Research

Task and technology fit: a comparison of two technologies for synchronous and asynchronous group communication

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Abstract

With the increasing use of emerging communication technologies for collaborative work and group communication, organizations must recognize the benefits as well as the limitations of these technologies for communication effectiveness. An experiment was conducted to examine the interaction between task structure and technology to support synchronous and asynchronous group communication. Two communication technologies, e-mail and a group support system (GSS), and two levels of task structure (less structured and more structured) were used. Group outcomes were measured as total number of unique ideas generated, which were further decomposed into basic and inferential idea categories. Results indicate that GSS-supported groups generated more total and basic ideas. However, groups using e-mail performed a deeper problem analysis as indicated by a higher proportion of inferential ideas generated by these groups. The number and proportion of inferential ideas were also significantly higher in the less structured task than those in the more structured one. © 1999 Elsevier Science B.V. All rights reserved.

Keywords: Asynchronous communication; Computer-mediated communication; Electronic brainstorming; E-mail; Group support systems; Media choice; Synchronous communication; Task and technology fit

1. Introduction

Emerging information and communication technologies are spawning new business paradigms and introducing fundamental changes in business processes and workgroup communication. The use of electronic networks and computer-mediated communication is fast growing in today’s organizations [5, 30, 41]. Technologies based on computer networks including the internet, intranet, and groupware are playing an increasingly important role in organizational decision making by facilitating communication, collaboration, and coordination among workers at a single as well as dispersed locations. Network-enabled software systems and components, such as group support systems, electronic mail, computer and video-conferencing, electronic bulletin boards, and forums, are some of the vehicles of communication and collaborative support for members of task-oriented workgroups. However, despite the increased use of electronic communication and collaboration technologies, questions remain about their impact on group efficiency, quality of group work, and organizational productivity [36]. Although significant research has been conducted into the use of computer support for collabora-
tive work, most of it has focused on electronic meeting systems and group support systems (GSS). Hollingshead and McGrath [22] provide a detailed review of the findings and an annotated bibliography of some 50 such studies.

The GSS research has generally focused on four factors as determinants of the use and impact of electronic support: group structure, task, characteristics of the technology, and the context [42]. The technology factor has frequently been studied simply as the presence or absence of electronic support by comparing outcomes in face-to-face verbal meetings versus GSS-supported ones. Less emphasis has been placed on investigating the role of different technologies in information exchange and collaborative support in group settings. Studies of interactions among the four factors are also infrequent, in particular those between task characteristics and technology types. As McLeod observes, “Task-technology fit is universally recognized as a central influence on information exchange in GSS-supported groups. Despite this, the relatively low amount of empirical work explicitly designed to examine this factor is a glaring gap in the GSS literature” [29]. The studies which did investigate the task-technology link, either used only one type of technology (e.g. [37]), or studied the relationship from an individual worker, and not a group, perspective (e.g. [1, 14]). Few studies of collaborative work have varied task type and technology configuration together.

The lack of multiple task, multiple technology research is a motivation for this study, which experimentally investigates the task-technology link in collaborative work. In particular, the study is designed to examine task structure (less- and more-structured tasks), and group communication technologies (GSS and e-mail) in terms of their impact on idea generation. In order for the two technologies to be comparable, the GSS was used in the study as a simple group communication and idea generation tool; none of the available decision support tools was utilized (see, [2] for reference to similar research). Group support systems have frequently been used for group communication and idea generation in synchronous meetings, meetings in which group members meet in one place at the same time. Although GSSs, in principal, can also be used to support asynchronous group work (in which group members may be temporally and spatially dispersed), research in dispersed groups has, however, been frequently conducted using either e-mail or computer conferencing. ‘Real-life’, organizational workgroups are considered as continuing, intact social systems engaged in projects that are likely to extend beyond temporal boundaries of a single meeting. With

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>E-mail</th>
<th>Group Support Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication richness</td>
<td>Lean medium of communication</td>
<td>Richer than e-mail but leaner than face-to-face communication</td>
</tr>
<tr>
<td>Communication structure</td>
<td>Supports one-many and one-one communication</td>
<td>Commonly support one-many communication only</td>
</tr>
<tr>
<td>Support for synchronous and asynchronous communication</td>
<td>Commonly used in temporally and spatially asynchronous mode</td>
<td>Although asynchronous use is possible, frequently used in a decision room setting (synchronous mode)</td>
</tr>
<tr>
<td>Interactivity</td>
<td>Not interactive</td>
<td>Highly interactive</td>
</tr>
<tr>
<td>Feedback</td>
<td>Feedback time-lagged and unpredictable in terms of time</td>
<td>Feedback fast but uncertain</td>
</tr>
<tr>
<td>Anonymity</td>
<td>Anonymity generally not supported</td>
<td>Support both identified and anonymous communication</td>
</tr>
<tr>
<td>Group memory</td>
<td>External group memory (communication stored on hard disk; hard copy may also be used)</td>
<td>Both external and internal group memory. Group communication automatically stored on hard disk and also available during the meeting</td>
</tr>
<tr>
<td>Parallel communication</td>
<td>Supports parallel communication</td>
<td>Support parallel communication</td>
</tr>
</tbody>
</table>
this in mind and because e-mail is the predominant medium of computer-mediated communication today [20], we chose to study e-mail for asynchronous and GSS for synchronous group communication. A comparison of e-mail and GSS characteristics of interest in the present study appears in Table 1 and serves as a reference for our discussion.

2. Task characteristics and choice of communication medium

The important role of communications in organizational productivity has long been recognized [13]. From the perspective of group productivity, the quality of communications has been viewed as the single most important factor in group decision making success or failure [19]. The influence of communication on group performance is, however, mediated by the type of task a group performs [18, 33]. For effective and efficient deliberation among group members, the communication medium must support information processing and exchange needs of the task on hand. Task needs, in turn, are affected by modality restrictions placed on the media; these include, for example, interactivity and feedback. Prior findings suggest that less restrictive media is generally associated with higher quality decisions in ill-structured and complex tasks but media makes no difference for simple brainstorming tasks [18].

2.1. Information richness and media choice

Research in task type and media choice has frequently used the concept of information ‘richness’ which suggests that the communication channel should match the equivocality or richness of the message being exchanged. Rich media provide multiple channels, can process many cues, and facilitate immediate feedback [7, 8, 21, 39]. Thus, media may be arrayed at some point on a rich-lean continuum; alternatives include face-to-face interaction, telephone conversation, written (addressed) documents, such as memos and letters, and written (unaddressed) documents, such as a bulletin [23]. A GSS supports interactivity and a fast feedback. If used in a decision room setting with group members able to see and verbally communicate as necessary, a GSS offers computer-augmented face-to-face communication and could, therefore, be considered at least as rich as face-to-face communication [6]. Electronic mail, on the other hand, lacks interactivity, temporal and spatial proximity of communicating individuals, and the ability to convey multiple cues. E-mail is, therefore, a ‘lean’ medium in comparison to GSS.

Results of empirical studies are, however, not unequivocal: some have found that e-mail, considered a lean medium, supported informationally rich communication [10, 25]. The information richness theory has also been challenged on conceptual and theoretical grounds. It has been argued that richness is not an inherent or invariant property of the medium; the interaction between the medium and the organizational context, along with group characteristics, provides a better understanding of the media choice hypotheses [12]. Nonetheless, our study uses some of the basic tenets to determine the appropriateness of e-mail and GSS for different task types.

2.2. Task characteristics

Groups may generate ideas, choose a preferred solution, negotiate conflicting views or interests, or engage in competition with an opponent or against some performance standard [28]. Further, ideas generated may relate to any one or more of the phases of a task, such as those in ‘normative decision sequence,’ as suggested by Poole [31]. These involve the definition and discussion of the problem or task; developing criteria for solving the problem; generating solutions; discussing and evaluating solutions; making a decision, and (optionally) developing an implementation plan. The communication technology that is more appropriate will depend on the collaborative activity and phase of the task performed. The focus of our study, for example, was the idea generation activity in the first two phases of the normative decision sequence. Also, we compared group performance on less- and more-structured tasks.

Prior research suggests that tasks that are ill-structured, ambiguous, or equivocal require rich media that can carry different types of messages [35]. A continuum of structured and unstructured tasks and their distinguishing features have been suggested in the literature [4, 15]. Structured tasks are routine with well-established methods for handling them; they
have a limited and well-defined solution space; they entail little use of human judgement. Also, structured tasks are simple, have a small and finite set of possible solutions, and do not require much cooperation from group members [3]. On the other hand, unstructured tasks require a great deal of decision maker insight, judgement, and evaluation and have no definite boundaries or well-understood procedures. Incompleteness, conflicting task objectives, inconsistent task inputs, and large solution space may also make the task more ill structured. Task ambiguity or equivocality, involving multiple and conflicting interpretations about a situation, is another feature of unstructured tasks [38]. Since most tasks fall in between the extremes, less- and more-structured categorization may be more appropriate, particularly when comparing two tasks.

Unstructured tasks require ambiguity reduction and need group members to establish a common ground for deliberation. Since uncertainty in unstructured tasks is caused by lack of information, need for information exchange among group members is higher in ill-structured tasks. Task unstructuredness increases group member interdependence thereby increasing the need for coordination. A relatively rich communication medium that facilitates frequent intragroup communication, interactivity, fast feedback, and ability to transmit social context cues, is needed for tasks requiring a high degree of coordination [29]. GSS, a richer group deliberation technology than e-mail, should, therefore, be more appropriate for less-structured tasks than e-mail. Having established boundaries and procedures, structured tasks have less information exchange and coordination needs. Also, the role of social context cues in structured tasks is minimal; such tasks could be carried out with a lean communication medium and media richness does not deliver any significant advantage.

2.3. Idea generation in synchronous and asynchronous modes

Of the two communication technologies used in our study, GSS are often used in a decision room setting in time- and place-synchronous mode. E-mail, on the other hand, is generally used by individuals who are temporally and spatially dispersed. How communication synchronism affects idea generation is one of our concerns. Not conducting a meeting at the same time and place eliminates social and verbal cues. A GSS used in a decision room setting with members in close visual and physical proximity (as in our study) retains most of the cues, as well as allows group members to coordinate tasks through non-textual feedback. This rich communication characteristic of synchronous GSS-supported meetings should contribute toward superior idea generation.

Temporal distance, a prominent e-mail feature, could affect idea generation in a number of ways. On the negative side, lack of interactivity and uncertain feedback may hinder coordination, so important in less-structured tasks. Idea generation in the problem definition phase, involving exchange of basic facts about the task on hand, may particularly suffer. However, the lack of time pressure in e-mail would enable group members to read other members’ contributions completely, thus aligning individual members’ task-related memory with that of the group. Such an information symmetry may have beneficial consequences in terms of ‘deeper’ thinking and inferential knowledge. An assimilation and synthesis of facts should also enable individual members to generate better quality ideas for the task phases beyond problem definition.

2.4. Basic versus inferential ideas

Human problem solving expertise involves using facts and figures as well as inference. Inferential knowledge is derived from stated facts using reasoning and implication. Problem solving requires reasoning and the use of inference chains and strategies to generate ‘deeper’ knowledge. Ideas necessary for defining a problem are different from those suggesting possible solutions or alternatives. Inferential, ‘deeper’ knowledge is generated by combining a group member’s task-related knowledge, training, and experience with the basic factual information. Ill-structured problems, in particular, must rely on human problem solvers to ‘make sense’ of the problem by recombining elements in new ways [40]. For individual group members to be effective in synthesizing basic information into possible solutions, they must be able to see and recall the pool of group-generated ideas. A communication tool that makes the group memory available to individual members as and when needed (both on- and off-line) should help. A GSS allows on-line
access to group contributions during meetings and an automatic external storage and hard copy are also available to GSS users after the meeting. Parallel communication in GSS results in a large number of ideas that individual members must process in a short period of time [17]. In brainstorming large or complex problems, the collection of group ideas could become very large and prevent individual group members from keeping track of the collective output. In addition, members must take time to type their own comments. This often leaves them with just enough time to react to the comments being continually added to the pool, but little time for reflection, thorough digestion, and thoughtfulness [29], essential for deeper knowledge discovery. E-mail users, on the other hand, can avail themselves of the benefit of external memory which allows them to overcome limits to human information processing [26]. They can review all prior contributions in the form of a hard copy or in electronic form. GSS-supported groups should, therefore, fair poorly on ideas requiring inferential or integrative thinking.

3. Research hypotheses

Categorization of ideas into basic and inferential ones provides a better and more accurate perspective on their quality than occurs when all ideas are lumped together. From the decision-making viewpoint, basic ideas are helpful in identifying, sorting, highlighting, and bringing to fore basic facts and figures related to the task on hand. Through this discovery process, task-related data, assumptions, and other essential task parameters become a part of the group memory and can thereafter be used as a common fact-base. Inferential ideas go one step further; they involve recombination and synthesis of basic ideas. Along with individual members’ task-related expertise, such ideas may suggest possible solutions or alternatives. The number and proportion of such ideas in the overall pool of ideas should be a good predictor of decision quality.

Parallel communication and interactivity provided by GSS encourages frequent and simultaneous intragroup communication resulting in a large number of unique ideas. Yet, the same features of a GSS used in a decision-room setting may also cause information overload and leave little time for group members to reflect, infer, or synthesize. Technologies which encourage asynchronous communication may thus fare better on inferential idea generation. Accordingly, the following set of technology-related hypotheses was formulated.

Hypothesis 1A: Total number of ideas generated by groups using GSS will be more than those generated by groups using e-mail.
Hypothesis 1B: The number of basic ideas generated by groups using GSS will be more than those generated by groups using e-mail.
Hypothesis 1C: The number of inferential ideas generated by groups using GSS will be less than those generated by groups using e-mail.
Hypothesis 1D: Groups using GSS will generate less inferential ideas as a percent of total ideas than groups using e-mail.

Less structured tasks are characterized by ambiguity about objectives and criteria, incomplete knowledge of variables affecting outcomes, unclear causal relationships, and unknown alternatives [32]. Consequently, there should be increased need for communication to coordinate work [11] and for information exchange to define the problem and establish its boundaries. The following set of task-related hypotheses was formulated.

Hypothesis 2A: Total number of ideas generated for the less structured task will be more than those generated for the more structured task.
Hypothesis 2B: The number of basic ideas generated for the less structured task will be more than those generated for the more structured task.
Hypothesis 2C: The number of inferential ideas generated for the less structured task will be more than those generated for the more structured task.

GSS are richer communication medium than e-mail. In our study, the GSS was used to support face-to-face meetings and thus many of the social context cues were retained. Structured tasks, having specified boundaries, criteria, and alternatives should be less susceptible to variations in media characteristics; once a group has identified the given task parameters, additional time available in asynchronous communication will not result in incremental gain in terms of basic ideas. Inferential ideas, however, should
continue to benefit from temporal distance provided by e-mail. The following set of hypotheses result:

Hypothesis 3A: Groups using GSS for less structured tasks will generate more total ideas than groups using e-mail for less structured tasks.

Hypothesis 3B: There will be no difference in the number of total ideas between groups using GSS and those using e-mail for more structured tasks.

Hypothesis 3C: Groups using e-mail for less structured tasks will generate higher ratio of inferential to total ideas than groups using GSS for less structured tasks.

Hypothesis 3D: Groups using e-mail for more structured tasks will generate higher ratio of inferential to total ideas than groups using GSS for more structured tasks.

4. Experimental methodology

An experiment was conducted to compare GSS and e-mail as tools for group communication and idea generation in more- and less-structured tasks. A $2 \times 2$ research design was used to manipulate technology and task factors.

4.1. Technologies

Two technologies, GSS and e-mail, were used in an experimental setting as a means of group idea exchange, pooling, storage, and retrieval. The GSS used was GroupSystems, a popular group decision support system. The electronic mail used was a menu-driven system. For the sake of comparability, GroupSystems was not in Windows but was the menu-driven DOS version. In addition, only the electronic brainstorming tool of GroupSystems was used; none of the decision support features of the package was utilized.

One objective of the research design was to differentiate the two technologies with synchronous versus asynchronous group communication support. GroupSystems was employed in a decision room setting with group members sitting face-to-face in close proximity. E-mail was used by group members to communicate with one another from different locations over a one week period. Since e-mail communication is not anonymous, GroupSystems was implemented to attach the sender’s name with each comment.

4.2. Tasks

The task factor was manipulated at two levels, less- and more-structured tasks. Two business case studies were used for this purpose [24]. The first case, a less structured task involving a competitive analysis of Citicorp’s situation, provided information on the company’s information systems, business acquisitions, and corporate strategy. It entailed an open-ended discussion of the bank’s competitive strategy, with the strengths and weaknesses of its policies.

The second and more structured task concerned selecting an operating system, either Windows or OS/2, based on its strengths and weaknesses and the given business needs. Information about the operating systems and corporate needs was made available. With a fairly well-established criteria for selection (such as 32- or 16-bit, multitasking capability, robustness, etc.) and known variables and causal relationships, this case was considered more structured.

The two tasks were about equal in size, based on average amount of time the groups needed to deliberate on each task and the number of possible idea categories (Appendix A). Both were from the course textbook. The participants had already covered the task-related material and hence were well-introduced to the necessary business strategy and analytical methodology.

4.3. Subjects

One hundred and forty-eight graduate students participated in the experiment. The subjects were all M.B.A. students enrolled in an information systems course at a US, accredited business school. It has been argued that M.B.A. students may serve as surrogates for managerial decision makers [32]. The subjects were randomly placed in 4–5 person groups, once for the GSS experiment and also later for the e-mail one. A total of 46 groups were formed.

4.4. Experimental procedures

In the GSS experiment, the subjects used networked computer terminals in a computer lab and group members sat in close proximity. They were instructed to use only the GSS for their communication. All the
GSS sessions began with a brief oral and 20 min hands-on introduction to GroupSystems, where subjects discussed a familiar topic in the news. The subjects were then given 50 min to brainstorm. This time duration was deemed appropriate based on a pilot experiment in which group idea generation activity virtually came to a halt on average in less than 45 min. Ideas generated through the brainstorming sessions were automatically saved on the hard drive and later printed out for content coding.

The groups using e-mail were all familiar with the system. They were given oral and written instructions and were asked to use e-mail for all of their task-related group communication. Again, based on experience from the pilot study, e-mail groups were given one week to complete the experiment. The ideas generated by the subjects were also sent to the experimenters through e-mail. These were stored on the hard drive and later used in content coding.

4.5. Dependent measures

This study used basic, inferential, and total ideas as dependent measures. Content coding, adapted from [27], was used to identify unique ideas generated by each group. First, a list of all task related elements derived from the two tasks was compiled. Two people then independently coded the hard copy output of GSS and e-mail idea generation sessions. Unique ideas belonging to basic and inferential categories were identified for each; most of the basic ideas contained task-related facts and information available in the case. Actual examples include the following:

- “Is the operating system user friendly?”
- “Does the system allow for multitasking?”
- “Citcorp used Quotron and transaction technology.”
- “Credit cards and POS systems were introduced.”

Inferential ideas, however, went beyond providing factual information about the case; they entailed synthesis of a number of basic ideas, used inference, gave opinions, or suggested alternatives. Actual examples include:

- “The lack of steep market entry barriers enabled these competitors to quickly emerge.”
- “This indicates that SOP’s (standard operating procedures) were not structured properly to allow for employees to effectively make lending decisions.”
- “Management must also consider the possibility that a more developed system will emerge in the future which may render the newly acquired operating system obsolete.”

Kendall’s coefficient of concordance \( W \), a useful measure particularly in studies of interjudge or inter-test reliability [34], was used to calculate agreement rate between the coders. \( W \) for basic ideas was 0.92 (\( p < 0.005 \)), for inferential ideas 0.85 (\( p < 0.005 \)), and for total ideas it was 0.87 (\( p < 0.005 \)).

5. Results

Statistical tests were conducted using factorial (two-way) as well as one-way analysis of variance (ANOVA). Since the GLM procedure is more appropriate to use with unbalanced designs [16], PROC GLM of the SAS system was used. Table 2 shows means and standard deviations of the study variables while Table 3 is a summary of the ANOVA results.

The first set of hypotheses examined the technology factor. Following the theory and previous findings, Hypotheses 1A and 1B suggested that GSS should perform better than e-mail in terms of total and basic ideas generated. The hypotheses were tested using separate ANOVAs and were both supported (\( p < 0.01 \) for both). Hypothesis 1C and 1D were concerned with inferential ideas. Due to temporal asynchronous nature of the e-mail communication, it was postulated that e-mail would yield better results than GSS on the count as well as proportion of inferential ideas in the total pool of ideas. Hypothesis 1C was not supported at a 5% level of significance (\( p = 0.06 \)). Hypothesis 1D was, however, confirmed (\( p < 0.01 \)) indicating that e-mail yielded higher proportion of inferential ideas than GSS. Overall, statistical results provided mixed support to the assertion that e-mail may be better-suited for in-depth problem analysis.

The second set of hypotheses looked at task structure as a determinant of productivity in idea genera-
tion. Due to greater information exchange need in less structured tasks, it was hypothesized that the less structured task would encourage a higher idea generation rate than the more structured task and would consequently result in groups generating more basic, inferential, and total ideas. Hypotheses 2A and 2B for total and basic ideas, respectively, were not supported. In effect, the results were significant \( (p < 0.01) \) for both but the relationship was in the direction opposite to that postulated indicating that groups generated more basic and total ideas in the structured task. Hypothesis 2C was supported \( (p < 0.01) \) confirming that less structured tasks yielded more inferential ideas than more structured tasks.

Focus of the current research was task-technology fit and the third set of hypotheses examined interaction between task structure and group communication technology. Based on prior empirical findings and on theoretical grounds (including the media richness theory), a set of four hypotheses was tested. Results were analyzed using a one-way ANOVA, between-groups design. Hypothesis 3A suggested that since GSS was a richer communication medium than e-mail, it would generate more total ideas in less structured tasks than e-mail. Although the association was in the hypothesized direction, it was not significant \( (p = 0.08) \). For more structured tasks, Hypothesis 3B proposed that technology would not make any significant difference in terms of total ideas. The analysis revealed a significant effect for technology \( (p < 0.01) \). The sample means for GSS groups were significantly higher than those for e-mail groups (Table 2); Hypothesis 3B was thus not supported. Since temporal delay would allow groups using e-mail to do better synthesis and deeper analysis, Hypotheses 3C and 3D proposed that the ratio of inferential to total ideas for the less- and more-structured tasks, respectively, would be higher in e-mail groups than in GSS groups. Interaction between technology and task for the ratio of inferential to total ideas was significant at a 5% level \( (p = 0.02) \). Both hypotheses were separately tested using one-way ANOVAs. Hypothesis 3C was supported \( (p < 0.01) \); hypothesis 3D was, however, not supported \( (p = 0.30) \).

### Table 2

<table>
<thead>
<tr>
<th>Dependent measures and task type</th>
<th>E-mail</th>
<th>GSS</th>
<th>Both technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic ideas</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less structured task</td>
<td>5.1 (1.2)</td>
<td>8.7 (2.0)</td>
<td>6.7 (2.4)</td>
</tr>
<tr>
<td>More structured task</td>
<td>10.7 (2.2)</td>
<td>15.4 (3.6)</td>
<td>12.9 (3.7)</td>
</tr>
<tr>
<td>Both tasks</td>
<td>8.0 (3.3)</td>
<td>12.5 (4.5)</td>
<td>10.1 (4.4)</td>
</tr>
<tr>
<td><strong>Inferential ideas</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less structured task</td>
<td>4.9 (1.9)</td>
<td>3.2 (1.7)</td>
<td>4.1 (2.0)</td>
</tr>
<tr>
<td>More structured task</td>
<td>1.2 (1.9)</td>
<td>0.8 (1.3)</td>
<td>1.0 (1.6)</td>
</tr>
<tr>
<td>Both tasks</td>
<td>2.9 (2.6)</td>
<td>1.8 (1.9)</td>
<td>2.4 (2.4)</td>
</tr>
<tr>
<td><strong>Total ideas</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less structured task</td>
<td>10.0 (2.3)</td>
<td>12.1 (2.7)</td>
<td>10.9 (2.6)</td>
</tr>
<tr>
<td>More structured task</td>
<td>11.92 (2.5)</td>
<td>16.1 (3.8)</td>
<td>13.9 (3.8)</td>
</tr>
<tr>
<td>Both tasks</td>
<td>11.0 (2.6)</td>
<td>14.4 (3.9)</td>
<td>12.5 (3.6)</td>
</tr>
<tr>
<td><strong>Inferential ideas as percent of total ideas</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less structured task</td>
<td>47.1 (12.6)</td>
<td>26.4 (12.3)</td>
<td>38.2 (16.1)</td>
</tr>
<tr>
<td>More structured task</td>
<td>8.9 (13.4)</td>
<td>4.4 (7.2)</td>
<td>6.7 (10.9)</td>
</tr>
<tr>
<td>Both tasks</td>
<td>27.3 (23.3)</td>
<td>13.8 (14.6)</td>
<td>21.1 (20.7)</td>
</tr>
<tr>
<td><strong>Number of experimental groups</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less structured task</td>
<td>12</td>
<td>9</td>
<td>21</td>
</tr>
<tr>
<td>More structured task</td>
<td>13</td>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>Both tasks</td>
<td>25</td>
<td>21</td>
<td>46</td>
</tr>
</tbody>
</table>
6. Discussion

With the increasing use of a variety of communication technologies - including electronic mail, computer conferencing, groupware, intranets, and the Internet - organizations must recognize the benefits as well as limitations of these technologies in terms of group communication effectiveness. Much research in brainstorming and group decision making has compared verbal, face-to-face meetings with those supported by electronic meeting systems. However, the question more relevant today is not whether to use electronic communication for workgroup collaboration but which technologies would better augment face-to-face deliberations.

Overall, the results indicate that in terms of total and basic ideas, GSS-supported groups performed better than those using e-mail. GSSs used in synchronous mode (in a decision room setting) provide interactive communication without a considerable loss of social context cues. E-mail communication is asynchronous in time and place. The lack of interactivity and absence of social and verbal cues may explain a reduced rate of intra-group communication and consequently a low rate of idea generation in groups using e-mail. GSS-supported groups outperformed e-mail supported ones, particularly on more-structured tasks.

However, e-mail-using groups generated significantly more inferential ideas. The role of temporally asynchronous communication in the depth of problem analysis, in general, may have implications for practice. Asynchronous communication allows, and perhaps encourages, greater use of human information processing resulting in deeper analysis which is crucial in the late stages of a group decision. Interactive and synchronous communication, on the other hand, may be more appropriate for initial stages of problem solving when emphasis is more on generating a large number of new ideas than on generating alternate solutions and strategies.

Although the current study was not designed to test the information richness and media choice theory, the results do not generally support its stipulations. These results are consistent with studies that have found little support for the theory [9]. We take the view that richness is not an invariant property of a communication medium. It may be more meaningful to view various technologies as bundles of attributes. While some of these attributes may be unique features of a particular technology (the absence of anonymity in e-mail, for example), others may be common among different technologies and may be added, removed, or recombined as needed in a particular decision making context.

7. Conclusions

This study compared two technologies GSS and e-mail used by work groups for communication in synchronous and asynchronous settings. Controlled experiments were conducted and group outcomes were measured in terms of basic and inferential ideas. Results indicate that GSS-supported groups generated significantly more total and basic ideas than groups supported by e-mail; the latter groups, however, generated a higher proportion of inferential ideas.

Clearly, these findings are relevant only for the particular technology features and decision environment used in the experiments. The current study was designed to compare the two technologies in comple-

| Table 3 | Results of two-way analysis of variance |
|-----------------|-----------------|------------------|
| Dependent measures | F-value | p |
| Basic ideas | | |
| Main effects | 35.06 | 0.00 |
| Task | 67.44 | 0.00 |
| Technology | 31.56 | 0.00 |
| Interaction | 0.53 | 0.47 |
| Inferential ideas | | |
| Main effects | 13.77 | 0.00 |
| Task | 33.93 | 0.00 |
| Technology | 3.74 | 0.06 |
| Interaction | 1.21 | 0.27 |
| Total ideas | | |
| Main effects | 9.21 | 0.00 |
| Task | 11.66 | 0.00 |
| Technology | 12.72 | 0.00 |
| Interaction | 1.61 | 0.21 |
| Inferential ideas as percent of total ideas | | |
| Main effects | 33.42 | 0.00 |
| Task | 75.00 | 0.00 |
| Technology | 13.20 | 0.00 |
| Interaction | 5.44 | 0.02 |
tely synchronous or asynchronous modes: the e-mail was asynchronous in both time and place while the GSS groups met in one room at the same time. Future research may want to study idea generation with other configurations of these and other group communication technologies. For example, replications could be performed in which GSS groups are distributed geographically, temporally, or both.

Appendix A

Task-related categories and elements

A.1 What happened to CitiCorp?

1. Technology policy and integration of technology: Decentralization of the IS function (Project Paradise); lack of integration of information technology with business functions; Citibank overlooked potential compatibility problems; had a disproportionally large IS program.

2. Competitive strategy/strategic management: Purchase of Quotron was a ‘strategic blunder’; impracticality of ‘Reward America’ POS system.

3. Customer-related issues: Customers were overcharged; escrow account accumulations were often incorrectly calculated; Citibank did not connect its ATMs with competitors’ networks.

4. Business processes and procedures: Citibank lacked a process to identify delinquent loans; Citibank lacked procedures to effectively evaluate risky loans.

5. Other task-related elements

A.2 OS/2 or Windows? Toronto Dominion Securities and Delta Airlines

1. Strengths and weaknesses of the operating system: Stability and robustness; multitasking capability; security features; 32-bit versus 16 bit (processing speed); comparative cost versus benefits of the operating system.

2. Compatibility with existing hardware and software: Compatibility with existing applications and hardware.

3. Business and organizational factors: Suitability for real-time data needs; acceptable response time; need for operating system diversification; compatibility with corporate culture; fit with company’s long-term, strategic plans.

4. Implementation factors: Ease of installation, data conversion, learning, and use; training issues; need for technology integration with distributed functions; cost and lead time for software and hardware upgrades.

5. Other task-related elements

References


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