Improving Student Processing and Assimilation of Conceptual Information: GSS-Supported Collaborative Learning vs. Individual Constructive Learning

Dorothy E. Leidner and Mark A. Fuller
Baylor University

Abstract: A great deal of time in the traditional classroom environment is spent gathering information (taking notes) rather than processing the information and assimilating the information. The traditional learning model goes from the gathering to recall stage without regard for whether the information is actually comprehended (processed and assimilated). This paper examines whether technology enabled collaborative learning involving case analyses is superior to individual constructive learning involving individual case analyses where the goal of both methods is to increase student interest in the course, increase student understanding of the material, and enhance student performance. The study found that students working collaboratively in either small or large groups were more interested in the material and perceived themselves to learn more than students that worked individually but that students that worked individually outperformed students that collaborated in small or large groups before working individually.

1. Introduction

IT instructors have recently begun an introspective process of examining the most effective ways of implementing information technology into their own profession of helping others to learn. This has coincided with a general trend toward improving business education which has largely failed to keep pace with the technological advances in the business world. The focus takes two angles: exposing students to more technology to better prepare them for their role as managers and to use technology to enable new or more effective methods of learning. Initial research has focused on the latter angle, examining how information technology alters traditional teaching and learning [Leidner and Jarvenpaa, 1], how IT can improve certain teaching methods such as the CASE method [Hashim, Rathnam, and Whinston, 2] and such learning methods as collaborative learning [Alavi, 3; Brandt and Briggs, 4], and how IT can create new learning environments [Knolls and Jarvenpaa, 5; Leidner and Jarvenpaa, 6]. These studies are part of a nascent body of IT in higher education research the cornerstone of which is the belief that the traditional method of teaching and learning has failed to sufficiently engage students in the learning process and that IT can be used to either compensate for inefficiencies inherent in the typical traditional environment or to enable the effective application of alternative methods of learning [Leidner and Jarvenpaa, 6].

Alternative learning models criticize the traditional method on the grounds that it transmits knowledge to students with little concern for whether the students understand or assimilate the material into their cognitive schema. Alternative models of learning emphasize enabling students to construct the knowledge themselves (constructivism), enabling students to collaborate with other students to expose them to a wider variety of ideas (collaborativism), enabling students to process information in a manner that best suits their cognitive style (cognitive information processing theory), and providing a realistic learning context (social learning theory) [for a summary of all of these models, see Leidner and Jarvenpaa, 6]. However, of these alternative models, there is not yet empirical evidence to suggest which of the methods leads to the most effective learning and given what context. In fact, a weakness of much of the learning research is that it compares a single alternative learning method to the traditional method and usually finds that the alternative method leads to greater satisfaction and learning. However, little is known about when to apply a particular alternative model.

In terms of the additional factor of information technology, the most one can conclude is that the technology is an enabler of the effective application of the models of learning. For example, research by Alavi [3] found that technology enabled collaborative learning was superior to non-technology enabled collaborative learning [Alavi, 3]. While some results (e.g. increased participation) may be related to other factors (such as class size), technology may still serve a role by changing the
perceived size of a class without decreasing the true physical size. Given the constraints facing most universities, technology may be the most feasible and economical way to enable new and creative applications of learning methods.

While alternative methods have been compared to the traditional methods and IT enabled methods have been compared to the same method without IT, there also exists a need to compare alternative methods with and without IT support to begin to understand when to apply the alternative methods of learning and what the appropriate role of the technology is. This paper will examine whether technology-enabled collaborative learning involving case analyses is superior to individual constructive learning involving individual case analyses where the goal of both methods is to increase student interest in the course, increase student understanding of the material, and enhance student performance. The research question is thus: will the use of collaborative learning via electronic case discussions prior to individual case analyses lead to higher perceived learning, higher interest, and greater performance than constructive learning via individual case analyses in the absence of group interaction.

This paper is organized as follows: section 2 presents the theory and hypotheses, section 3 presents the research design and methodology; section 4 presents the results, and section 5 discusses the implications of the results, the limitations of the study, and the conclusions.

2. Theory and Hypotheses

This section reviews relevant findings in the areas of GDSS research and learning research and develops hypotheses for study.

2.1 Theory

Various learning outcomes have been addressed in learning research. Among the most common are student interest in learning (in that interest is viewed as a requisite to motivation), student performance, self-efficacy (student belief in their ability to learn which is believed to affect motivation), and student perceived learning [Martookie & Webster, 7; Hidi, 8; Baldwin & Kar, 9]. Consistent with Alavi [3], we are going to examine student interest and student perceived learning. As with Alavi, our concept of “student interest” is limited to the student’s short term interest in the task, as opposed to a “vested interest” where learners believe the task increases their long term success. Perceived learning, our second dependent variable, is also interesting in at it may not completely correlate with actual learning. Despite this, perceived learning is still of interest to educators (and thus this research) because the greater the perceived learning, the more likely it is that students will be satisfied with their learning experience, and the better the educator performance evaluation will be. Lastly, we are going to examine student performance. Performance is considered distinct from perceived learning because past research has indicated that subjective and self-measures of performance are often very inconsistent with objective measures of performance [Connolly, Jessup, and Valacich, 10; Le Blanc and Kozar, 11].

This study will thus compare individual learning interest, perceived learning, and performance for students engaged in individual constructive learning versus students that first engaged in technology-enabled collaborative learning in the form of small (5 students) or large group (the entire class, in this case 40 students) anonymous electronic discussions. Collaborative learning, for the purposes of this study, is broadly defined as peer to peer interaction designed to promote individual learning.

2.2 Hypotheses

Prior research in the area of learning suggests that the traditional method whereby an instructor speaks until interrupted by a student question is inadequate in effectively fostering student interest and active processing of the material. Learning in such an environment can become a rote process involving information acquisition and recall particularly when conceptual (the acquisition of general concepts) rather then procedural learning (the acquisition of methods and techniques for problem solving) is involved. The cognitive information processing theory of learning suggests that learning methods must foster active assimilation and processing of the information in order for meaningful learning to occur. There are various teaching techniques available to foster such learning. One technique is the use of case analyses whereby the burden rests with the student to apply relevant information to the situation being discussed [Hashim, Rathnam, and Whinston, 2]. The goal of the cases are to enable students to process instructional inputs and assimilate the course material. Such cases can be analyzed individually or in the context of a group.

The collaborative model of learning further suggests that feedback is crucial to effective processing as is the exchange of diverse ideas. Collaborative groups working together to discuss a case thus are suggested to expose students to a greater amount and diversity of ideas which should improve learning, to provide immediate peer feedback for the ideas which should increase performance, and to make the students an active part of the learning process which should increase interest in learning. The value of collaborative learning should not be that a group of students outperforms a single student on a given learning task such as a case analysis, but that each student learns more and performs better after having interacted
with a group than if they had worked entirely alone. The increased exposure to different points of view and quick feedback for ideas should increase student performance on subsequent individual tasks closely tied to the group task. We thus hypothesize that:

**Hypothesis 1a:** Students who participate in collaborative learning via small group anonymous electronic discussions prior to writing individual case analyses will be more interested in the material than students engaged in individual case analyses without prior group discussion.

**Hypothesis 1b:** Students who participate in collaborative learning via small group anonymous electronic discussions prior to writing individual case analyses will perceive greater learning than students engaged in individual case analyses without prior group discussion.

**Hypothesis 1c:** Students who participate in collaborative learning via small group anonymous electronic discussions prior to writing individual case analyses will perform better than students engaged in individual case analyses without prior group discussion.

**Hypothesis 2a:** Students who participate in collaborative learning via large group anonymous electronic discussions prior to writing individual case analyses will perceive greater learning than students engaged in individual case analyses without prior group discussion.

**Hypothesis 2b:** Students who participate in collaborative learning via large group anonymous electronic discussions prior to writing individual case analyses will perform better than students engaged in individual case analyses without prior group discussion.

**Hypothesis 2c:** Students who participate in collaborative learning via large group anonymous electronic discussions prior to writing individual case analyses will perform better than students engaged in individual case analyses without prior group discussion.

Hypothesis 3a: Students engaged in collaborative learning via small electronic case discussions before writing individual analyses will be more interested in course material than students engaged in collaborative learning via large group electronic case discussions before writing individual analyses.

Hypothesis 3b: Students engaged in collaborative learning via small electronic case discussions before writing individual analyses will perceive greater learning than students engaged in collaborative learning via large group electronic case discussions before writing individual analyses.

An advantage to increasing group size, though, is that as size increases, potential information exchange increases. Particularly in small groups that are homogeneous (as is often the case in university undergraduate classrooms where the majority of students have similar socioeconomic and cultural backgrounds [Hermstein and Murray, 13, Chapter 1]), the members reach agreement very quickly on the major issues and spend little time discussing diverse ideas [DeSanctis and Gallupe, 14]. The tendency is to agree with each other rather than challenge each other to offer different perspectives on issues presented to the group. We thus hypothesize that:

**Hypothesis 3c:** Students engaged in collaborative learning via large electronic case discussions before writing individual analyses will perform better than students engaged in collaborative learning via small group electronic case discussions before writing individual analyses.

3. Research Design and Methodology

This section presents the research design and methodology.

3.1 Context and Subjects

The context of the study is an undergraduate required Management Information Systems course for all business majors at a large private university in the Southwestern United States. The course is highly conceptual and managerial focused rather than technology or software focused. The students are mostly juniors with an occasional sophomore or senior majoring in business who have completed a basic computer literacy course but with little other computer experience. The average age of the students taking the course each semester hovers around 20, with very few students having had any prior full-time work experience. The course is currently being taught in a newly remodeled classroom facility which incorporates networked laptop computers available...
at each student station.

Two sections of the course taught during the Spring semester, 1995 by the same professor comprise the sample for the current study. Each section had 40 students. The average age of the students was 20, with one student in each of the sections having had prior full-time work experience. Approximately half of each section was female and half male students. There was one African-American student in each section, two Hispanic students in each section, and two Asian-American students in one of the sections. The remaining students were Anglo-Americans. The instructor had taught the course several times before, but had never before used electronic case discussions as part of the course requirements.

3.2 Task and Equipment

The goal of each task was the completion of a written analysis of a scenario (referred to as "cases") that described a situation dealing with some issue relating to the course material. Each Tuesday a lecture was given and each Thursday (excluding test days and computer lab days), the students engaged in a case analyses that related to the material covered on Tuesday and completed on Thursday. The tasks were developed by the instructor so that they very clearly related to material that had been discussed prior to the analysis. There were seven such analyses during the course. In general, the cases required the students to either generalize from the specifics of a case to major points addressed in previous course material or to take generalized points from the lecture material and then adapt it to the specifics of a case (the cases thus fostered either deductive or inductive reasoning). Forty-five minutes of the Thursday class were devoted to the case analysis. In the electronic discussion conditions, the students had 30 minutes to discuss the case in the electronic groups and then 15 minutes to write their individual analysis. They were allowed to consult their class notes, to write down comments from other students during the electronic discussion, and to look at the output of the electronic discussion on the screen while writing their individual analyses. For the individual learning condition, the students were given the 45 minutes to think on their own, look at their notes, and write their analyses. The average of the the cases completed before each major test in the course counted for 10% of the test grade. This was to provide motivation to the students to take the cases seriously (and also to enforce attendance). The first case analysis was treated as a pilot with both sections engaging in an electronic discussion for the primary purpose of technology familiarization and getting them familiar with the grading. These cases were not counted toward their final grade but were substituted in the case of an absence on a later case.

The remaining six were comprised of two individual analyses with no prior group discussion, two individual analyses preceded by a small group electronic discussion using Group Systems Software, and two individual analyses preceded by a large group electronic discussion also using Group Systems Software. The order of the analyses was different for the two sections of the course included in the study. A random assignment resulted in the following sequence of conditions across the two sections of the course (sg=small group, lg=large group, ind=individual):

<table>
<thead>
<tr>
<th>Case</th>
<th>Section 1</th>
<th>Section 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>sg</td>
<td>ind</td>
</tr>
<tr>
<td>2</td>
<td>sg</td>
<td>lg</td>
</tr>
<tr>
<td>3</td>
<td>lg</td>
<td>ind</td>
</tr>
<tr>
<td>4</td>
<td>ind</td>
<td>sg</td>
</tr>
<tr>
<td>5</td>
<td>sg</td>
<td>ind</td>
</tr>
<tr>
<td>6</td>
<td>lg</td>
<td>ind</td>
</tr>
</tbody>
</table>

While it would have been advantageous from an experimental design perspective to use cases of an equivalent nature and completely randomize their order, our interest was in the long term learning (semester long) in a real educational context. For this reason, true randomization of the cases (given that they were directly tied to book and lecture material) was inappropriate.

3.3 Design

The research design is a 3 by 1 factorial design intended to provide a means for comparing large GSS supported collaborative learning, small GSS supported collaborative learning, and individual learning. We chose to vary conditions within two sections of a class taught by the same instructor rather than varying the conditions across three sections of the course. This within subjects design was done to control for differences in the group (class) composition between courses offered at different times of the day. In addition, given the fact that this technology was new, University authorities were anxious to see it used, and the course instructors wanted to gain as much experience with this technology as possible with as many students as possible. This particular design poses some limitations which will be mentioned in the discussion section.

3.4 Environment

This study was undertaken using GroupSystems, a GSS developed at the University of Arizona. GroupSystems is a PC-DOS based GSS which runs on several Personal Computers (PC's) networked over Novell Netware. The collaborative technology classroom used in this study contains 43 PCs embedded in a semi-circular classroom configuration. No front screen or group oriented audio visual support were turned on for this study.

Group Outliner, the GroupSystems program used, is an interactive discussion tool which allows users to read comments from the other group members and add
comments of their own. When a comment is added, the participant will see his comment added to the group list. One file is accessed by all members of a group simultaneously. In the large group condition for this research, all 40 members of the class accessed the same discussion area. In the small group condition, the class of 40 was broken up into eight 5-person teams. Each of these teams had their own discussion area within the software that was not accessible by other non-team members in the class. In all conditions, the anonymity setting was enabled (comments were not signed) and comment numbering was turned on (a unique number was assigned to every comment submitted in the discussion).

3.5 Procedure

A survey immediately following the completion of the written analyses was designed to assess perceived interest and perceived learning. The items used to assess perceived learning and interest had been pretested in a survey given to a group of 200 students to assess their perceived interest and learning in an electronic classroom at the university. Because the students would be required to complete a survey after each class in which a case analysis was conducted, the survey had to be kept short to avoid students becoming bothered by having to complete it each time. The survey was as follows:

This questionnaire is designed to get your perceptions of today’s case analysis. Please be honest and accurate in your responses. Please rate the extent to which you agree with the following questions:

Today’s case analysis:
- helped make the class more interesting
- helped me better understand the material
- helped me learn during class
- helped make the class more enjoyable
- helped me more attentive during class
- helped me acquire knowledge during class

The students responded on a 5-point Likert scale ranging from "to no extent" to "to a great extent.

The factor analysis on the pretest sample indicated two factors (an interest factor comprised of the items asking about interest, enjoyment, and attention; a learning factor comprised of the items asking about understanding, learning, and acquiring knowledge) both with reliabilities over .8.

To measure performance, two graduate students both of whom had taken sufficient IS and strategy coursework to qualify them for grading the cases were used as graders. The graders were given detailed instructions for the expectations of each case. They then independently assessed each analysis and compared their evaluations. The graders were unaware of the conditions or of the experimental nature of the cases. Where there was an initial disagreement in the evaluations, the coders were required to discuss the reasons for the given grade and agree on the final grade. To ensure a common frame of reference, the graders were asked to express student performance evaluations on a four-point scale that included "Below Average" (1), "Average" (2), "Above Average" (3), and "Outstanding" (4). Grading was non-competitive in the sense that there were no limits on the amount of students who could receive a particular grade. The class after the completion of each analysis, the instructor discussed the case and the points that were brought out in the responses. The instructor read and displayed the best two or three cases. This was intended to help the students on subsequent case analysis. It also provided a means of reinforcing student learning and completing a cycle that began with a lecture.

4. Results

This section presents the statistical results of the study and the results of hypothesis testing.

4.1 Normality, linearity, and homoscedasticity

Table 1 presents the descriptive statistics for each variable. In general, the case analyses regardless of condition seemed very satisfying to the students. Normality is the assumption that each variable is normally distributed. The Shapiro-Wilks test was used to assess normality. The data were significantly skewed and had significant kurtosis. The data were thus transformed into the logarithm before conducting the multivariate statistical analysis.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>StDev</th>
<th>Max</th>
<th>Min</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Interest</td>
<td>4.24</td>
<td>0.7</td>
<td>5</td>
<td>1</td>
<td>374</td>
</tr>
<tr>
<td>Perceived Learning</td>
<td>3.98</td>
<td>0.75</td>
<td>5</td>
<td>1</td>
<td>374</td>
</tr>
<tr>
<td>Performance</td>
<td>3.16</td>
<td>0.88</td>
<td>4</td>
<td>1</td>
<td>374</td>
</tr>
<tr>
<td>Individual Interest</td>
<td>4.01</td>
<td>0.77</td>
<td>5</td>
<td>1</td>
<td>115</td>
</tr>
<tr>
<td>Perceived Learning</td>
<td>3.85</td>
<td>0.83</td>
<td>5</td>
<td>1</td>
<td>115</td>
</tr>
<tr>
<td>Performance</td>
<td>3.36</td>
<td>0.83</td>
<td>4</td>
<td>1</td>
<td>115</td>
</tr>
<tr>
<td>Small Group Interest</td>
<td>4.1</td>
<td>0.63</td>
<td>5</td>
<td>2.33</td>
<td>124</td>
</tr>
<tr>
<td>Perceived Learning</td>
<td>4.09</td>
<td>0.67</td>
<td>5</td>
<td>2</td>
<td>124</td>
</tr>
<tr>
<td>Performance</td>
<td>3</td>
<td>0.93</td>
<td>4</td>
<td>1</td>
<td>124</td>
</tr>
<tr>
<td>Large Group Interest</td>
<td>4.31</td>
<td>0.64</td>
<td>5</td>
<td>2.33</td>
<td>100</td>
</tr>
<tr>
<td>Perceived Learning</td>
<td>3.98</td>
<td>0.75</td>
<td>5</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>Performance</td>
<td>3.08</td>
<td>0.86</td>
<td>4</td>
<td>1</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 1: Descriptive Statistics
4.2 Construct validity & reliability

Construct validity addresses the question of whether the measures are adequate surrogates for the true constructs describing the event or merely artifacts of the methodology. Factor analysis was conducted on the survey questions. For an item to be considered in the composition of a variable, it had to have a loading of at least .7 on the factor, with no loading exceeding .5 on another factor, had to conform to a priori assignments, and had to add to the variable’s reliability.

The mean of the items in each scale was used to combine the items into a variable score. Cronbach’s alpha was used to assess the inter-item reliability of the final, multi-item scales. Both factors exhibited high reliability (.87 and .90 for interest in learning and perceived learning, respectively). The factor loadings and the reliability scores for each variable are provided in Table 2.

**Factor Cronbach’s Alpha Loading Items**

<table>
<thead>
<tr>
<th>Items</th>
<th>Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>helped make the class more interesting .798</td>
<td></td>
</tr>
<tr>
<td>helped make the class more enjoyable .987</td>
<td></td>
</tr>
<tr>
<td>helped make me more attentive during class .715</td>
<td></td>
</tr>
<tr>
<td>Factor: Perceived Interest</td>
<td>.8095</td>
</tr>
<tr>
<td>helped me better understand the material .915</td>
<td></td>
</tr>
<tr>
<td>helped me learn during class .884</td>
<td></td>
</tr>
<tr>
<td>helped me acquire knowledge during class .813</td>
<td></td>
</tr>
<tr>
<td>Factor: Perceived Learning</td>
<td>.90</td>
</tr>
</tbody>
</table>

Table 2: Factor Analysis and Reliability

4.3 Inter-Coder Reliability

In total, 374 cases were graded by each coder. There were 82 differences in initial grades given, indicating an initial agreement of 292/374 =78%. While the reliability is less than desirable, all of the differences in initial grades were of only 1 point on the four point scale and were resolved by the coders discussing the reason for the assigned grade and agreeing on the final grade.

4.4 Statistical Analysis Performed

MANOVAs were run to test for an overall condition effect. The results were significant for both the perceived interest and learning variables (F=3.8, p<.001) and for the performance variable (F=7.359, p<.000). Because the survey was anonymous, and hence the responses of the subjects were not tracked over time, repeated measures MANOVA was not possible; rather, the effect of time had to be controlled for within MANOVA. MANOVA was run to test for a significant time effect. The result was also significant for the perceived interest and learning variables (F=3.9, p<.000) and for the performance variable (F=9.149, p<.000). Further analysis using regression revealed that interest decreased over time (B=-.087) but not to a significant degree (T=-1.6, p>.1053), perceived learning increased over time (B=0.9) but not significantly (T=1.6, p>.1085), and performance increased significantly over time (B=-1.377, T=5.346, p<.000). MANOVA was run to test for a significant difference in the two sections of the course. There was no significant section effect (F=0.465, p>.495).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Individual VS Small Group</th>
<th>Small Group VS Large Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest</td>
<td>Individual Mean</td>
<td>4.01</td>
</tr>
<tr>
<td>Perceived Learning</td>
<td>3.85</td>
<td>4.09</td>
</tr>
<tr>
<td>Performance</td>
<td>3.36</td>
<td>3.00</td>
</tr>
</tbody>
</table>

Table 3: MANOVA's

T-Tests were conducted comparing the perceived interest, perceived learning, and performance variables across the three conditions. Table 4 summarizes the t-test results.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Individual VS Small Group</th>
<th>Small Group VS Large Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest</td>
<td>Individual Mean</td>
<td>4.01</td>
</tr>
<tr>
<td>Perceived Learning</td>
<td>3.85</td>
<td>3.88</td>
</tr>
<tr>
<td>Performance</td>
<td>3.36</td>
<td>3.08</td>
</tr>
</tbody>
</table>

Table 4: T-Tests Across Conditions
4.5 Hypotheses Testing

Hypothesis 1 predicted that students after having discussed a scenario related to the course material would be (1a) more interested in the material, (1b) perceive themselves to learn more, and (1c) perform better than students that worked individually. Hypothesis 1a was supported by the data (T=-4.28, p<.000)–students working first in small electronic groups reported greater interest in the material than students that worked alone; Hypothesis 1b was also supported by the data (T=-2.42, p<.02)–students that worked first in small electronic groups perceived themselves to learn more than students that worked alone, but Hypothesis 1c is rejected: in fact, students working alone significantly outperformed students that had the opportunity to discuss the case electronically within a small group (T=3.18, p<.000).

Hypothesis 2 predicted that students after having discussed a scenario related to the course material in a large group would (2a) be more interested in the material, (2b) perceive themselves to learn more, and (2c) perform better than students that worked individually. Hypothesis 2a is supported by the data (T=-3.13, p<.000)–students that worked initially in large groups reported greater interest than when they worked alone; Hypothesis 2b is not supported by the data (T=-1.21, p=.23)–there was no perceived difference in learning when the students worked first in large groups versus when they worked entirely alone; Hypothesis 2c is not supported by the data; in fact, students working independently consistently outperformed students that first discussed the case with a large group of students (T=2.63, p<.01).

Hypothesis 3 predicted that students working in small groups would (3a) be more interested in the material and (3b) would perceive themselves to learn more than students working in a large group before conducting their individual written analyses more but that (3c) students working first in large groups would perform better than students that worked first in small groups before completing their individual analysis. None of these hypotheses were accepted. There was no significant difference in the interest (T=1.07, p>.29), perceived learning (T=1.12, p>.26), or performance (T=-.69, p>.49) variables for students that discussed scenarios in small groups versus students that discussed the scenarios in large groups before analyzing the scenarios themselves.

5.1 Discussion

The findings of this study suggest that collaborative learning via electronic case discussions contributes significantly to student interest in the material of a course. Both small and large group electronic discussions were associated with greater interest in course material than when students did not participate in the collaborative learning. We purposely chose a course that had previously suffered from indifference and found that the students responded very positively to the incorporation of the technology. There may be several reasons why the students rated their interest higher following collaborative learning via case analyses versus individual constructive learning via case analysis. One explanation is simply that, as the collaborative model suggests, people enjoy communicating when they are given a non-threatening environment within which to participate. The GSS technology provided such a non-threatening environment. Collaborative research generally compares collaborative learning to traditional learning and finds that collaborative learning creates greater interest. Our findings suggest that collaborative learning also exceeds individual constructive learning in terms of creating interest. Another explanation is that the students were able to use the technology during the group discussion conditions but not during the individual analyses and that the technology itself created interest. The students were allowed to write their analysis using a word processing software during all conditions, but the fact that special communication’s software was used during the electronic discussion likely contributed a fascination with the technology. In addition to the fascination effect, the students may perceive value to using technology in and of itself, particularly for a course they associate with computers. Thus, there may in fact be a symbollic value to the technology in the minds of the students [Feldman and March, 15]–they felt privileged when getting to use the technology and hence were more interested. The study did continue throughout the semester with only a slight and nonsignificant drop in interest. Should the students be using a similar learning method in other classes, perhaps the interest would drop rapidly.

Although enjoying the technology-enabled collaborative learning more than the individual learning condition, the students performed better when they worked alone than after they worked in either small or large collaborative groups. This is a major finding that has not surfaced in past research which has looked at group performance rather than individual performance after group involvement. There are several explanations for this. One explanation is that the same amount of time was given for each case analyses regardless of condition, yet the electronic discussions took more time than when the
Another finding of the study is that the students perceived their learning to be higher after they first interacted in a small group discussion than when they worked entirely alone but that their performance was significantly higher when they worked entirely alone. Hence, consistent with Connolly, Jessup, and Valacich [10], self-ratings of effectiveness were in direct opposition to the measure of actual output. This poses a dilemma for the instructor contemplating incorporating the technology: if the students are more interested and think they are learning more when using the technology but are actually performing worse, should they incorporate the technology method or not? Interestingly, the students did not perceive greater learning after having interacted with a large group than when they conducted the analysis entirely alone. A possible explanation for this finding is that the large group discussions, while interesting, seemed to pose an information overload problem. There were times when gasps of frustration could be heard following the appearance of a sudden onslaught of messages on the screen. It was also hard for the students to follow the logical flow of arguments because if they were responding to a particular point addressed on the screen, by the time they finished typing and sending their response, there were 5 or 10 other responses to something else in between their response and the intended comment to which they were responding.

Another finding of the study is that the students neither perceived greater interest, learning, nor performed better when they engaged in small group electronic discussion versus large group discussions. The statistical findings in this case are contradictory to the written comments students were asked to make on the final survey completed for the course. The written comments largely indicated that students preferred smaller groups—with the entire class of 40 there were too many comments and students complained of offensive or digressive comments from other students. With large groups, there was a higher perceived anonymity (particularly after a case discussion the topic of which focused on conditions of anonymity in the context of using OSS) resulting in a greater amount of digression and sometimes offensive comments. Students also showed annoyance in the large discussions when no one responded to their comments but merely inputted comments with no relation to previous statements (they indicated their annoyance by inserting a comment asking for feedback in a rather forceful way: “WILL SOMEONE PLEASE RESPOND TO THE COMMENT ON LINE 5???? I'M WAITING.”).

At the same time, the groups of five seemed too small for two reasons. First, the university population used in this study is fairly homogeneous. As suggested by Dennis, Nunamaker, and Vogel [16], drawing subjects from a narrowly defined population may lead to the formation of groups whose members have the same basic knowledge domains and hence with a group size that is logically smaller than the physical size. In addition, in the small group condition, students were annoyed when there were not enough comments and sometimes students requested, but were denied, the capability to switch into another group. Thus, our observations of the discussions in progress and student written comments led us to conclude fairly early that five was in fact too small but that forty was too large for groups. Neither size was ideal. After the six cases that were part of the study were completed, the instructor for the remainder of the course used group sizes of 20 which seemed manageable and the most pleasing to the students.

Several observations were made during the course of the study that are worth mentioning. The pilot study used a case at the end of the chapter in the textbook and in fact the intention was to use the two-page cases and questions at the end of each chapter covered as the basis of the case discussions and analyses. While the pilot was characterized mostly by technological familiarization and the accompanying problems when forty individuals used a

---

1 For example, one day the professor was walking around and stopped behind a male student. In full view of the professor and apparently as a joke, he typed in a comment that GDSS should not be used in the business world because then there will be no more need for pretty young secretaries to take notes. This received a barrage of furious responses.
software for the first time, it was noticed that the
discussion itself was less interesting to the students than
the technology. Part of the reason was that there was little
controversy or even debatable material in the case. The
questions asked in the text were so broad as to leave the
students dumbfounded regarding what to discuss. Another
problem was the case length. Despite being told to read
the case in advance of coming to class, few of the students
actually did and they had to spend ten minutes just reading
through the case. The instructor thus custom created the
six used in the study. The cases each involved a topic of a
conceptual nature (thus, where there was no clear right or
wrong answer), of a slightly controversial or at least
debatable nature, and tied very closely to the material
covered in class. The cases were short enough to be read
in several minutes before the discussions began, required
no extra outside of class work for the students, and
included very specific questions to be addressed in the
analysis.

An observation made by the instructor of the two
sections used in the study was that the nature of her own
style of teaching in the traditional environment was altered:
knowing that the majority of the Thursday class
would be occupied by a case closely tied to the material
covered on Tuesday, the instructor felt pressure to cover
the material. Whereas in previous semesters, the
professor’s style involved asking a lot of questions, after
postponing some of the cases for having failed to cover
required material, the instructor began lecturing without
questions for the sake of sticking to the syllabus and
completing the material before the associated case. Thus,
the professor became even more traditional in style during
traditional teaching. Yet during the collaborative sessions
and individual constructive sessions, the role of the
professor was one of observer and technology supervisor.
Future research can examine various roles of the professor
during electronic discussions. For example, the professor
could act as a confederate injecting critical comments
aimed at encouraging students to evaluate the ideas of
others rather than just accepting them. Connolly, Jessup,
and Valacich [10] found that the simple injection of a
stream of either critical or supportive comments had
substantial effects on group performance. The professor
can take a more active role in the discussion than was
designated in our study.

5.2 Limitations

Several limitations to the current study warrant
mention. One limitation is the fact that we varied the
conditions within the sections rather than across the
sections. This is both an advantage and disadvantage. The
advantage is that the same group of students are exposed to
different learning contexts, thus reducing effects due to
differences in the group composition across the different
classes used in the study. As noted, interest declined
slightly over time but no significantly. It is possible, and
feel likely, that had one section done individual case
analyses the entire time, one done small group discussions
the entire time, and one group large discussions the entire
time, that their interest level would have declined
significantly over time. Several times on the surveys
following individual case analysis, students wrote
comments stating that they would have preferred using the
electronic discussion technology. Nevertheless, they rated
the case analyses as very beneficial. Thus the mere
variation of conditions may help maintain interest. This
could be tested in future research. At the same time, this
within class design also presents certain disadvantages.
The variation itself (changing conditions within each class
may have mitigated effects that would have occurred over
time, thus reducing our ability to draw firm conclusions
regarding the effects of repeated use of the technology.

Another limitation is that we made no attempt to
establish the same group during each small group
discussion. Mennecke, Hoffer, and Valacich [17] suggests
that established groups should have greater cohesion and
therefore be more satisfied than ad-hoc groups. Possibly if
the students engaged consistently in electronic discussions
with the same members, they would begin to be more
critical and serious in their analyses than seemed to occur
in our study. Additionally, we did not have a means to
determine if in fact all students were participating during
the electronic discussion. The instructor was observing
the students during their electronic discussions and interest
and participation appeared to be high and among all
students, but it is possible that particularly a few students
on the back row could have not engaged in the discussion
but merely observed others.

5.3 Conclusion

This paper has presented the results of an
experiment examining whether collaborative learning
using electronic discussions for case analysis creates
higher interest, higher perceived learning, and greater
performance than learning in an individual constructive
environment for the same task. The study found that
students working collaboratively in either small or large
groups showed more interested in the material and
perceived themselves to learn more than students that
worked individually but that students that worked
individually outperformed students that collaborated in
small or large groups before working individually. The
findings of this study are at once sensational and suggestive.
It makes sense that students enjoy collaborating more than
when they work alone, but it also makes sense that, if
given the same amount of time, they perform better when
they work alone by virtue of the fact that they do not have
to analyze and critique the ideas of others. A great deal of
time in the traditional classroom environment is spent
gathering information (taking notes) rather than processing
the information and assimilating the information. The
traditional learning model goes from the gathering to recall
stage without regard for whether the information is
actually comprehended (processed and assimilated). This
study was an examination of whether collaborative
learning and constructive learning via case analyses can be
used to supplement the traditional method and encourage
the processing and assimilation phases of learning. As an
early study in an emerging field, the findings from this
research (as with all research) requires replication and
extension before making prescriptive comments. It is our
hope that this research will be helpful in building an
understanding of the appropriate and successful
implementation of technology and learning models within
the classroom context.

References

[1] Leidner, Dorothy E. and Sirkka L. Jarvenpaa, “The
Information Age Confronts Education: Case Studies
on Electronic Classrooms,” Information Systems

[2] Hashim, Safaa, Rathnam, Sukumar, and Whinston,
Andrew B., “CATT: An Argumentation Based
Groupware System for Enhancing Case Discussions in
Business Schools,” Proceedings of the Twelfth
Annual International Conference on Information
Systems (ed. DeGross, Benbasat, DeSanctis, and

Learning: An Empirical Evaluation”, MIS Quarterly,
June 1994, pp. 159-174.

EMS in the Classroom: Two Field Studies, The
Proceedings of the 28th Hawaii Conference on

Distributed Global Teams,” The Proceedings
of the 28th Hawaii Conference on Systems Sciences,

“Information Technology to Support Management
Education: A Theoretical View,” forthcoming in MIS
Quarterly.

[7] Martocchio, Joseph J. and Webster, Jane, “Effects of
Feedback and Cognitive Playfulness on Performance
in Microcomputer Software Training”, Personnel
Psychology, 45, 1992, 553-578.

[8] Hilul, Suzanne, “Interest and Its Contribution as a
Mental Resource for Learning” Review of

[9] Baldwin TT , and Kar, KAI, “The development and
Empirical Test of a Measure for Assessing Motivation
to Learn in Management Education. In Hoy F (ed.),
Academy of Management best paper proceedings (pp.
117-121). New Orleans: Academy of Management,
1987.

[10] Connolly, Terry, Jessup, Leonard M. and Valacich,
Joseph S., “Effects of Anonymity and Evaluative Tone
on Idea Generation in Computer Mediated Groups,”
Management Science, 36, 6, June 1990, pp. 689-703.

Investigation of the Relationship Between DSS Usage
and System Performance: A Case Study of a
Navigation Support System,” MIS Quarterly, 14, 3,
September, 1990, pp 263-278.

[12] Valacich, Joseph S., Alan Dennis, and Jay F.
Nunamaker Jr., “Group Size and Anonymity Effects on
Computer-Mediated Idea Generation,” Small Group

Curve: Intelligence and Class Structure in American

Foundation for the Study of Group Decision Support
Systems,” Management Science, May 1987, pp. 589-
609.

Organizations as Signal and Symbol”,

[16] Dennis, Alan R., Jay F. Nunamaker Jr., and Douglas R.
Vogel, “A Comparison of Laboratory and Field
Research in the Study of Electronic Meeting
Systems,” Journal of Management Information

[17] Mennecke, Brian E., Jeffrey A. Hoffer, and Joseph S.
Valacich, “An Experimental Examination of Group
History and Group Support System Use on
Information Sharing Performance and User
Perceptions,” The Proceedings of the 28th Hawaii
153-162.