VOTING IN GROUP SUPPORT SYSTEMS RESEARCH: LESSONS, CHALLENGES, AND OPPORTUNITIES

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Abstract

Voting tools have been incorporated into Group Support Systems (GSS) for a long time. However, theory and research on voting in GSS have been neglected. This paper reviews findings of GSS research on voting and examines the lessons learned on using voting tools in GSS. A framework is proposed to investigate voting in GSS. Additionally, directions for future research are discussed

Keywords: Group support systems, GSS, voting, group decision making

Introduction

Computerized voting, or electronic voting, or automated voting, has gained attention because of the recount incident in the 2000 U. S. Presidential Election. However, the attention paid to computerization and voting is concentrated on large-scale elections (Hoffman & Cranor, 2001; Mohen & Glidden, 2001; Phillips & von Spakovsky, 2001). Research on voting in GSS to support small groups in decision making is sparse.

George & Jessup (1997, p.505) criticize that GSS research usually maps the linear path of intelligence-design-choice in Simon's rational decision making model to brainstorming-idea analysis-voting activities. Nevertheless, even with this simple view of decision making processes, voting has never been the focus in GSS research. For instance, Barkhi (2000) suggests that research on group collaboration typically concentrates on idea generation tasks. It is undeniable that voting has not received enough emphasis in GSS research. While most GSS have incorporated voting tools, e.g., EIES 2 (Dufner et al., 1995), GroupSystems (Nunamaker et al., 1991), SAMM (Watson et al., 1988), and TERMS (Turoff et al., 1993), researchers seldom report how voting tools are used in their studies. In addition, published research rarely mentioned what kind of voting method (for example, plurality method, majority rule, or approval voting. See table 1 for a brief description for some voting methods.) was implemented in the systems.

In a comprehensive review of GSS studies (Fjermestad & Hiltz, 1999), thirty-five (35) of the 184 studies reviewed have reported their systems incorporate voting tools. However, only two (2) studies have included voting conditions into the experiment treatment: One study (Beauclair, 1989) compares the participation, interaction, and satisfaction between Face-to-Face (FtF) voting and Computer-Mediated-Communication (CMC) voting; the other study (Dufner et al., 1995) compares discussion quality, perceived media richness, and satisfaction for groups with or without a voting tool. There is only one study (Winniford, 1991) that reports group's behavior on voting, i.e., number of votes needed to reach consensus in FtF or CMC conditions. A summary of findings related to voting from these studies is listed in table 2.

Lessons about Using Voting Tools in GSS

Although voting has not been studied much in GSS research, it is by no means a trivial activity for decision making. Kraemer and King (1988, p. 131) has suggested that voting systems have a pronounced effect on group decision making, that is, voting systems allow groups to identify variance in issues rapidly and anonymous voting can reduce bias of dominant individuals. They also

suggest voting tools should not be not used to signify the end of the decision process but to discover the lack of consensus, and enable the group to explore the issue at a deeper level.

Nunamaker and his colleagues (1994) have reported lessons learned with the use of GroupSystems. Their conclusion on electronic voting is similar to these suggestions of Kraemer and King (1988). Use of voting tools can uncover patterns of consensus and encourages thinking. Anonymous voting can bring up issues that were buried during normal conversation. Electronic voting can make facilitate decisions that are too painful to make using traditional methods. They also warn that all criteria should be clearly established and defined before voting. They observed that groups using structured voting to focus discussion have higher decision quality than groups using traditional voting methods. However, their report does not illustrate the relationship among voting tools, voting procedures, and decision outcomes.

Table 1. Description of Some Commonly Used Voting Methods

Voting Methods	Description
Plurality Method	Everybody has one vote. Each one will endorse the most preferred alternative. The alternative has the most votes wins.
Majority Rule	Similar to the plurality method except that the winning alternative must have more than 50% of the total votes. If there is no alternative with more than half of the votes, people have to vote again until there is one alternative wins more than 50% of the votes.
Instant Run-off	This is a multi-round voting method. Everybody has one vote and endorses the most preferred alternative in the choice set just as in plurality method. Start with all alternatives. Eliminate the alternative with the least vote in each round. Repeat the process until there is only one winning alternative left.
Borda Count	Each alternative is given a count based on its ranking on each individual's preference. For *n* alternatives, the most often used way to assign count to an alternative is *n-1* points for each ballot it is ranked first, *n-2* for second, etc., down to 1 point for second to last, and 0 for last place. The alternative with the highest total count wins.
Average Rating	Voter has a fixed amount of scores that can be assigned to alternatives. Each alternative is given a total score by adding the scores by all voters. The alternatives with the highest total score wins.
Approval Voting	Every voter can cast one vote for any number of alternative(s) he/she approves. The alternative with the most votes is declared as the winner.

Table 2. Findings of Studies on Voting in GSS

Study	Task	Independent Variables	Dependent Variables	Findings Related to Voting
Beauclair, 1989	Type 2; Idea Generation Task	Brain Storming: FtF and GSS Voting: FtF and GSS	Participation Quality Interaction Satisfaction	No significant differences between FtF voting and GSS voting for all three dependent variables.
Dufner et al., 1995	Type 4; Decision Making Task	Task Support: Tools and No Tools Process Structure: Sequenced and Non-sequenced	Perceived Discussion Quality Perceived Media Richness Satisfaction	Groups with voting tools had higher perceived discussion quality, perceived media richness, and satisfaction than groups without tools.
Winniford, 1991	Type 4; Decision Making Task	Communication Mode: FtF and GSS Group Size: Large (10) and Small (5)	Decision Quality Number of Votes Decision Time Process Satisfaction	GSS groups needed more number of votes than FtF groups did. Large groups needed more number of votes than small groups did.

A Framework to Study Voting in GSS

It is clear that a framework is needed to study the effects of voting tools and voting procedures in GSS. Here we adopt the system view of input-process-output (Figure 1). Table 3 presents a listing of factors, identified from past research (e.g., Fjermestad &

Hiltz, 1999; Hollingshead & McGrath, 1995; Nunamaker et al., 1991; Pinsonneault & Kraemer, 1990), that should be considered when studying voting in GSS.

Input Factors in Voting in GSS

When studying voting in GSS, in addition to those factors that have been studied in GSS research such as task support, task characteristics, group characteristics, and process structure, factors about voting, i.e., voting procedure and voting methods should also be considered. The possibility of interactions among these input factors should also be examined.

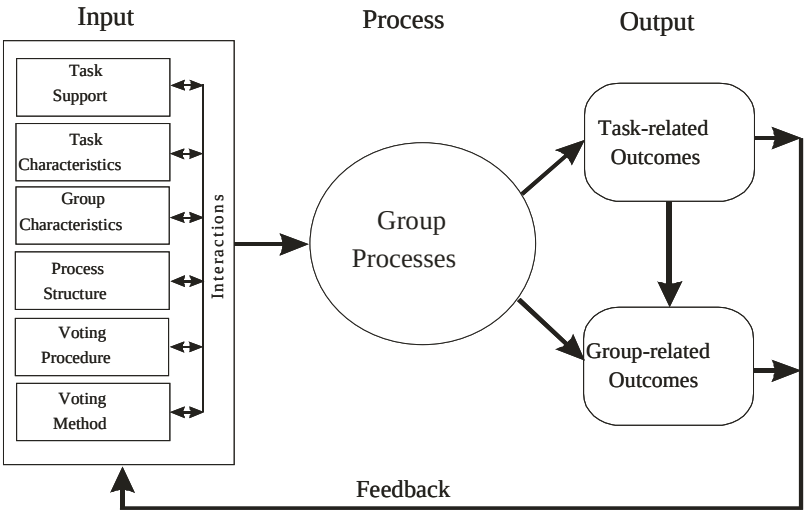

Figure 1. Framework for Studying Voting in GSS

Task Support
The most obvious benefits of having computerized voting tools in GSS are speed and accuracy. The results of the poll can be computed rapidly and displayed in a summary format. The computing power in GSS also enables the use of more complex voting methods. Voting tools can also support anonymity, which can reduce personal influence of dominate individuals.

Voting in a GSS can be changeable. Members can change their votes during discussion and the GSS will calculate then display the changed result immediately. In addition, a GSS can implement anonymous changeable votes by hiding the identities during polling sessions, and destroy the identities after the ends of polling sessions. The group can focus their attention by seeing the group is moving towards or away from consensus dynamically.

Task Characteristics
The optimal use of voting tools in GSS may depend on the type of task. For example, for a type 3 intellective task in McGrath's task circumplex (McGrath, 1984), it may be better to use voting tools to determine the decision criteria rather than to decide the final choice because the task has a correct answer based on decision criteria. On the other hand, it may be better to use voting tools to discover the viewpoints of participants in a type 5 cognitive-conflict task, which is to resolve conflicting viewpoints.

The complexity of the task will also affect how voting should be used. A complex task may require division of the task into sub-tasks. Later the results of these sub-tasks will be combined to form the final decision. There is no theory on how voting should be used for sub-tasks and the final decision.

Group Characteristics
We know very little about the effects of group characteristics on voting in GSS. One study (Winniford, 1991) has shown that group size does affect the use of voting in GSS. Large groups need more rounds of votes to reach decision than small groups do. However, there is no significant difference in decision time for large and small groups. In addition, the decision quality is higher for large groups. Since large groups usually suffer more group process losses (Nunamaker et al., 1991), it seems that the use of voting tools can reduce group process losses more effectively in large groups. Nevertheless, studies are needed to verify this hypothesis.

Because the use of voting tends to equalize members' influence on decision making, the members' behavior may affect by the use of voting tools according to their status in the group. The power relationship will also be affected after the group adopts voting tools. It should be interesting to explore the effects of this and other group characteristics on voting in GSS.

Voting Procedure
The time to invoke voting, length of the poll, stop conditions, and rules to interpret the result are all parts of the voting procedure. Variations in procedures may lead the group to emphasize certain aspects of the decision processes. The procedures may be designed to speed up consensus building, to achieve higher decision quality, or to prompt information exchange. Clearly, a contingency theory is needed to match the procedures with task support and task characteristics.

Table 3. Factors Related to Voting in GSS

Input Factors **Input Factors**	Task Support	speed accuracy anonymity changeable votes display format communication channel
	Task Characteristics	task type complexity degree of uncertainty
	Group Characteristics	culture reason for membership group size group composition group norm power relationships status relationships group cohesiveness
	Voting Procedure	time to invoke voting length of the poll stop conditions rules to interpret the result
	Voting Method	plurality method run-off method Borda count approval voting
	Process Structure	nominal group technique Delphi process
Process Factors	Pattern of communication	task related non-task related uninhibited
	Participation	amount of time on task amount of time off task
	Process gains/losses	More information Synergy Attenuation Blocking Attention Blocking Conformance Pressure …
	Depth of analysis	
	Exchange of information	shared information unique information
Output Factors	Task-related Outcomes	decision quality consensus time to reach decisions decision confidence satisfaction of the process
	Group-related Outcomes	group cohesiveness perceived equality of influence group norm power relationships

Process Structure

The use of voting should be designed to match the process structure. For example, a computerized Delphi process (Linstone & Turoff, 1975) could be matched with dynamic voting tools to enable the members to explore their difference and speed up consensus building without the need to wait until all opinions are collected and tallied as in the traditional Delphi process.

Voting Method

In a study of rank-order effects (Hollingshead, 1996), groups in which members had to rank order alternatives exchanged more information than groups in which members only needed to choose the best alternative. Voting methods, such as the plurality method, approval voting, or Borda count, require a person to either choose only one alternative, select several acceptable alternatives, or rank order all alternatives, yield different channel capacity and put different information processing loads onto the decision making group. The way the votes are tallied could also direct the group's attention to a certain area.

On the other hand, how the alternatives are compared and selected may also have an effect on individuals. For example, certain voting methods, such as approval voting and Borda count, allow an individual to advocate not only the most preferable alternative but also several other acceptable alternatives at the same time. This may reduce post decision regrets if the individual's most preferable alternative is not chosen. However, nothing has been done to examine the effect of voting methods on processes and outcomes in GSS.

Process Factors in Voting in GSS

It is not clear how the input factors of voting affect process factors such as the pattern of communication, participation, process gains/losses, and information exchange. This is attributed to the fact that not much research has been reported. How users adopt voting tools for their own use also complicate the study of the effect of voting on process factors. Although the designers of the GSS may have an intention for a certain design feature, the group may adapt and use the feature in its own way, rather than in the way GSS designers expected (DeSanctis et al., 1993). For example, the voting tools can level the influence of members of a group, but what will the dominant member do to counter this effect?

Output Factors in Voting in GSS

There are two kinds of outcomes: task-related outcomes and group-related outcomes. These outcomes will also affect future use of voting in GSS especially if the group uses more than one round of voting before reaching a conclusion. All these should be considered when studying voting in GSS.

Task-related Outcomes
From the report by Nunamaker and his coworkers (1994), the use of voting tools, coupled with the right procedure can improve decision quality. While most groups reduced the time to reach decisions using voting tools, some groups spent more time to reach decisions. Dufner and his colleagues (1995) have also reported that groups with voting tools had higher perceived discussion quality. However, there is no theory on how to match voting tools and procedures to achieve better task-related outcomes.

Group-related Outcomes
Research regarding the group-related outcomes when groups use voting tools is limited. There are many open research questions in the area. For instance, will group members be more satisfied with the group when they utilize voting tools? The satisfaction level possibly will be related to the member's status. An influential member may be less satisfied, because voting tools take away some of his/her power in the group. On the other hand, a less influential member may have a higher satisfaction level with the voting tools, as the voting tools remove the status difference.

Directions for Future Research

Several directions can be pursued for the study of voting in GSS. One approach is to build theories about the use of voting in GSS. For example, a theory that classifies voting methods based on their effects. These theories can adopt theories from other relevant fields such as Social Choice Theory (Arrow, 1951; Craven, 1992), Prospect Theory (Tversky & Kahneman, 1992), and Choice Shift (El-Shinnawy & Vinze, 1998; Friedkin, 1999).

Researcher can also construct contingency theory that matches the use of voting to different factors such as group size, task type, and process structure.

Another approach is the empirical approach. One possible direction is to build different voting tools into GSS to test the relationships among the input-process-output factors. Findings by this approach can be used to verify theories and to refine future GSS design. Researchers can also observe the changes of user's behavior to study the long-term effects of voting tools in GSS.

Conclusion

Voting in GSS has been seen as a straightforward task. However, the underlying relationship among the input-process-output connection of voting is complex, yet not fully understood. Many research questions are still waiting to be answered. Theories about voting in GSS should be built from fields such as Group Dynamics, Psychology, Political Science, and Economics. Next, experiments and field studies should be conducted to test these theories. Undoubtedly, this will be a rich area for future GSS research.

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