On the Impact of Chat Communication on Computer-Supported Idea Generation Processes

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Abstract. It has been shown that traditional forms of communication negatively affect idea generation processes. Creativity support systems can help to avoid these impacts and provide alternative means of interaction for which the known negative affects do not apply. In this paper, we investigate the impact of chat communication on computer-supported idea generation processes. The results show that idea quantity, quality and group satisfaction are not affected by the option to use a chat as an additional communication channel. This implies that positive as well as negative influence factors of communication described in previous studies seem to offset each other in computer-supported idea generation processes. We discuss several of these potential positive and negative influence factors. Furthermore, we discuss why a chat feature can help to lower acceptance barriers for creativity support systems.

1 Introduction

In the 1950s, Alex Osborn [1] proposed four central guidelines for groups to follow in idea generation processes: Criticism is ruled out, freewheeling is welcome, quantity is wanted and combinations / improvements are sought. As of today, brainstorming is probably the most popular and most often applied (group) creativity technique for idea generation processes. According to a study of Fernald and Nickolenko [2], 92% of the American companies use the brainstorming technique in meetings.

Studies on the effectiveness of this technique consistently show that brainstorming groups yield better results than groups conducting traditional meetings [3]. This is mainly due to the strict separation between a divergent phase, where ideas are only generated but not yet discussed, and a consecutive convergent phase, where ideas are evaluated.

Taylor et al. [4] made the finding that for brainstorming, nominal groups[2] are more effective (in both quantity and quality of ideas) than groups where the participants communicate. Conducting creativity techniques as a real group process seems to imply some negative consequences that outbalance potential benefits. Three factors can explain the decrease of efficiency for interacting groups [3]:

[2] *In nominal groups, participants work separately from each other and at the end their ideas are merged.*

1. Group pressure: Fear of judgment by the other group members and power misbalance (e.g. when hierarchies exist) inhibit participation and can lead to unwanted conformity of idea proposals.
2. Social loafing: Social loafing describes the tendency of group members to do less than their potential would allow them to do. It can occur either if a group member feels isolated from the group or if he feels too submerged.
3. Production blocking: Diehl and Stroebe see production blocking as the dominant factor for efficiency losses in group brainstorming processes [5]. Production blocking refers to the fact, that in interacting groups only one member can speak at a time, while the others have to listen; hence all but one member of the group are blocked and cannot work on their own ideas in this time.

Computer support for idea generation can help to mitigate the negative effects of interacting groups. Carte et al. [6] state that due to the fact that a creativity support system (CSS) is able to anonymize the users and their contributions, the group pressure on the participants is lowered. Shepherd et al. [7] have shown that by improving the participation awareness in the process, social loafing effects can be reduced. Finally, when the team members do not communicate verbally, they can enter ideas parallely using keyboards and doing so are not interrupted by others. That's why the production blocking does not occur in computer-supported idea generation processes. All these factors lead to improved team effectiveness in idea generation sessions [8].

The studies mentioned above clearly indicate that it is preferable to avoid than to allow verbal communication in idea generation processes, which can be well explained with the effect of production blocking. However, this does not imply that other kinds of communication that enable direct communication between the participants must have a negative impact on the team effectiveness. E.g. using communication means that to allow parallel (non-blocking) communication such as a chat could be an improvement, as suggested in recent studies on computer supported group work (see section 2). In this paper, we want to present and discuss an empirical study we conducted on the research question whether a chat is beneficial for computer supported idea generation processes.

2 Communication in idea generation processes

An idea generation process is a series of activities leading to creative ideas. According to Sternberg [9], an idea is creative if it is “both novel (i.e. original, unexpected) and appropriate (i.e. useful, adaptive concerning task constraints)”. Creativity techniques are guidelines that structure idea generation processes, e.g. by defining distinctive phases or by regulating the participants’ behavior. These restrictions often affect the communication between the group members, as is the case for the brainstorming technique, where criticism is forbidden during idea generation. The strong empirical evidence on the effectiveness and result quality of creativity techniques with strong restrictions on communication (such as brainstorming)

indicates that direct communication may not be a positive or necessary factor for idea generation processes.

Applegate et al. [10] investigated a group decision support system for idea generation and issue analysis in organization planning. The participants could exchange ideas using the system, but had no means of direct communication via the system. Even though the participants were allowed to communicate verbally, the authors observed that approximately 96,6 % of the participants' time was spent on working on ideas using the system and only 3,4 % was used for non-electronic group interaction and communication. From this non-electronic communication, a large majority (47,54 %) was relatively short and technology-oriented. They also noted that the majority of verbal interaction was directed to the session facilitator (57 %). Given these small percentage values for "true" task-related direct group communication acts, one could assume that the overall role of direct communication in the process is neglectable.

Hilliges et al. [11] investigated the effects of using a tabletop interface in combination with a large wall display for face-to-face group brainstorming. They compared the results of this setting with control groups using the traditional paper-based method. When counting the groups' ideas for the analysis of the experiment, they differentiated between new independent ideas, ideas that built on their own earlier ideas, ideas that resulted from seeing somebody else write down an idea and ideas that resulted from talking about an idea. 29 % of the ideas of the paper-based groups and 26% of the ideas of the electronically-supported groups ideas emerged as a result of a communication process. This implies that direct communication is the source of a substantial percentage of ideas which (in contrast to the studies and arguments presented above) may advocate the point of view that direct communication is beneficial in creative processes.

Comparing more than 40 studies on teams that interact mainly or exclusively using computer systems, Powell et al. [12] come to the conclusion that communication is the key success factor in virtual team situations. They argue for a high media-richness of the communication channels, which contrasts with the principle of creativity techniques for idea generation processes that have the tendency to limit the communication channels to allow only task-related idea exchanges and to avoid direct communication between the team members.

Summarizing major findings in GSS reserach, Nunamaker et al. [13] point out that support systems increase the number of ideas generated during a divergent (generation) process. The participation tends to be more equally distributed than in traditional meeting scenarios, which is mainly due to anonymity and the possibility to input ideas parallely. While Nunamaker refers only to parallel input of the generated ideas, we want to investigate the impact of a chat as a channel for direct communication between the participants of an idea generation process.

In conclusion, theories and studies of creative processes give ambiguous signals with respect to the question, whether direct communication, as provided by a chat actually supports idea generation processes or not.

3 Study

3.1 Setting

In order to find out more about the impact of chat communication on computer-supported idea generation processes, we conducted an experimental lab study. As participants we selected computer science students, mainly pursuing their Bachelor's degree. A total of 60 students, divided into 18 different groups, took part in the experiment.

The groups were composed randomly by picking the students who had signed up for an experiment date and dividing them into groups of four persons each. This was done in advance. Due to the fact that not all people showed up, the final groups split up into twelve groups with three students each and six groups with four students. Each participant had his own PC, and all PCs were set up with the same configuration (Windows XP, Firefox web browser). Any kind of explicit (e.g. verbal, visual) communication outside of the tool was strictly forbidden. A dedicated facilitator monitored the strict adherence to this rule.

3.2 Experiment

The students used a creativity support system named IdeaStream to find ideas for the given problem “For which purpose could the student fees be used?”. IdeaStream allows teams to collaborate on a virtual whiteboard using a broad set of different creativity techniques [14]. The user interface is shown in figure 1.

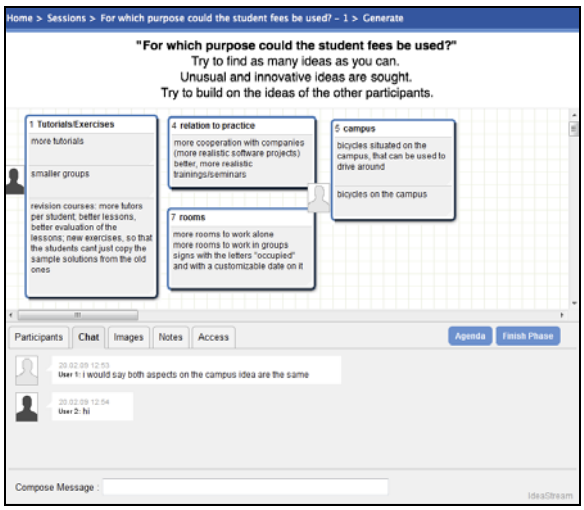

Fig. 1. Screenshot of the virtual whiteboard and the chat in IdeaStream.

There, people can work collaboratively on their ideas by creating new ones, changing, moving or deleting them. All ideas on the whiteboard are publicly

accessible, but without any information on who created or changed them. An idea is represented by a title and a set of components called aspects that represent pieces of information that in turn compose the idea. These pieces of information consist of texts, uploaded images or sketches. The participants used pseudonyms of the form "user x" that were randomly assigned by the system.

In half of the sessions, the groups were able to chat with each other by using the integrated chat-function. This set consisted of a total of 29 students partitioned into seven groups of three students and two of four students. The other half (31 students) had no means of direct communication at all. Those students were divided into five groups of three and four groups of four.

At the beginning of each session, the facilitator explained the user interface and the applied creativity techniques. After that, a 10-minute test case was played through, in order to let the participants get familiar with the user interface and the features of the tool. After this introduction the main part of the experiment took place.

The idea generation process of the experiment consisted of three connected phases, each following a different creativity technique for idea generation (Brainwriting, Unrelated Stimuli and Forced Combination, see [15] for detailed explanations of the techniques). The duration of each phase was 10 minutes, so each group spent 30 minutes for idea generation, which is a typical period for idea generation sessions [18] [19]. During those phases, all participants' activities were logged. After completion of all phases, the students evaluated their generated ideas with respect to creativity and feasibility by using a score from 0 (worst) to 4 (best).

4 Results

While analyzing the results of the lab study, we were particularly interested in idea quantity, idea quality and participant satisfaction. When describing the results, we refer to the groups having a chat with "*chat*" and the groups having no chat with "*no-chat*".

4.1 Idea quantity

Chat produced a total of 172 ideas, while *no-chat* generated 215 ideas. In relation to the number of participants, *chat* averaged 5.9 ideas per group member, being slightly outscored by *no-chat* with 6.9 ideas per participant.

4.2 Idea quality

The members of *chat* rated their ideas with respect to creativity with an average of 2.2 of 4 points , with respect to feasibility with an average of 2.6 of 4 points. *No-chat* evaluated their idea's creativity with an average of 2.0 and their idea's feasibility with an average of 2.3. So for both criteria, *chat* assessed slightly higher scores than *no-chat*.

For an external measure, we asked three researchers from our group to rate the ideas as objectively as possible. In this external rating, *chat* scored 2.1 for both

creativity and feasibility, while the ideas of *no-chat* were rated with an average of 2.2 for creativity and 2.1 for feasibility. So the external rating showed no significant difference in the quality of contributions between the two groups.

4.3 Participant Satisfaction

In a survey that was conducted immediately after the experiment, the participants were able to suggest improvements for the IdeaStream application. In 7 of the 9 groups of *no-chat*, at least one member requested a *chat*. However, both groups equally enjoyed working with the IdeaStream tool (4.6 of 6, where 0 means worst and 6 means best). *No-chat* rated their satisfaction with the group slightly higher than *chat* (5.0 / 4.8 of 6).

Table 1. Results of experiment comparing groups with chat and without chat during computer-supported creativity techniques for idea generation.

	Chat	No Chat
Participants (total)	29	31
Idea quantity (total)	172	215
Idea quantity (per participant)	5.9	6.9
Idea creativity average (group, 0 worst ... 4 best)	2.2	2.0
Idea feasibility average (group, 0 worst ... 4 best)	2.6	2.3
Idea creativity average (external, 0 worst ... 4 best)	2.1	2.2
Idea feasibility average (external, 0 worst ... 4 best)	2.1	2.1
Fun working in sessions with tool (0 worst ... 6 best)	4.6	4.6
Satisfied with group (0 worst ... 6 best)	4.8	5.0

4.4 Summary

Even though there are numerical differences in the means of most of the relevant variables, t-tests showed that they are not statistically significant. Hence, the hypothesis that chat communication affects a collaborative idea generation process is not supported (H_0 saying that there is no difference cannot be rejected). This is true for idea quantity, idea quality (internal and external) and group satisfaction.

5 Discussion

The design of the IdeaStream application and its use and configuration in our experiment provide means to counteract the three well-known negative influences that are usually credited for negatively impacting collaborative creative processes. The user awareness functions can help to inhibit social loafing. To prevent negative effects from social pressure, the users had pseudonyms assigned. Hence, the fear of negative judgment from others was lowered. Lastly, production blocking effects were minimized, since the system allows parallel input of ideas (and, for the chat-groups, of chat messages) and oral communication was strictly forbidden. In this way we provided an environment in which the known negative influence factors on group

creativity are mostly suppressed. Based on this, we were able to investigate the question if groups in idea generation processes can benefit from a chat as a channel for direct communication besides the means to enter ideas and view the ideas of others.

5.1 Impact on the process

Our experiment shows that neither overall quality nor quantity of the ideas that are generated by groups in computer-supported creativity techniques are influenced by the group having the possibility to chat. So, looking at the overall *process results*, there is no net impact of this additional direct communication at all. However, this does not imply that the *process itself* is not influenced by the communication. The theories presented in the previous chapters provide reasonable arguments on these effects and support the assumption that communication does actually affect the creative group process. However, our experiment showed that different process effects implied by communication definitely cancel each other out in creative group processes, since both settings yielded the same results.

To be able to better support the creative process with creativity support systems, it will be necessary to gain an understanding on the factors which influence communication. As a starting point for future research, we summarized potential positive and negative influence factors, which emerge from direct observations in the experiment as well as personal considerations (see figure 2).

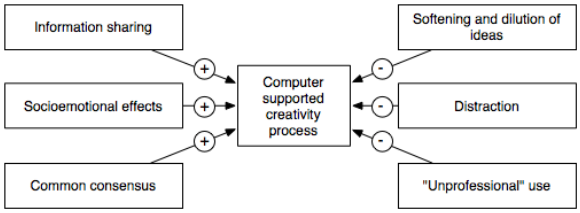

Fig. 1. Potential positive and negative influence factors of communication on computer-supported idea generation processes.

Potential positive factors:

1. Information sharing: Letting others participate in your knowledge on a particular subject may enable them to create new or improved ideas. The stimulus through direct communication between the participants may be different from and additional to the stimulus received by seeing other people's ideas. Furthermore, people may have an information need with respect to the given problem that they can express via a channel such as a chat. That may also help in producing good quality ideas for that particular problem.

2. Socio-Emotional effects: It can be assumed that direct communication can improve emotional states of mind in a very general way, not only with respect to the initial

acceptance of the tool (see below) but also with respect to e.g. expressing and thus alleviating temporary emotional indispositions.

3. Consensus or commitment building: While in idea generation processes consensus or "general acceptability" with respect to ideas may not be necessary or in most cases even unwanted, direct communication may contribute to a certain consensus or commitment to some ideas that may give participants incentives to improve, structure or reposition the idea in question during the creative process without diluting it or neglecting alternative ideas.

Potential negative factors:

1. Softening and dilution of ideas: An effect that applies to all forms of "free" communication in creative processes and therefore may also affect chat is that communication may contribute to softening and dilution of innovative radical ideas. One possible reason can be the attitude in groups that induces the desire for agreement on proposed solutions. In order to reach this state the described softening on ideas in view of general acceptability often takes place which sometimes leads to a decreased quality or novelty compared to the original ideas.

2. Distraction: While it can be assumed that a chat is a parallel medium and electronically mediated communication requires fewer adherences to social norms that enforce listening to others while they speak, participants still have to take their time to read the chat contributions, which may distract them from their actual task of idea generation.

3. "Unprofessional" use: In the groups that were able to chat we observed tendencies for unfocused behavior such as joking, which may exert a social force on other participants to join this unfocused and thus potentially distracting behavior.

5.2 Impact on acceptance

As our survey shows, the majority of the groups that were not able to communicate with a chat suggested improving the system by adding a chat feature. This is in particular interesting given the fact that, after all, these groups were not less satisfied with the computer support system or the group than the groups that actually had the chat feature, so we must assume that actually providing them a chat would not have positively affected their satisfaction level. Nevertheless, there seems to be an inner need to communicate in group settings in general or the need for a communication assurance in view of the fear of having to use an unknown tool together with the pressure to produce good ideas.

As Dennis and Reinicke [17] point out, acceptance of creativity support systems in practice is still weak, despite of the positive research results in the field. Our experiment findings suggest that there is a strong a priori demand for having a chat in a creativity support system, so providing a chat can help lowering acceptance barriers.

Conclusion

In this article we presented the results of a study concerning the use of chat for communicating in computer-supported idea generation processes. First we introduced some of the typical communication problems in interacting groups and showed how using creative support systems can decrease the impact of these factors. Then we reviewed what role recent literature assigns to communication in idea generation processes. Related work gave valid arguments supporting both theories that direct communication via a chat during idea generation processes is necessary and beneficial and that direct communication has negative influence and thus has to be avoided respectively. For this reason we conducted an experiment that resulted in approximately equal performance values for teams having chat as a communication tool and teams without chat function. In the discussion we then interpreted our results and addressed possible causes for them.

However, further research is needed, first of all to comprehensively identify possible other effects. Another important question regarding these effects is what influence they have on the idea generation process and its results. This could be accomplished by designing new experiments to isolate each of the effects. In addition there may be hidden context variables that change the weights depending on the situation, which makes the investigations even more difficult. Such context variables for example include time, place, setting, problem statement and/or type, creativity technique used, etc. For example the weight of "unprofessional" use may increase if the team members know each other well or if the computer support system is buggy.

It is also important to consider that experimental settings have restrictions, especially regarding relationships between participants, motivation and other important aspects that can influence the results of experiments significantly. Therefore we want to emphasize the need to conduct field studies as well with whose help new effects and aspects of intra-team communication may be discovered. On the other hand the complexity of field studies is far higher than of experiments. Trying to isolate effects (as described above) may be very hard or sometimes even impossible in some field study so that we believe that additional lab experiments still have to be used (as far as possible) in a complementary way.

References

1. Osborn, A. F., “Applied imagination. Principles and Procedures of Creative Thinking”, Creative Education Foundation, 3rd edition, 1993
2. Fernald, L. W. and P. Nickolenko, “The creative process: Its use and extent of formalization by corporations”, Journal of Creative Behaviour, vol. 27, no. 3, 1993, pp. 214–220
3. Isaksen, S. G., “A Review of Brainstorming Research: Six Critical Issues for Inquiry”, Technical report, Creative Problem Solving Group, Buffalo, New York, 1998
4. Taylor, D., P. Berry, and C. Block, “Does group participation when using brainstorming facilitate or inhibit creative thinking?”, Administrative Science Quarterly, vol. 6, 1958, pp. 22–47

5. Diehl, M. and W. Stroebe, “Productivity loss in idea-generating groups: Tracking down the blocking effect”, Journal of Personality and Social Psychology, 1991, vol. 61, pp. 392–403.
6. Carte, T. A., L. Chidambaram, M. J. Garfield, L. Hicks, and C. Cole, “Group Creativity and Collaborative Technologies: Understanding the Role of Visual Anonymity.”, 12th International Workshop on Groupware CRIWG, 2006, pp. 12–21
7. Shepherd, M. M., R. O. Briggs, B. A. Reinig, J. Yen, and J. F. Nunamaker, Jr., “Invoking Social Comparison to Improve Electronic Brainstorming: Beyond Anonymity.”, Journal of Management Information Systems, vol. 12, no. 3, 1995, pp. 155 – 170.
8. Bostrom, R. P. and M. Nagasundaram, “Research in Creativity and GSS”, Proceedings of the 31. Hawaii International Conference on System Sciences, Washington, DC, USA, 1998, pp. 391–405, IEEE Computer Society
9. Sternberg, R. J. and T. I. Lubart, “The Concept of Creativity: Prospects and Paradigms”, Cambridge University Press, Chapt. 1, 1999, pp. 3–14
10. Applegate, L. M., B. R. Konsynski, and J. F. Nunamaker, “A group decision support system for idea generation and issue analysis in organization planning”, CSCW ’86: Proceedings of the 1986 ACM conference on Computer supported cooperative work, ACM Press, New York, NY, USA, 1986, pp. 16–34
11. Hilliges, O., L. Terrenghi, S. Boring, D. Kim, H. Richter, and A. Butz, “Designing for collaborative creative problem solving”, Proceedings of the 6th ACM SIGCHI conference on Creativity and Cognition, ACM Press, 2007, pp. 137–146
12. Powell, A., G. Piccoli, and B. Ives: “Virtual teams: a review of current literature and directions for future research”, SIGMIS Database, vol. 35, no. 1, 2004a , pp. 6–36
13. Nunamaker, J., R. O. Briggs, D. D. Mittleman, D. R. Vogel, and P. A. Balthazard, “Lessons from a Dozen Years of Group Support Systems Research: A Discussion of Lab and Field Findings”, Journal of Management Information Systems, vol. 13, no. 3, 1997, pp. 163–207
14. Forster, F., “Distributed Creative Problem Solving over the Web”, ICIW ’08: Proceedings of the 2008 Third International Conference on Internet and Web Applications and Services, IEEE Computer Society, Washington, DC, USA, 2008, pp. 283–288
15. Vangundy, A. B., “Techniques of Structured Problem-Solving”, Springer Netherland, 1st edition, 1988
16. Reinig, B., R. Briggs, and J. Nunamaker, “On the measurement of Ideation Quality”, Journal of Management Information Systems, vol. 23, no. 4, 2007, pp. 143–161
17. Dennis, A. and B. Reinicke, “Beta vs. VHS and the Acceptance of Electronic Brainstorming Technology”, MIS Quarterly, vol. 28, 2004, pp. 1–20.
18. Helquist, J., Santanen, E., Kruse, J., “Participant-driven GSS: Quality of Brainstorming and Allocation of Participant Resources”, Proceedings of the CSCW 2007, ACM Press, pp. 1530-1605
19. Prante, T., Magerkurth, C., Streitz, N., “Developing CSCW Tools for Idea Finding – Empirical Results and Implications for Design”, Proceedings of the CSCW 2002, Luisiana, USA, ACM Press, pp. 106-115