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# The Effects of Process and Content Facilitation Restrictiveness on GSS-Mediated Collaborative Learning [1]

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## Abstract

Group Support Systems (GSS) technology, extensively applied in decision-making contexts, is now seeing increased application in the educational sector. Previous work has suggested that GSS applications can have significant positive effects on both the process and the outcome of collaborative learning. This study extends this work to examine the effects of process (high/low) and content (high/low) facilitation restrictiveness on GSS-supported collaborative learning. Our results indicate that content facilitation restrictiveness has no significant bearing on student learning. Process facilitation restrictiveness, on the other hand, is more influential, with knowledge acquisition by students requiring a low restrictive environment.

Keywords: Collaborative Learning, Concept Mapping, Group Support Systems, Process Restrictiveness

## 1. Introduction

Group Support Systems (GSS), developed over the last two decades, were initially researched in laboratory-based experiments (e.g., Dickson et al., 1993; Nunamaker et al., 1991). More recently, fieldwork has examined how GSS function in real world environments involving businessmen, diplomats, the military and students, and how GSS fit between culture and technical functionality (e.g., Lyytinen et al., 1993; Watson and Ho, 1994; Vreede et al., 1999;

Davison and Vogel, 2000). Overall, results from prior GSS research have been very mixed and depend on the measures used and the nature of the task, environment, facilitation, etc. GSS were originally designed to support discussion and decision making in the commercial/business sector, but in the last few years there has been a surge of interest in their usage to support collaborative learning, e.g. (Alavi, 1994; Khalifa and Kwok, 1999; Leidner and Fuller, 1997; Leidner and Jarvenpaa, 1995; Schneiderman et al., 1995; Vogel et al., 2001). Previous empirical research indicated that GSS had significant positive effects on both the process and the outcome of collaborative learning. GSS were shown to encourage participation and to enhance knowledge acquisition (Khalifa and Kwok, 1999). GSS-supported learners also demonstrated higher levels of interest in the material and perceived that they achieved higher levels of learning than without GSS (Alavi, 1994; Leidner and Fuller, 1997). However, do such positive effects of GSS on learning occur naturally in all learning environments?

As facilitation has been shown to be an influential factor in overall GSS success, it should therefore be considered as a potential factor in GSS collaborative learning success. However, although previous studies reported positive effects of GSS on learning, they have not explained how such effects could be affected by facilitation. The potential effects of facilitation on the process and outcome of electronic meetings have been investigated extensively (Anson et al., 1995; Bostrom et al., 1993; Clawson et al., 1993; Dickson et al., 1993, 1996; George et al., 1992; Griffith et al., 1998; Herik and Vreede, 2000; Miranda and Bostrom, 1999; Niederman et al., 1996; Wheeler and Valacich, 1996), but not in the context of collaborative learning. According to the facilitation framework proposed by Bostrom et al. (1993), a facilitator can influence three general targets: meeting process, relationships and task outcomes. Structures (e.g. activities in an agenda) are applied primarily through the development of the meeting process. These structures influence the exploration and accomplishment of tasks (content) and relationships (feelings, emotions).

In return, the individual's and/or the group's relationships influence an individual's involvement in and contribution to the process, the quality of his/her contribution, and his/her commitment to and acceptance of the task outcomes (decision, plan, etc.). While most researchers agree on the importance of the facilitator's role, it is not clear how interventionist it should be. Some researchers (e.g. Albright and Post, 1993; Dennis et al., 1997), stress the active role of the facilitator in defining the agenda and enforcing it. Others (e.g. Dickson et al., 1993), on the other hand, call for more open and less restrictive facilitation. The basic problem with the discussion of how interventionist the facilitator's role should be is that there is no one universally correct answer (and it is not a binary decision in any case). Circumstances including the facilitator's level of expertise, prior group experience, group member expectations and group goals will vary, as will the facilitator's skill at intervening as an expert while still retaining credibility as a moderator. Some facilitators can do this marvelously while others fall apart.

Teachers who use GSS to support collaborative learning need specific guidelines for their new role as facilitators. Although some studies (e.g. Clawson et al., 1993) have discussed good practices, it is still not clear how much influence the facilitators should exert on the various facilitation dimensions. Teachers may be tempted to introduce too much structure in an attempt to focus the discussion. But, is restrictive process facilitation good or bad? Teachers may also feel obligated to give as much feedback as possible. But, does content facilitation really matter? These are important questions that remain to be answered.

Structure and feedback are both complex processes. For memorization or internalization of a manual task, a highly structured set of processes is generally quite effective; for creating broader insights and creative abilities, some structure and some exploration seem to work well. Knowing when, how much, and what type of feedback to provide is a wonderful expertise that we know when we see it, but find difficult to specify. Therefore in this research, we examine the effects of restrictiveness of content and process facilitation on collaborative learning. We do not attempt to fully explain the relationship between restrictiveness and learning, as this would be too ambitious to achieve in a single study. Instead, we compare two specific levels of restrictiveness in terms of their effects on the learning process and outcome. In addition to studying the main effects of restrictiveness for both process facilitation and content facilitation, we also examine possible interaction effects between the process and content dimensions.

The layout of this paper is as follows. Following the introduction, we present the background and theory underlying the study. Next we present the research methodology, describing the experimental design, procedure and measurement. We then discuss the results and their implications. In the conclusion, we summarize the contributions of this study and propose future research.

## 2. Background and Theory

### 2.1 Group Support Systems (GSS)

GSS have been used in the distance and face-to-face learning contexts for a number of years (e.g. Alavi, 1994; Dennis et al., 1997; Jarvenpaa and Leidner, 1998; Davison, 2001). To extend their application, this paper focuses on GSS-mediated face-to-face collaborative learning. GSS are lauded for their capacity to increase the opportunity for all members of a group to participate in discussions. Such discussions may be loosely structured, with participants free to create their own topics and submit any ideas they choose, tightly structured, with a pre-set agenda and substantial facilitator control of activities, or anywhere in between. In addition to providing various levels of structure, participants can communicate in parallel, choose to be identified or anonymous, and rely on the tool as a form of group memory. Through the use of these features, GSS can alleviate some of the negative consequences of group interactions, often referred to as process losses (Diehl and Stroebe, 1987; Steiner, 1972), such as production blocking, airtime fragmentation and evaluation apprehension. Since group members are able to focus on the discussion topic at hand and the comments of others, "the opportunity for process gains from synergy and learning should increase" (Nunamaker et al., 1991, p.1326). As a result, these positive effects of GSS on group process gains/losses enhance knowledge acquisition (Kwok and Khalifa, 1998). However, the positive impact of GSS is not certain since it depends on how group interaction is facilitated. Successful use of GSS requires a fundamental shift in the thinking paradigm of the facilitator (Dickson et al., 1993). Therefore, if facilitation appears to be a key distinguisher of success in GSS, it should continue to be in the collaborative learning task, even though intervention remains a controversial issue in GSS facilitation more generally.

The role of the facilitator in GSS has been shown in much previous research to be very important. As Bostrom et al. (1993 p.147) remark, "one cannot understand or manage GSS sessions without focusing on facilitation". Facilitation and structure are two key components of the application of GSS to learning, and a key element of facilitation is knowing how to introduce appropriate structures so as to help a group of learners to achieve a better outcome. However, in the learning context, there is little consensus on how this facilitation should be undertaken.

Previous work addressing the application of GSS tools to decision making (but not specifically collaborative learning) suggests that flexible modes of facilitation are preferred, with minimal use of prescriptive structures to guide the decision process. For example, Dickson et al. (1993) note that facilitation should be open and adaptive rather than restrictive. At the same time, Bostrom et al. (1993, p.153), in their analysis of the group dynamics literature (e.g. Miner, 1979; Van de Ven and Delbecq, 1974) note that "applying structured procedures produces better results than normal group interaction [while] more-structured interventions are generally found to be superior to less-structured or naturally occurring group interaction".

Despite these findings, experimental GSS research has found that, for example, groups may resist a unilateral imposition of a task structure, even though such 'supported' groups achieved more satisfaction and consensus than groups that were totally unsupported by technology (Dickson et al., 1993). Anson and Heminger (1991) found that flexible process facilitation resulted in significant improvements in participant perceptions of group processes and task outcomes. Much of the literature describes the role of the facilitator vis-à-vis meeting processes, with much less focus on meeting content. Traditionally facilitators have been encouraged not to become involved with content issues (e.g. Griffith et al., 1998; Miranda and Bostrom, 1999; Niederman et al., 1996), though in practice they may choose to do so, especially if the group requests this involvement (Davison and Vogel, 2000).

## 2.2 Theories of Collaborative Learning

Where the application of GSS to learning is concerned, two theories can be considered: collaborative learning theory and process restricted adaptive structuration theory. Collaborative learning theory (CLT) was developed from the work of such psychologists as Johnson and Johnson (1975) and Slavin (1987). The collaborative process involves learners working with one another on a problem-solving task and so participating in the discussion of a wider variety of ideas than they would if working alone. The result of this collaboration is that learners fine-tune the skills they require to synthesize knowledge (Bligh, 1972) while also thinking critically (Smith, 1977).

Leidner and Fuller (1997), in their examination of individual constructive learning, make the trenchant observation that much classroom time is occupied by the taking and subsequent regurgitating of notes, though there may in practice be little assimilation and comprehension of the information. Thus, there is an explicit need to increase not only the interest and motivation that students have in courses, but also their understanding of material, so that their performance can be enhanced. Leidner and Jarvenpaa (1993, p.50), in a study of electronic classroom cases, found that preferred contexts involved giving students the opportunity to interact with computers, while also working "independently of the instructor" so as to "encounter their own problems".

Related to CLT is Rogers' (1994) description of the right of individuals to have the freedom to learn what they want and in the manner of their choice. CLT suggests that learners enjoy communicating when they are given a non-threatening and liberated environment in which to participate (Leidner and Fuller, 1997). To make this happen, the right atmosphere has to be developed so that the facilitator can focus on providing the resources and opportunities for learning to take place, rather than merely managing and controlling learning. Considering the notion of CLT, Rogers (1994, p.103) used the following quotation from Tzu (1962) to explain how a facilitator can assume the best role of a “leader” in a learning environment:

> *A leader is best when people barely know that he exists,*
>
> *Not so good when people obey and acclaim him,*
>
> *Worst when they despise him.*

Rogers (1994) suggests that facilitation involves empowering learners to take control of and responsibility for their own efforts and achievements. The general role played by the facilitator involves meeting the needs of a group of learners, and assisting the group to achieve its goal. To develop the right atmosphere for knowledge acquisition, Bentley (1994, p.10) identified three key requirements to facilitate a group of learners, viz.:

1. *Provide opportunities for the learners to go in the direction that they want, or seem to want, to go in;*
2. *Constantly be aware of what is happening in the group;*
3. *Stay quiet and be attentive to the needs of the individual learners in the group.*

By fulfilling these requirements, the facilitator can serve the group and ensure that his/her energy is focused on group needs. To enable the proper facilitation of learning, Casey et al. (1992) suggest that the facilitator should find an appropriate strategy to stimulate learners' awareness in others by sharing their insights, and by offering learners the opportunity to "work it out for themselves".

In contrast to CLT is process restricted adaptive structuration theory (PRAST). Wheeler and Valacich (1996) explain how GSS and facilitation may act as appropriation mediators through the forces of guidance and restrictiveness to influence specific procedural dimensions of the social interaction process, and ultimately, decision outcomes. GSS can add process structure to the meeting through the use of a detailed agenda which the facilitator can employ to guide the group during the meeting (Dennis et al., 1997). In this way, it is possible to focus the group's attention on the task at hand in depth and reduce the chance for that focus to be diverted.

One of the major roles of the facilitator is to help learners find the most appropriate solution to a problem. PRAST suggests that the facilitator can make use of the structure inherent in the technology, e.g. the agenda, to support the group's social and cognitive processes, freeing the learners to focus their attention on more substantive issues (Schuman, 1996). By managing the sequencing and connectedness of the group activities, and by breaking the task into smaller and more manageable pieces, the facilitator can ease the group’s work and help learners to focus on and analyze task-related information more effectively (Albright and Post, 1993).

In addition to CLT and PRAST, researchers have considered the extent to which the facilitator should influence the content of a group's interaction. In general, facilitation involves empowering learners to take responsibility for their own efforts and achievements. The facilitator may choose to exert his/her influence to prevent the group from following non-constructive paths and protect the group from taking inappropriate actions (Griffith et al., 1998). Furthermore, the facilitator can choose to provide learners with flexible content feedback in response to their needs, and even take an active role in the meeting to provide expert advice, direction and counseling. In a content-facilitated learning environment, learners may perceive the content facilitator to be an expert, and hence believe that the facilitator is more likely to lead them to good decisions (cf. Griffith et al., 1998). However, the influence that enables facilitators to enhance a group’s process and outcome may also have a negative impact, with facilitators unintentionally violating their duty to be open-minded and unduly swaying the content of a group's interaction (Miranda and Bostrom, 1999; Niederman et al., 1996). In general, however, there is no agreement in the literature as to whether facilitators should provide more or less content structure to groups of learners.

Clearly there are differences between CLT and PRAST, which reflect the former's focus on learning contexts, and the latter's focus on decision making contexts. CLT proposes that group members should be able to tackle their problems in a flexibly-facilitated environment, while PRAST proposes that group members need to have their activities structured in order that they are able to focus on the task at hand more effectively. Where content structure is concerned, opinions vary widely, some taking the line that content should not be interfered with, others that the facilitator should provide expert guidance to aid the learners in their deliberations. Each of the theories has its proponents, and each seems plausible, if for different reasons. However, as far as we are aware, no previous research has attempted to investigate both content and process structure in a collaborative learning context in a single study. Based on the research model depicted in Figure 1, we investigate the individual and combined effects of process and content facilitation on the process and outcome of collaborative learning. We compare the learning effects of two levels of process and content restrictiveness (low vs. high). More specifically, we suggest that the facilitator should provide appropriate freedom (low restrictiveness on process and content structure) for students to interact and learn from each other in the collaborative-technology supported environment. Our hypotheses are:

Insert "Figure 1" about here

**H1:** There will be a significant inhibiting effect of process restrictiveness on the learning process and outcome.

**H2:** There will be a significant inhibiting effect of content restrictiveness on the learning process and outcome.

Our hypotheses imply that members of groups that are provided with a lower level of both process and content restrictiveness will achieve the best results in terms of the learning process and outcome as compared with members of other groups.

## 3. Research Methodology

To study the main and interaction effects of process facilitation restrictiveness and content facilitation restrictiveness on the learning process and outcome, we conducted a field experiment with 120 senior students enrolled in an electronic commerce course. Although participation was voluntary, 120 out of 140 students opted to participate, as the experiment was very similar to their natural learning setting and was perceived as a valuable learning experience. We used a between group 2X2 factorial design representing two levels of restrictiveness (low and high) on two facilitation dimensions (process and content). As illustrated in Figure 2, the 120 students (58 males, 62 females) were randomly assigned to 4 treatments: 1) low process restrictiveness and low content restrictiveness (LPR-LCR), 2) low process restrictiveness and high content restrictiveness (LPR-HCR), 3) high process restrictiveness and low content restrictiveness (HPR-LCR) and 4) high process restrictiveness and high content restrictiveness (HPR-HCR). Three groups of 10 students each were assigned to each treatment resulting in a total of 12 groups. The four treatments were balanced in age and sex, and the average age of the students participating in the experiment was 21.02 years (see Table 1).

Insert "Figure 2" about here

Insert "Table 1" about here

The task consisted of a GSS-based discussion of an e-commerce case. It involved the analysis of the e-business model of a local supermarket, where the students were supposed to apply a number of frameworks presented in previous lectures to identify the strengths and weaknesses of the presented business model and suggest improvements. To alleviate possible evaluation apprehension effects, the student contribution was anonymous. Within an anonymous GSS environment, the students are not intimidated and are less inhibited. Furthermore, anonymity encourages more objective evaluation and more error catching in problem analysis (Gallupe et al., 1991; Gallupe et al., 1992). The students were familiar with the task type, as they routinely used the GSS (GroupSystems for Windows) to discuss e-commerce cases, as part of the requirements of the course in which they were enrolled. The case discussion lasted one hour and was followed by an online survey designed to assess the students' perceptions of the quality of the discussion. After a short break, the students were given a concept-mapping test designed to assess the learning outcome of the meeting. The students were taught concept mapping techniques in two separate sessions of one hour each. To test the ability of the students to represent their knowledge with concept maps and to check for possible individual differences, a pre-treatment test was conducted. No significant individual differences were detected. Furthermore, the students did not report any difficulties in constructing concept maps. In this study, students were motivated by the opportunity to gain extra (group-based) participation marks for good performance.

### *Process Restrictiveness Treatment*

*The GSS' A*genda tool was used to set the level of structure restrictiveness. For the high restrictiveness group, the agenda included four activities: defining the task objectives (5 minutes); studying the facts of the case (10 minutes); discussing the methods for reaching the objectives (10 minutes); and lastly, generating the final list of recommendations (10 minutes). The time allocation for the different activities was based on a pilot run. The agenda was designed to restrict the discussion procedure to the pre-defined steps. The group discussion in this setting was expected to be more focused and within schedule. For the low restrictiveness group, the agenda consisted of only two activities: discussion (25 minutes) and drafting the list of recommendations (10 minutes). This setting provided students with substantial control over the discussion format.

### *Content Restrictiveness Treatment*

The instructor assumed the role of the facilitator. For the low restrictiveness group, the instructor acted as the system operator, starting and stopping the GSS sessions. The instructor was also responsible for executing the pre-set agenda without contributing his own comments to the discussion. Therefore, there was no instructor-student, content-specific interaction during the meeting. For the high restrictiveness group, the instructor was involved in the discussion. Using *GroupSystems' 'categorizer'*, the instructor sorted the content of the students' contributions into three different "buckets" labeled "relevant", "marginal" and "irrelevant". The instructor also gave feedback to the students in the form of comments (e.g., highlighting the importance of some ideas) or ideas (e.g., reminding the students of some important points that they missed).

To minimize the threats to the validity of the experimental setting across treatment groups, two independent raters were instructed to perform a manipulation check for the process and content restrictiveness treatments. Both raters were unaware of the experimental nature of the cases. About the process restrictiveness treatment, both of the raters agreed that all the treatment groups followed exactly their pre-set schedule to complete the experimental task. Regarding the content restrictiveness treatment, both of the raters agreed that the facilitators followed exactly the instructions to perform their tasks, and there was no systematic bias of facilitator's feedback across the 6 high content restrictiveness groups.

### *Measurement*

**Learning Process -** The learning process was assessed according to two dimensions: 1) the discussion intensity as measured by the total number of contributions (ideas and comments) made the students in the group and 2) the student's satisfaction with the quality of his/her own contributions, the quality of contributions of the other group members and the overall relevance of all contributions. While discussion intensity was based on the GSS log, the students' satisfaction was assessed with a post-treatment online survey, using the three-item instrument developed by Tyran (1997), involving the rating on a five point Likert-type scale (Strongly Agree = 1, Agree = 2, Neutral = 3, Disagree = 4, Strongly Disagree = 5) of the following statements:

1. I was typically satisfied with the quality of my own contributions during the electronic discussion.
2. I was typically satisfied with the quality of contributions made by the members of the class during the electronic discussions.
3. The contributions (ideas/comments) were relevant to the objective of the discussion.

**Learning Outcome** - The learning outcome was assessed by the complexity and level of integration of the knowledge acquired by the students, using concept-mapping techniques (Novak and Gowin, 1984). Concept mapping is a well-accepted method for monitoring student comprehension (Heeren and Kommers, 1992; Khalifa, 1998). A concept map is a graphical representation of meaningful relationships between concepts. It is a semantic network describing a cognitive structure: ideas and their interrelationships. Concept maps can be used to describe a person's structural knowledge (Jonassen, 1992). With concept maps, learners can develop a schematic representation of their mental model regarding a particular knowledge domain through the externalization and visualization of concepts and meaningful relationships between them. With concept mapping, each key concept can be represented as a hierarchy of concepts moving from a higher level of abstraction (general concept) to lower and lower levels (specific concepts, examples, objects and events).

As illustrated in Figure 3, a concept map consists of a graph where the nodes represent the concepts at different levels of abstraction and the direct-links and cross-links represent meaningful relationships between these concepts. Direct-links relate concepts that belong to the same hierarchy. They are useful for defining general concepts in terms of more specific concepts. Cross-links, on the other hand, relate concepts from different hierarchies. They are useful for representing meaningful relationships between different concepts.

Insert "Figure 3" about here

During the experiment, the students were given a list of concepts and were asked to create as many meaningful relationships as possible between the given concepts. All relationships had to be labeled with propositions indicating their respective meanings. The proposed relationships could be of two types: direct links and cross-links. The knowledge acquired by the students, as represented by the proposed relationships, can be characterized by its complexity and its level of integration (interconnectedness). As a measure of knowledge complexity, we used the total number of valid direct-links. To measure knowledge integration, on the other hand, we used the total number of valid cross-links (see Appendix A for an example of a concept map of a student, and the measurement of direct- and cross-links). The validity of these measures was demonstrated in Khalifa & Kwok (1999). The assessment of the proposed links was done by two “experts” (knowledgeable academics) independently. The scores given by the two assessors were averaged.

## 4. Results and Discussion

In this study, analysis of variance procedures were employed to test the hypotheses. ANOVA was used to detect the main effect and the interaction effect of content and process restrictiveness on the dependent variables, while T-tests were conducted to find significant differences between treatment conditions. The results were mixed and did not fully support our hypotheses. The only significant effect was that of process facilitation on the complexity of the knowledge acquired by the students, providing some support for hypothesis 1. The following is a detailed description of the results.

Given that the students' contributions (ideas/comments) were made anonymously and so were not identifiable, the number of contributions of particular students could not be counted. Therefore the number of contributions (i.e. the average number of contributions per student) had to be measured at the 'group' level, in which we divided the total number of contributions of a treatment group by its total number of students, which was 10 for each treatment group. Although the number of contributions was measured at the group level rather than the individual level and hence could not be compared statistically, it still provided some indications. As illustrated in Table 2, the average number of contributions per student was higher for high content-restrictiveness groups (19.31) than for low content-restrictiveness groups (14.73), which is not consistent with hypothesis 2 and higher for low process-restrictiveness groups (18.02) than for high process-restrictiveness groups (16.02), which is consistent with hypothesis 1. The effect of content restrictiveness (a difference of 4.58), however, seems to be more important than that of process restrictiveness (a difference of 2).

Insert "Table 2" about here

The number of contributions, although indicative of the intensity of the discussion, does not necessarily reflect the discussion quality. To test for the main and interaction effects of content restrictiveness and process restrictiveness on the perceived quality of the discussion, we averaged the responses for the three items (used to measure the perceived discussion quality) and conducted an ANOVA. As illustrated in Table 3, we did not find any significant main or interaction effects.

Insert "Table 3" about here

While the results concerning the effects on the learning process were inconclusive, those regarding the learning outcome provided some support for our hypotheses. As illustrated in Table 4, the average score for knowledge complexity is the highest for the LPR-HCR group (5.46) and the lowest for the HPR-HCR group (4.08). Different results are found for knowledge integration with an average score of 3.13 (highest) for the LPR-LCR group and 2.61 (lowest) for the LPR-HCR group. In addition, the *t*-test results (see Tables 5 and 6) indicated that students in the LPR-LCR group (*p*=0.023) and the LPR-HCR group (*p*=0.012) had significantly higher scores in knowledge complexity than students in the HPR-HCR group.

Insert "Table 4" About here

Insert "Table 5" About here

Insert "Table 6" About here

As shown in Table 7, the ANOVA results indicate a significant main effect of process facilitation restrictiveness on the complexity of the knowledge acquired by the students, providing some evidence for hypothesis 1. The other main and interaction effects, however, were not found to be significant.

Insert "Table 7" about here

In addition to the ANOVA tests, *t*-tests were conducted to find significant differences between the LPR (LPR-LCR & LPR-HCR) and HPR (HPR-LCR & HPR-HCR) groups (see Table 8). There is a clear indication that low process restrictiveness leads to the acquisition of more complex knowledge structures by learners.

Insert "Table 8" about here

Overall, the results did not support hypothesis 2, showing no evidence of the content facilitation restrictiveness having any effects on the process and outcome of collaborative learning. There were also no interaction effects between content facilitation restrictiveness and process facilitation restrictiveness. The level of feedback provided to the students during the case discussion did not have any effect on the perceived discussion quality or the complexity and integration of the knowledge acquired by the students. Content facilitation did not hurt, but did not help either. Such results should, however, be treated with caution, as the effects of content facilitation could vary depending on the timeliness and quality of the facilitator’s contributions. As for hypothesis 1, the results were mixed. The restrictiveness of process facilitation did not have any significant effects on the perceived quality of the discussion, but did hinder knowledge acquisition. Less restrictive process facilitation led to the acquisition of more complex knowledge structures. This provides support for researchers who favor more flexible process facilitation. Furthermore, the optimal level of facilitation restrictiveness might be different for collaborative learning than for group decision-making. This research also raises important issues about the evolving role of the instructor in electronically-supported environments. Does the instructor's job involve more structuring of the process than provision of content expertise? This question remains to be carefully examined.

## 5. Conclusion

In this study, we have examined some of the potential effects of two variables that a facilitator can influence in a GSS-supported learning environment: meeting process (process structure) and task outcome (content structure). In studying these potential effects, we looked for possible answers in collaborative learning theory, process restricted adaptive structuration theory and a number of empirical studies. We found conflicting suggestions, some supporting more restrictive environments and others calling for more flexible facilitation. Believing that the arguments for flexibility are more consistent with the objectives and spirit of collaborative learning, we hypothesized that the restrictiveness of content and process facilitation would hinder both the process and outcome of learning. Our empirical results did not support all of our hypotheses. We found no significant effects of content facilitation restrictiveness, implying the limited influence of the facilitator's feedback. As for process facilitation restrictiveness, we found some support for our hypothesis, with restrictiveness hindering significantly the learning outcome: knowledge acquisition.

The results provide some preliminary support for flexible facilitation in GSS-supported collaborative learning. The generalization of these results, however, should be treated with caution for a number of reasons. Firstly, the subjects of the field experiment had sufficient prior knowledge in the learning task to engage in a meaningful discussion without relying heavily on the instructor's feedback. This explains perhaps the insignificant effects of content facilitation in this particular case. Secondly, the complexity of the learning task could interfere with the effects of process facilitation, a factor that was not examined in this study. Future research may investigate task complexity more thoroughly.

Despite its limitations, this paper supports the notion of collaborative learning theory (CLT), which emphasizes students' "freedom to learn". However, what can we now say about the appropriate degree of freedom that the students should be given for the best learning outcome? In future research, it would be valuable to contrast **low** process restrictiveness (LPR) with **zero** process restrictiveness (ZPR). This would enable researchers to establish whether a minimal degree of process structure is valuable, or if learners can be left entirely to their own devices. Furthermore, in the case of ZPR, it might be that content support would exert a greater influence on knowledge acquisition.

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## Legends of Figures and Tables

Figure 1: Research Model

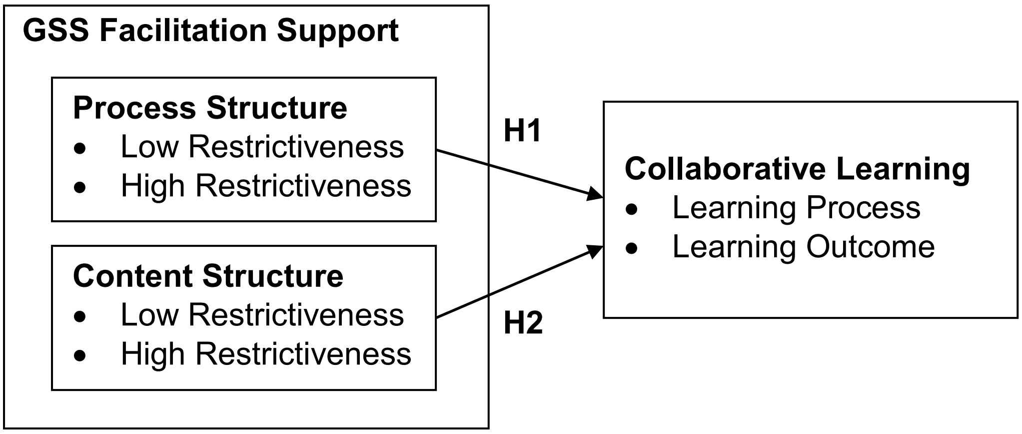


Figure 2. Experimental Design

|  |  |  |  |
|---|---|---|---|
| **Process Facilitation Restrictiveness** | High | HPR-LCR | HPR-HCR |
|  | Low | LPR-LCR | LPR-HCR |
|  |  | Low | High |
|  |  | **Content Facilitation Restrictiveness** |  |

Figure 3: A concept map

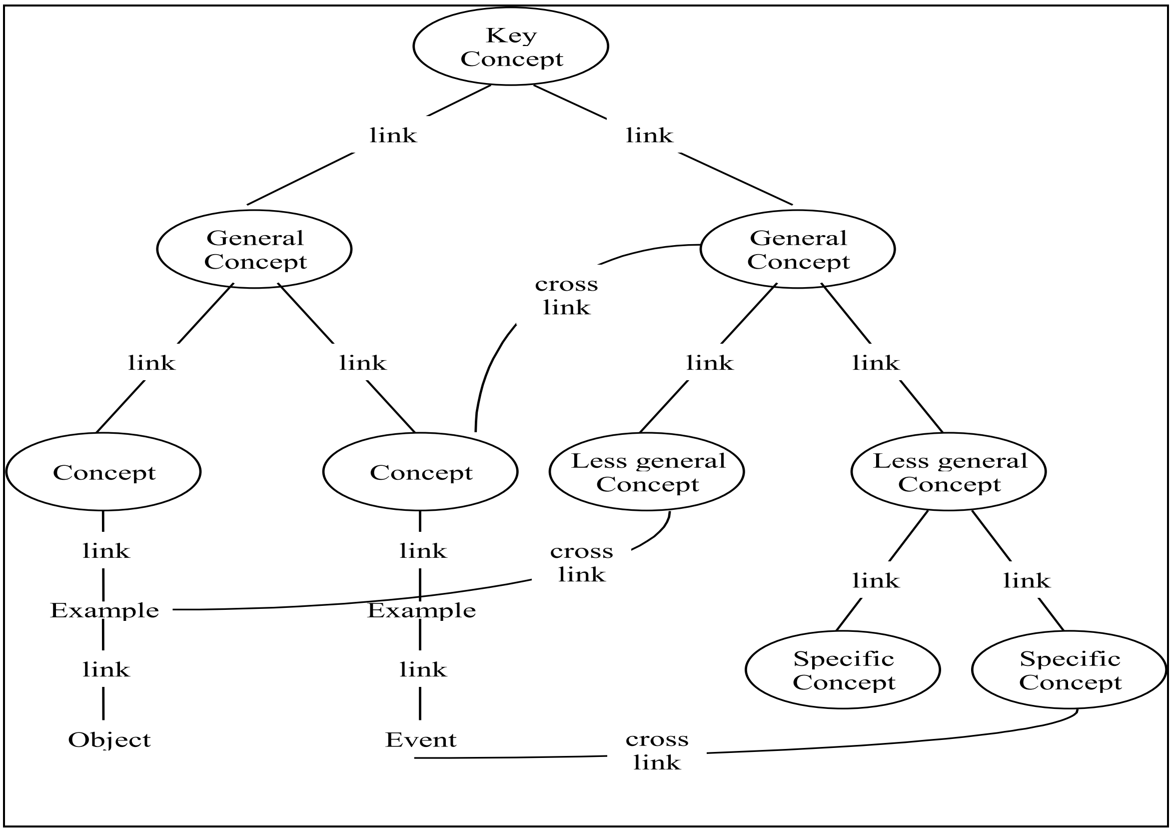


Table 1. Age and Sex Distribution of the Students

| | LPR-LCR | LPR-HCR | HPR-LCR | HPR-HCR |
|---|---|---|---|---|
| Average Age / (S.D.) | 21.10 / 1.07 | 20.93 / 0.90 | 21.09 / 0.98 | 20.97 / 0.87 |
| Male | 14 | 15 | 15 | 14 |
| Female | 16 | 15 | 15 | 16 |

Table 2. Overall Average Number of Contributions

| | LCR | HCR | Overall |
|---|---|---|---|
| LPR | 17.79 | 18.26 | 18.02 |
| HPR | 11.67 | 20.37 | 16.02 |
| Overall | 14.73 | 19.31 | |

Table 3. ANOVA Results for Quality of Contributions

| | DF | F ratio | Sig. of F |
|---|---|---|---|
| Content | 1 | 2.37 | 0.126 |
| Process | 1 | 1.65 | 0.201 |
| Content x Process | 1 | 0.285 | 0.594 |

Table 4. Means (S.D.) Results for Knowledge Complexity and Integration

| | Mean Scores / (S.D.) | | | |
|---|---|---|---|---|
| Dependent Variable | LPR-LCR | LPR-HCR | HPR-LCR | HPR-HCR |
| Knowledge Complexity | 5.10 (1.97) | 5.46 (2.47) | 4.61 (2.12) | 4.08 (1.94) |
| Knowledge Integration | 3.13 (1.42) | 2.61 (1.40) | 2.85 (1.23) | 2.77 (1.55) |

Table 5. Results of *t*-tests for Knowledge Complexity Between LPR-LCR and HPR-HCR Treatment Conditions

| Dependent Variable | **LPR-LCR**<br>Mean (S.D.) | **HPR-HCR**<br>Mean (S.D.) | t-value | p-value |
|---|---|---|---|---|
| Knowledge Complexity | 5.10 (1.97) | 4.08 (1.94) | 2.317 | 0.023 |

Table 6. Results of *t*-tests for Knowledge Complexity Between LPR-HCR and HPR-HCR Treatment Conditions

| Dependent Variable | **LPR-HCR**<br>Mean (S.D.) | **HPR-HCR**<br>Mean (S.D.) | t-value | p-value |
|---|---|---|---|---|
| Knowledge Complexity | 5.46 (2.47) | 4.08 (1.94) | 2.574 | 0.012 |

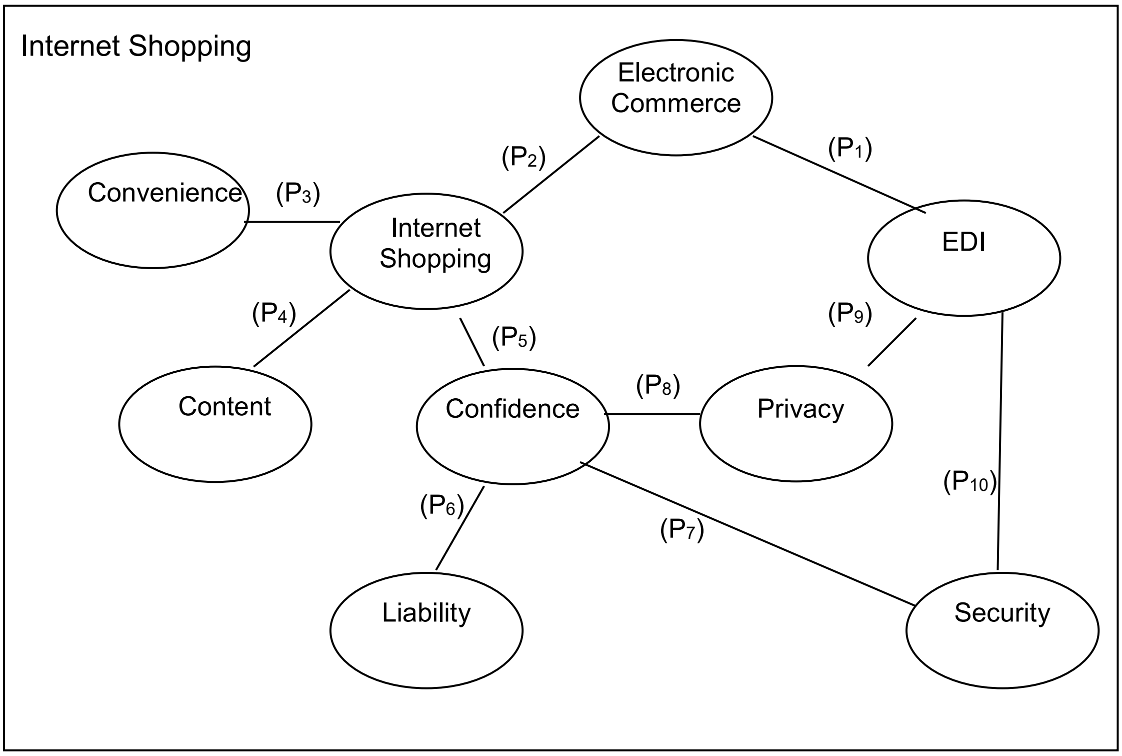
Table 7. ANOVA Results for Knowledge Complexity and Integration

| Dependent Variable | DF | F ratio | Sig. of F |
|---|---|---|---|
| Knowledge Complexity | | | |
| Content | 1 | 0.054 | 0.817 |
| Process | 1 | 6.817 | 0.010 |
| Content x Process | 1 | 1.524 | 0.219 |
| Knowledge Integration | | | |
| Content | 1 | 1.546 | 0.216 |
| Process | 1 | 0.059 | 0.808 |
| Content x Process | 1 | 0.838 | 0.362 |

Table 8. Results of *t*-tests for Knowledge Complexity Between LPR and HPR Treatment Conditions

| Dependent Variable | **LPR**<br>Mean (S.D.) | **HPR**<br>Mean (S.D.) | t-value | p-value |
|---|---|---|---|---|
| Knowledge Complexity | 5.25 (2.18) | 4.32 (2.03) | 2.616 | 0.010 |

Appendix A. An Example of Concept Map Drawn by a Student



| Proposition of the concept map | Description of the proposition |
|---|---|
| **P$_1$** | EDI is the first type of EC. |
| **P$_2$** | Internet shopping is a business-to-customer EC. |
| **P$_3$** | Convenience is one of the three critical success factors of Internet shopping. |
| **P$_4$** | Content is one of the three critical success factors of Internet shopping. |
| **P$_5$** | Confidence is one of the three critical success factors of Internet shopping. |
| **P$_6$** | Confidence relates to liability. |
| **P$_7$** | Confidence relates to security issue. |
| **P$_8$** | Confidence relates to privacy |
| **P$_9$** | Privacy is one of most important factors, hindering the development of EDI |
| **P$_{10}$** | Security is another important factor, hindering the development of EDI |

Remark: There are eight direct-links and two cross-links in this example.