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ABSTRACT

Many studies have investigated the effects of various meeting facilitation techniques on groups, but few have directly compared the effects of different electronic techniques on group interaction. In fact, the vast majority of research in the area of electronic meeting support has used only two techniques: verbal brainstorming and electronic individual poolwriting. This paper describes an experiment involving four groups of 35 undergraduate students each using electronic individual poolwriting, electronic gallery writing, verbal brainstorming, and manual individual poolwriting. Results show that groups using the two electronic techniques were more satisfied and productive and experienced less production blocking and evaluation apprehension. Although there were no significant differences in production blocking, evaluation apprehension, and the number of quality ideas generated between the two electronic techniques, groups were more satisfied with and preferred electronic gallery writing over electronic individual poolwriting.

INTRODUCTION

Improving meetings has been a goal of many researchers, and several group facilitation techniques have been developed to reduce production blocking and evaluation apprehension and increase synergy and stimulation. However, most verbal and manual facilitation techniques have not increased meeting efficiency and effectiveness (Lamm & Trommsdorff, 1973). Computer-based facilitation techniques emerged in the 1970s and 1980s to overcome the limitations of these traditional meeting techniques, but experimental results using these new computer-based tools have been somewhat inconsistent (McLeod, 1992). The processes and outcomes of electronic meetings depend upon the interaction of four variables: group characteristics, task, organizational context, and technology (Pinsonneault & Kraemer, 1989). While extensive research has been conducted to study the effect of the first three variables on groups, the role of differences in the technology has not been explored in depth.

Although it is not always clearly stated in the literature, the vast majority of electronic meeting system research has been conducted using an electronic version of the brainwriting pool or individual poolwriting technique (see for example, Gallupe, et al., 1991). Others have used the nominal group technique, electronic blackboards, Delphi, or other methods to a lesser extent, but very few attempts have been made to compare these techniques with each other. Groups using electronic individual poolwriting often were compared with verbal brainstorming groups with no controls for the effect of structure or technology. Without these control groups, it is impossible to determine whether increments or decrements in outcomes are due to the electronic technology or simply due to imposing a problem-solving structure on the group (Watson, et al., 1998, p. 465). Because "small differences between GSS forms seem to account for the sometimes conflicting results of early GSS research" (Huber, et al., 1993, p. 268), a "comparison of results achieved using automated and manual versions of two or more structured techniques may help identify indicators of Group Support System success" (Nunamaker, et al., 1989, p. 148).

To address this imbalance in the literature, this paper describes an experiment comparing four meeting facilitation techniques: electronic individual poolwriting, electronic gallery writing, verbal brainstorming, and manual individual poolwriting.

GROUP IDEA GENERATION TECHNIQUES

Idea generation techniques generally fall into variations of two categories: *brainstorming* which refers to verbal generation of ideas and *brainwriting* which refers to written generation of ideas.

Brainstorming

Group participants take turns contributing as many innovative comments as possible in a brainstorming meeting, and these verbal comments are written down on a blackboard at the front of the room for all to see. The advantages of this technique are that it accommodates social interaction needs and encourages a high level of group cohesion. However, the disadvantages of the technique are that only a brief summary of the comments may be written down on the board, and shy people tend not to participate as much when responses are not anonymous. Due to the limitations of taking turns to speak, verbal brainstorming has been recommended for small groups (six or less people) (VanGundy, 1988, p. 75).

Brainwriting

This idea generation technique is characterized by silent, hand-written communication which can be interactive (face-to-face idea generation) or nominal (non-face-to-face idea generation). There are many advantages to brainwriting: (1) each group member is able to contribute at the same time, (2) all ideas are recorded, (3) a high degree of anonymity is preserved, (4) no skilled facilitator or leader is required, (5) group members need not be skilled or trained in brainwriting, (6) no one can dominate the discussion, and (7) there is little opportunity for conflict to arise among members (VanGundy, 1984). Therefore, group members often generate a greater number of ideas and participate more than when using brainstorming. However, brainwriting does not

satisfy social interaction needs as well as brainstorming techniques. There are many brainwriting techniques, but perhaps the two most commonly-used are individual poolwriting and gallery writing.

Individual Poolwriting

Using the individual poolwriting (or brainwriting pool) technique, each participant silently writes a comment on a piece of paper and then places it on a table in the middle of the group (Geschka, et al., 1981). The participant then picks up a paper left on the table by another group member, reads the comments, and writes additional ideas on the paper. This paper swapping process continues until the meeting time is up.

Because there is no time limit for individuals holding onto a particular sheet of paper, the exchange rate is not equal and the number of exchanges within the pool may be limited. This is especially true in small groups, and it can lead to decreased synergy and stimulation among group members. However, one study (Madsen & Finger, 1978) found that groups using the technique generated 20 percent more comments than groups using verbal brainstorming.

An electronic version of this technique has been developed for use on computer networks. Using the electronic individual poolwriting (EPW) technique, a group of N people exchange typed comments on N+1 files at computer terminals. Comments are totally anonymous, ideas are automatically recorded, and the group communicates in parallel.

In theory, the major advantage of this technique is that of a large number of comments will be generated during the course of the meeting since participants cannot see a new file of comments until after they have written something. However, the technique suffers from two major limitations. Because each participant is looking at a completely different subset of comments at any one time, when a verbal remark is made by one group member about a comment, nobody else in the group knows what the participant is talking about. In addition, group members may not be able to see all of the comments over the course of the meeting. Researchers have noted that "periods of extreme non-randomness can occur in file interchange between group members. As such, a group member may not see all of the files during a session and/or may see a small group of files an abnormally high percentage of the time" (Vogel & Nunamaker, 1990, p. 22). EPW structures the meeting process by "dividing participants' comments into several discussions, in an attempt to reduce cognitive inertia" (Nunamaker, et al., 1993, p. 139). However, this process structure can reduce feedback which can impair group decision making.

Gallery Writing

In the gallery writing method, sheets of paper are attached to the walls of a room and group members silently write down their ideas on the sheets and view all comments simultaneously. While this may increase the feeling of group cohesion, it may also reduce anonymity because other group members can watch while ideas are written down.

With the electronic version of gallery writing, the many sheets of paper posted on the wall of a room are substituted with one disk file. Typed comments may be submitted at any time, and participants may view all other submitted at any time, and participants may view all other submitted comments at any time. However, more time may be spent in reading other group members' comments than in creating new ones. This could limit the number of ideas produced by the group but may increase information sharing and group synergy among group members.

When multiple files are built into a group technique (as with electronic poolwriting), the interaction among group members can be fragmented, making the process more difficult to follow. Communication techniques with multiple files structure the meeting process by dividing group communication into many separate conversations in an attempt to reduce the tendency of the group to focus on one discussion. Small groups with this structure may generate more alternatives, but make lower-quality decisions. In contrast, communication techniques with a common file include all participants' comments in one discussion leading to increased feedback. Increasing feedback among group members is an effective way of stimulating the creation of new ideas and improving the group's decision making. Further, an electronic technique with one file may provide group members a clearer focus which is important for an intellective or decision-making task.

ELECTRONIC MEETING SYSTEM STUDIES

Electronic versus Verbal Groups

Most studies have compared electronically-supported groups with verbal groups. For example, one study (Gallupe, et al., 1988) examined the effect of GDSS technology on group decision quality and individual perceptions, and found that electronically-supported groups generated more alternatives and had better quality decisions than verbal groups. However, electronically-supported groups were less satisfied with the decision process. Another study (Daly, 1993) compared groups using a GDSS to verbal brainstorming groups and found that there were no significant differences in the number of correct solutions between the groups; however, groups using the GDSS tool took longer to finish the task and generated fewer comments. In general, however, studies have found that large groups using a GDSS are more productive and are more satisfied with the technique than verbal groups (Nunamaker, et al., 1991).

Electronic versus Manual Groups

A few studies have compared electronic techniques with manual, non-verbal techniques. In one study (Watson, et al., 1988), researchers examined the effects of three techniques (GDSS, paper-and-pencil, and verbal brainstorming) on the level of group consensus and group satisfaction with the process. The results showed that there were no significant differences between the

groups in consensus and attitudes toward the meeting process. However, groups using the GDSS were less satisfied with the process than unsupported groups. In another study (McLeod & Liker, 1992) in which groups were assigned to one of two techniques (GDSS or paper-and-pencil), researchers found that groups using the GDSS performed better than the other groups, but there were no significant differences in satisfaction between groups using either techniques.

Nominal and interacting groups were compared using electronic and non-electronic techniques in a third study (Gallupe, et al., 1991). Results showed that electronic groups generated more unique ideas than the other groups. Moreover, the electronic groups reported that they were more motivated to generate quality ideas, felt better about the idea generation process, and felt that they participated and expressed their ideas, indicating that the electronic technique was superior to the non-electronic technique in reducing process losses.

Electronic versus Electronic Groups

Relatively few studies have investigated the effect of different electronic techniques on groups. In one of these studies (Jarvenpaa, et al., 1988), researchers examined three different forms of meetings (electronic blackboard, networked workstations, and verbal/face-to-face) and found that decision quality was best for groups communicating via the electronic blackboard, second best for networked groups, and worst for face-to-face groups.

In another study (Sambamurthy & Chin, 1994), researchers examined two GDSS designs providing different levels of communication support. Results showed that the groups using the design with greater communication support performed better than other groups and perceived their systems as easier to use.

A comparison of two different electronic meeting techniques (electronic poolwriting and the electronic discussion system) in a third study (Easton, et al., 1990) found that electronic discussion system groups produced better quality solutions, but groups using electronic poolwriting generated more unique alternatives. However, there were no significant differences between the two techniques in terms of group satisfaction and consensus. In summary, these studies demonstrate that differences in GDSS techniques can have a profound effect on group efficiency and effectiveness.

RESEARCH METHODOLOGY

To investigate differences among two electronic and two non-electronic group facilitation techniques, an experiment was conducted.

Independent and Dependent Variables

The independent variable was the type of group facilitation technique (Verbal Brainstorming - VBS, Manual Individual Poolwriting - MPW, Electronic Individual Poolwriting - EPW, and Electronic Gallery Writing - EGW). Six dependent variables found in other studies were used:

1. *Synergy and Stimulation:* Subjects' perceptions of synergy and stimulation were measured on a self-assessed, seven-point Likert scale by three tiems: how stimulating the task was, how interesting the task was, and how motivated the subjects were to generate quality ideas.
2. *Production Blocking:* Subjects' perceptions of production blocking were measured on a self-assessed seven-point Likert scale using two items: whether they expressed ideas immediately after they thought of them and whether they had to wait to express ideas.
3. *Evaluation Apprehension:* Subjects' perceptions of evaluation apprehension were measured on a self-assessed seven-point Likert scale by two items: whether they were apprehensive and whether they felt at ease.
4. *Satisfaction with Process:* Subjects' perceptions of process satisfaction were measured on a self-assessed seven-point Likert scale by four items: how do you feel about the process, would you recommend this process, how do you feel about the idea proposed, and all in all, how do you feel.
5. *Number of Raw, Non-redundant, and Quality Ideas:* The ideas of all groups were typed in identical formats and independently coded by two raters.

Subjects

Four groups of 35 undergraduate Business students participated in the experiment. The subjects completed a pre-meeting questionnaire that asked for their age, sex, prior computer experience, computer skills, prior ideas generating meeting experience, and other measures of prior differences to control for subjects' prior knowledge and experience. A multivariate analysis of variance of these variables showed no significant differences among the groups ($F = 0.53$, $P = 0.659$).

Incentive

One of the limitations of this research is the use of undergraduate business students as subjects. Students typically have had little experience in businesses or large organizations, so generalizing the findings may be difficult. However, some researchers have suggested that experiments with student subjects can provide valuable insights provided that the students have a long-term stake in their performance (e.g., through grading or monetary incentives). Students were awarded extra credit toward their class grade, and a cash prize of $10 was paid to each member of the group judged to have generated the greatest number of quality ideas.

Tasks

For the sake of comparability, this study employed the idea generation tasks used in previous studies. Each group of subjects was asked to generate ideas for the solution of the following problems: (1) "How can the campus parking problem be improved at the university?," (2) "How can campus security be improved at the University?," (3) How can tourism in the region be improved?," and (4) "How can the curriculum in the School of Business Administration be improved?"

Experimental Procedures

At the start of each meeting, the instructions were read aloud while the subjects followed along with their own copies. For each group, the meeting consisted of four sub-meetings with the tasks and tools in a different order in a balanced design (although several studies have indicated that there be no interactions with the technique and task order.) Each sub-meeting lasted 10 minutes, an amount of time deemed to be sufficient for a low-complexity task.

EXPERIMENTAL RESULTS

Analysis of Variance tests were used to examine four hypotheses derived from experience and theory:

H1. **There will be a difference in synergy and stimulation among the four techniques.** Supported. Group members perceived a significant difference in synergy and stimulation when using the four techniques ($F = 49.04$, $p = 0.0001$). Specific differences among the techniques were investigated using paired comparison analyses. A Tukey test (at $p = 0.05$) showed that subjects perceived the same level of synergy and stimulation when using EGW and EPW and when they used VBS and MPW. However, subjects using EGW and EPW perceived more synergy and stimulation than subjects using VBS and MPW.

H2. **There will be a difference in production blocking among the four techniques.** Supported. Group members perceived a significant difference in production blocking when using the four techniques ($F = 38.89$, $p = 0.0001$). A paired comparison using the Tukey test at $p = 0.05$ revealed that subjects using the VBS technique reported the most perceived production blocking, followed by MPW, EPW, and EGW.

H3. **There will be a difference in evaluation apprehension among the four techniques.** Supported. Group members perceived a significant difference in evaluation apprehension when using the four techniques ($F = 41.29$, $p = 0.0001$). A Tukey test showed that subjects using the VBS technique felt the most apprehension followed by MPW, EPW, and EGW. There were no significant differences in perception of evaluation apprehension for subject using the two electronic techniques, but there were significant differences in perception when using VBS and MPW.

H4. **There will be a difference in process satisfaction among the four techniques.** Supported. Group members perceived a significant difference in process satisfaction when using the four techniques ($F = 44.57$, $p = 0.0001$). A Tukey test showed that subjects felt that all four techniques were statistically significantly different. Subjects felt most satisfied with EGW, followed by EPW, MPW, and VBS.

Number of Comments Generated

Group effectiveness was determined by counting the quantity of ideas, the number of non-redundant ideas, and the quality of ideas produced by each group. The ideas of all groups were typed in identical formats for subsequent coding. A rater who was blind to the experiment and the hypotheses assessed the number of non-redundant ideas produced by each group using the coding rules of Boudhard & Hare (1970). To test rater reliability, a second rater independently repeated the same procedure using the same coding rules with an inter-rater reliability of 0.97. Next, each group's non-redundant ideas were rated for their quality (defined here as an idea related to the topic of the meeting) by the two raters with an inter-rater reliability of 0.93.

Table 1. Total Raw, Non-redundant, and Quality Comments

Group	Technique	VBS	EPW	EGW	MPW
	Raw	15	136	69	64
1	Non-redundant	13	39	39	50
	Quality	9	28	28	21
	Raw	19	215	115	161
2	Non-redundant	9	70	51	60
	Quality	8	29	27	22
	Raw	22	182	97	119
3	Non0redundant	21	45	40	52
	Quality	16	22	28	24
	Raw	17	187	109	126
4	Non-redundant	15	79	40	54
	Quality	13	29	21	16
Non-redundant (Mean)		14.5	63.5	42.5	54
Quality (Mean)		11.5	27	26	20.75

Table 1 shows the number of raw, non-redundant, and quality comments generated by each group using each technique. Groups using the VBS technique generated the fewest comments, and groups using EPW generated the most. However, there was no great difference in the number of quality comments generated between groups using EPW and EGW.

DISCUSSION

The results of this experiment may be summarized as follows:

1. EPW participants generated the most non-redundatn comments, followed by MPW, EGW, and VBS.
2. Participants using both of the electronic techniques generated similar numbers of quality comments, followed by participants using MPW and VBS techniques.

3. Participants using the two electronic techniques had perceptions of synergy and stimulation, production blocking, and evaluation apprehension that were not significantly different, but were significantly less than those using MPW and VBS.
4. Participants using MPW perceived the same level of synergy and stimulation, but experienced less production blocking and evaluation apprehension than those using VBS.
5. EGW was perceived as the most satisfactory technique followed by EPW, MPW, and VBS.

The results of this research showed that participants in large verbal meetings produced the lease comments in terms of non-redundancy and quality compared to those using the other three techniques. Participants in verbal meetings experienced high levels of production blocking (no parallel communication) and high levels of apprehension (no anonymity), and many did not participate. However, with parallel communication and anonymity, participants using the two electronic techniques and manual poolwriting contributed more comments in terms of non-redundance and quality, because they experienced less blocking and apprehension than those using the verbal brainstorming technique. In addition, participants using electronic poolwriting contributed more comments because they were able to see additional comments only after they had submitted one. Using electronic gallery writing, they contributed less comments because they spent a large amount of time reading the one shared file rather than typing new comments.

Although there was no significant differences in production blocking, evaluation apprehension, synergy, and stimulation using the two electronic techniques, 73% of the subjects thought that communicating with EGW was the easiest to use compared to only 14% for the EPW technique.

The results of this research indicate that EGW was perceived as the most satisfactory technique followed by EPW, MPW, and VBS. Almost 62% of the participants felt that EGW provided them with the greatest meeting satisfaction, compared to 17% for EPW, 13% for MPW, and 8% for VBS. In addition, 61% of the participants felt that EGW is the preferred technique compared to 19% for EPW and 10% for both MPW and VBS. Earlier studies using large groups (Aljumaih, et al., 1995) and smaller groups (Aiken, et al., 1996) also showed that participants preferred EGW over EPW. Participants using EGW produced approximately the same number of quality comments as those using the EPW technique, and prior studies have found no significant difference in the number of quality comments generated between the two types of groups.

CONCLUSION

Studies of groups using electronics meeting technologies have shown that their performance is in part dependent on the specific meeting technique used by the group, but relatively few researchers have specifically investigated the effect of different electronic tools on groups. This research investigated how groups used four meeting techniques: verbal brainstorming, manual individual poolwriting, electronic individual poolwriting, and electronic gallery writing. Results supported earlier studies which showed that electronic group facilitation techniques may be superior to verbal and manual techniques. Further, electronic gallery writing may be superior to electronic poolwriting, although the latter is used in the vast majority of electronic group research.

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