to each other. (Figure 4c) This can be done in several ways, by dragging & dropping the items together in the drop area (6) and pressing "Create Group", or by dragging an item onto another item to drop it in order to group them together similar to managing folders and files in Windows systems (7). Both ways are very intuitive. Next (Figure 4d), the group leader can move the group to the "Voting" (8) step and press "Start voting" to let the participants start grading their ideas. This will help the group to set priorities among the ideas they identified. The voting results are presented neatly in both graph and table form. The last step is to conclude the meeting and to generate the report. This digital report can be send to the participants through regular e-mail.

CONCLUSION AND FUTURE RESEARCH DIRECTIONS

We consider the results from the first evaluation highly encouraging. All groups managed to use the tool as intended, and found out how it worked by themselves. The tool offered all benefits of GSS and the students reported that these benefits helped them in their task. Unlike other GSS, this tool does not offer any configurable functionality. This restriction of course limits the applicability of the tool in some ways, but it ensures that the participants follow the intended process, without the need for training and facilitation. This enables groups to use a GSS for smaller and less critical tasks, as the organization of a brainstorm requires less effort, and the costs are significantly lower. The use of the step buttons at the top of the screen,

and the labels of the activities (brainstorm, cluster, group, discuss) offered most groups sufficient instruction to perform the task.

Further, we expect the tool can be configured to offer even more guidance especially for the leader role. This could include clear and more specific build-in instructions that can be customized like the brainstorm question. For instance, an editable text box could be added to each functionality, to say e.g. "Please cluster the ideas based on our core competencies," instead of the current generic clustering instruction. This would help the leader to customize the tool to refer to specific organizational processes and templates for instance. Further, the creativity of the solutions might be improved if the tool would motivate participants with a target (minimum number of ideas) or with comments and feedback. We would in addition like to experiment with a timed instruction to the leader to motivate the group to come up with better ideas (e.g. after 10 minutes). The new version of TeamSupport shows that improvements in the user interface contribute highly into an even more self-guiding GSS. With the new trends in Web 2.0 techniques and usability focus, much can still be improved to accommodate the users of such tools.

Limitations of the study are numerous, as it was an explorative survey. We tried to compensate for the fact that some groups handed in multiple questionnaires, while other groups handed in one, but this was not always clear. Further we used a categorical scale for feedback. Also we did not get much input on the time difference between leaders and participants and what leaders did in this time difference.

Research indicated that a flexible/adaptive facilitation style is beneficial (Dickson, Limayem, Lee Partridge, & DeSanctis, 1996; Nunamaker, et al., 1997). However, we found that when groups want to use GSS without support, restriction increases the usability and enables groups to follow the process. We will further explore how we can support the appointed novice 'facilitator' in supporting the group and increasing the quality of their results. One of the directions for this research is to create intelligent collaboration support, to offer guidance to the leader, based on the computer's understanding of progress and activities. Also, we are interested in studying different types of users such as elderly and children, to see if they also can use these types of processes to collaborate and learn from each other.

ACKNOWLEDGMENT

We thank TeamSupport for providing the software for this research.

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KEY TERMS AND DEFINITIONS

Brainstorming: Generating new ideas or solutions in a participative group process.

Collaboration Engineering: "An approach to designing collaborative work practices for high-value recurring tasks, and deploying those designs for practitioners to execute for themselves without ongoing support from professional facilitators (Briggs et al. 2003)."

Divergence: Having a group generating a shared set of contributions, such as ideas, issues, problems, risks, solutions, etc.

Facilitation: Offering groups process and/or technology guidance to help them in achieving their collaborative goals.

Group Support Systems (GSS): A class of collaboration software used to move groups through the steps of a process toward their goals.

Restriction: Ensuring that users can only do those activities that are intended according to the work process designed.

ThinkLet: "A named, scripted collaborative activity that gives rise to a known pattern of collaboration among people working together toward a goal (Briggs et al. 2003)."