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ABSTRACT

Group support systems (GSS) can increase group productivity by effectively harnessing the knowledge, abilities, and skills of group members. Primarily, GSS usage and research has focused on small to medium-sized groups. Large groups of over fifty participants present difficulties for both the GSS system as well as the users of the system. With very large groups the volume of information that users must process grows dramatically and is challenging to manage effectively. This paper presents an approach to GSS brainstorming that manages the overall volume of brainstorming input while improving the quality of entries. Each new brainstorming input is routed to peers for review and modification. The goal of the peer review process is to limit the sheer volume of brainstorming input while increasing the overall quality of the input.

Keywords

Group support systems, large groups, brainstorming, peer review.

INTRODUCTION

Work within organizations frequently occurs within groups or project teams. Group work provides many advantages to the organization as the individual members are able to share information, generate ideas, make decisions, and review the effects of the decisions (Phillips and Phillips, 1993). Ideally, the group will come to a "better" decision than an individual because the collective knowledge, skill, and expertise of the group is greater than that of any individual (Maier and Hoffman, 1960; Martz, Vogel and Nunamaker, 1992).

Group support systems (GSS) can increase group productivity by effectively harnessing the knowledge, abilities, and skills of group members (Adkins, Burgoon and Nunamaker, 2003; Nunamaker, Alan, Joseph, Douglas and Joey, 1991). According to Nunamaker et al. (1995), GSS increases productivity through such things as increased information, objective evaluation, and synergy.

Fjermestad and Hiltz (1998) reviewed 200 GSS studies that were published in 230 articles. The results showed that the benefits of GSS usage became more pronounced as the group size increased. Every study varying group size showed that larger groups outperformed smaller groups in GSS environments. However, most of the experiments reviewed utilized small to medium-sized groups; the largest group size reported in the summary review was 24.

Experimentation with large groups (fifty or more participants) presents difficulties for researchers, systems, and participants. Large group experimentation requires larger subject pools, and may also present logistical difficulties, as the GSS facilities may not be able to accommodate large synchronous, proximal GSS sessions. Likewise, the GSS system itself may not be able to scale to larger groups. With very large groups, the volume of information that users must process grows dramatically and is challenging to manage effectively. Special large group support systems have been created that can handle the demands of a large group (Thorpe and Albrecht, 2004). One characteristic of these large group specific GSS is the ability to handle asynchronous, distributed groups.

Asynchronous, distributed collaboration enables large groups of individuals to overcome geographical and temporal constraints to collectively pool intellectual resources. The ability to work asynchronously and distributed not only facilitates large group meetings by alleviating physical constraints but also provides cognitive benefits to improve task performance. The asynchronous nature of the collaborative session allows the users to further examine and analyze a given task, enabling broader discussion of the issues at hand (Benbunan-Fich, Hiltz and Turoff, 2003). Others have claimed that good ideas occur while doing things totally unrelated to work and that people are more creative when performing their regular work, as opposed to sitting in a formal, proximal brainstorming session (Robinson and Stern, 1997; Stenmark, 2001). Inspiration and insight most likely occur outside the GSS facility; asynchronous systems allow the participants to log in and contribute to the collaborative work regardless of the time.
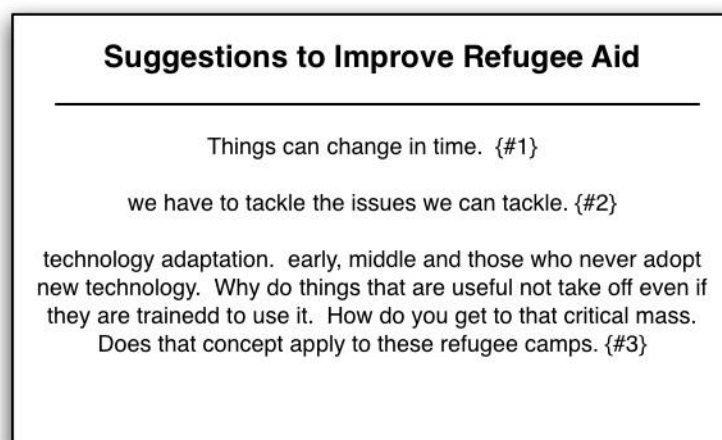
One complicating factor of distributed, asynchronous collaborative work is the quality of the writing. Brainstorming input must be clear, concise, and complete for the brainstorming input to be of value to the collaborative group. Unfortunately, many GSS brainstorming session outputs often include comments that are irrelevant, incomplete, or incoherent. These cryptic and "noisy" comments consume group resources, increasing the amount of time to synthesize and converge on the main themes from the brainstorming session. These problems are exacerbated in large groups as the amount of "noise" has the potential to increase dramatically.

This paper presents part of a new approach to handle asynchronous, distributed groups that scales to large groups. This approach utilizes peer review during brainstorming to control the volume of input, yielding a brainstorming pool that is more clear, complete, and cohesive than traditional brainstorming.

DIFFICULTIES OF LARGE GROUPS

Two phases of collaboration are divergence and convergence. Divergence moves the group from a state of having fewer ideas to a state of having more ideas (Briggs, Vreede and Nunamaker, 2003). Divergence includes such activities as brainstorming. Convergence focuses on synthesizing and making sense of the pool of divergent input. The goal is to move from a state of having numerous ideas to consolidating and identifying the few issues worthy of further attention (Briggs et al., 2003).

Traditional brainstorming in a GSS environment enables each participant to enter input into the system at will. Due to the nature of the brainstorming environment, the level of quality of the comments varies dramatically (Chen, Houston, Nunamaker and Yen, 1996). Figure 1 shows sample input from a brainstorming session. Between constraints on meeting time and individual differences in typing ability, comments can include numerous grammatical and typographical errors (#3 below). Likewise, the brainstorming input may contain ambiguous statements, unclear references, or incomplete ideas, hindering the ability of the other participants to successfully decode the meaning of the brainstorming input (#1-3 below).

Suggestions to Improve Refugee Aid

Things can change in time. {#1}

we have to tackle the issues we can tackle. {#2}

technology adaptation. early, middle and those who never adopt new technology. Why do things that are useful not take off even if they are trainedd to use it. How do you get to that critical mass. Does that concept apply to these refugee camps. {#3}

Figure 1: Noisy brainstorming input

Facilitators can address these "bad" brainstorming issues by engaging the group in a discussion. However, in an asynchronous and distributed environment, and as the size of the group grows, this type of resolution becomes increasingly difficult. The number of comments that are not clear or concise may grow to become too large to be handled in a timely manner. It is possible that these difficulties could consume enough resources to constrain the process, potentially stifling the ability of the group to find the best ideas (Briggs, Reinig, Shepherd, Yen and Nunamaker, 1997).

Convergence includes activities that organize the brainstorming input, identifying the key issues and making the problem cognitively accessible. However, the process is labor intensive as convergence activities, such as clustering, are often performed through a facilitator. The divergence process can overwhelm the convergence processes with too much information.

Previous work has focused on automating the clustering of the brainstorming input. While these attempts at decreasing the time required to converge have provided a good start, more work is required (Chen et al., 1996; Roussinov and Zhao, 2003). As Chen et al. (1996) state, the automated solutions still need work regarding the level of abstraction of the clustering as many categories are too general. Likewise, the agent cannot generalize, lacking the domain-specific knowledge to provide the proper layer of abstraction. Participants are better equipped to understand the correct level of detail from which to consolidate and synthesize the brainstorming input.

Other approaches have been advanced to improve the collaborative process by increasing automation (Adkins, Kruse and Younger, 2004; Adkins, Younger and Schwarz, 2003). One new approach to the large group brainstorming problem has been proposed (Faieta, Huberman and Verhaeghe, 2006) that involves circulating brainstorming input to small, local groups for evaluation. Highly rated items are circulated to ever larger groups - lessening information overload as only higher quality ideas are routed to the entire group. This approach does not, however, easily accommodate distributed and asynchronous participants or scenarios where not all participants are able to participate for the entire session.

This paper proposes a new framework that utilizes the skills and abilities of the participants to reduce the load on the facilitator and improve results. Specifically, we believe that improving the divergence process and its resultant output can decrease the difficulties associated with clustering and synthesizing. By increasing the quality of the brainstorming input, we can reduce the "noise" by ensuring the completeness and clarity of the brainstorming input pool. The end result is a set of brainstorming input that is easier to synthesize and consolidate. This framework defines the quality of the input as how well the brainstorming input can stand on its own rather than how well the given input drives the group toward an optimal solution. An entry that is clear, concise, and complete is considered quality input, regardless of the impact of the comment on the group's ability to achieve an optimal outcome.

Early GSS literature equated more brainstorming input with more productivity. Osborn first introduced brainstorming and asserted that groups who produced more brainstorming ideas would also produce better ideas (Osborn, 1953). However, this position is equivocal as research has questioned the link between quality being a function of quantity (Briggs et al., 1997; Reinig and Briggs, 2006). This framework utilizes the idea that more brainstorming input isn't necessarily better. This approach posits that the number of "noisy" comments can be reduced, increasing the average quality of the brainstorming input.
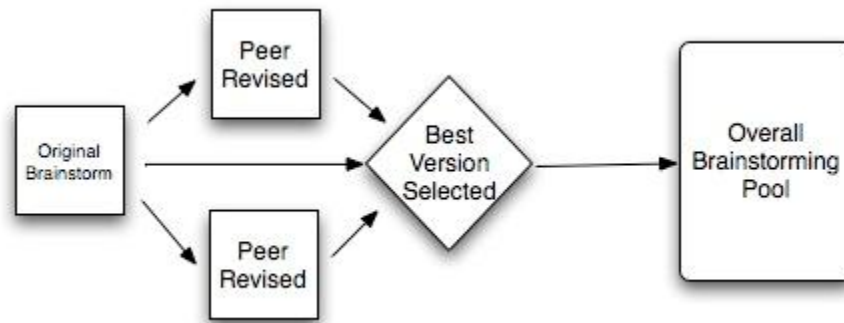
PEER-REVIEW BRAINSTORMING

Peer-review brainstorming is a new approach to conducting brainstorming activities in an asynchronous, distributed session. The goal of this new approach is to improve the divergence process, decreasing the effort required to converge on the key brainstorming ideas. Each brainstorming input goes through a review process that increases the clarity and completeness of the brainstorming input. Each brainstorming input is routed to collaborative peers so that the original comment can be edited and clarified prior to being submitted to the overall brainstorming pool.

Implementation of the peer-review brainstorming proceeds along the following workflow. First, a new brainstorming input is entered and submitted by the original author. This new brainstorming input is submitted into a revision queue, where it waits to be reviewed by other participants. As other participants have room in their own personal work queue, they are presented with the original comment and prompted to revise the original comment. The review is based on a "framing" process outlined by Schwarz (2002) for face-to-face groups that Adkins and Schwarz (2002) have modified for computer-mediated environments. This framing of the original comment will include instructions and prompts that guide the reviser to edit the original comment in such a way to make it more complete and coherent.

The original brainstorming input and the revised versions are routed to another peer, who is responsible for selecting which option is deemed the best from the randomized list. Again, prompts are utilized to guide the participant to select the version

that is the most clear and complete. The version that is selected as the best is then submitted to the overall brainstorming pool for the entire group to see (Figure 2).

Figure 2. Peer-review brainstorming

This new approach to brainstorming emphasizes the importance of the instructions and prompts that are used within the system. When new brainstorming input is entered into the system and when the revised versions are entered, the system should provide clear prompts to remind the participant of the importance of completeness and clarity. The prompts should underscore the importance of each input containing a complete idea that can stand on its own, reducing the ambiguity of the input.

The peer review process not only provides higher quality input to improve convergence activities but it also increases the comprehension of the input by the participants. By forcing participants to read and edit input from their peers, the peer review process increases the information processing and integration of the information by the participants (Hilmer and Dennis, 2000). Dennis (1996) found that even though GSS groups had access to more information, they were not likely to use or internalize that information. Explanations given for the lack of information processing include the lack of time to process all of the information, information credibility, and information saliency. According to Focus Theory, participants' limited attention is required to access and process new information (Briggs, 1994). Peer-review brainstorming should improve information processing as the information is presented in a more refined, coherent state that allows easier access to the new concepts. Improving the quality of the brainstorming input allows for easier assimilation of the input.

CONCLUSION

Peer-review brainstorming presents a new framework for conducting brainstorming activities within a group. The goal of this approach is to improve the quality of the brainstorming input by utilizing human resources to review the brainstorming input. The end result is a set of divergent information that can be more efficiently processed during subsequent convergent activities. Poorly crafted brainstorming input creates a cognitive load that consumes attention resources and may stifle the brainstorming process.

This framework is currently being implemented in a prototype and examined experimentally to examine the effects of this new approach. Not only is it important to verify the improvement in the clarity and completeness but experimentation also needs to be conducted to monitor any potential side effects of the peer review process. These potential negative consequences include such things as decreased participant satisfaction levels and lower creativity rankings. Success of this new framework will be partially determined by assessing the number of quality comments (Reinig et al., 2006) as well as the number of noisy comments.

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