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Improving Case Instruction: Computer-Mediated Learning vs. Face-To-Face Learning

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Research in computer-supported cooperative learning provides evidence that collaborative communication technology can enhance learning performance and increase the affective experience of students in the context of cooperative learning. Most studies, however, have examined learning performance only during the middle and end of the learning process. Thus, it is not clear how information technology can continuously facilitate and improve student performance and learning experience over time. The purpose of this research is to examine how the communication medium facilitates the case instruction in the field of operations management. This study compared traditional, face-to-face cooperative learning environments to computer-supported cooperative learning environments for differences in students' learning performance and group member satisfaction. Students in the Face-to-Face learning environment consistently perceived higher learning performance compared to Computed mediated environment.

Keywords: Operations Management Education, Co-operative Learning

1. Introduction

Today's business environment is very challenging in nature. In order to cope with challenges facing today's managers, students need not only to retain knowledge, but also to learn how to integrate and apply knowledge from various perspectives to address business issues. The case instruction (e.g., case study) is one method that is widely adopted by instructors in an effort to equip students with analytical and synthesis skills. Specific benefits of the case instruction include increasing students' knowledge of many different disciplines, sharpening students' analytical skills, providing a platform on which students share with each other of their experiences (Corey, 1996). While the case instruction may proceed in a variety of forms, a general format is that the instructor guides the discussion assuming that students had studied the case beforehand. This approach could realize the benefits of case instruction to a certain degree. However, it is instructor-centered and is not suitable for a medium- to large-sized class.

Cooperative learning is a pedagogical method that might potentially realize the full benefit of case instruction, while overcoming problems of big class size. Cooperative learning is a philosophy that enables students to learn from one another. It is an instructional method that creates an environment to challenge students and develop a better decision-making skill (Slavin, 1990). Previous studies show that cooperative learning facilitates the activeness on students' part and improve information exchanges.

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As the collaborative information technology proliferates, cooperative learning method is supported with electronic communication technology to further improve the learning effectiveness and provide more learning opportunity by overcoming space and/or time constraints. Computer-Supported Cooperative Learning (CSCL) is the use of information technology in instructional settings and is designed to facilitate greater learning, based on group cooperation (Alavi, 1994; Brandon & Hollingshead, 1999). Drawing from the success of more traditional face-to-face cooperative learning (FTFCL) environments, CSCL is intended to form a synergic collaboration between information technology and cooperative learning.

The purpose of this research is to examine the effect of communication modes on case instructions in those two different mediums. Literature has supported the positive outcome of cooperative learning in different disciplines (Symons & Symons, 1995; Maier & Keenan, 1994). However, it is yet to be established that what will be the outcomes if the concept is applied to differentiate between FTFCL & CSCL in the field of production and operations management. Since operations management is very quantitative in nature, the purpose of the research is to use case instructions in two different mediums and see the effect of learning process from decision making perspective. The research will examine how computer-mediated (CM) collaborative technology facilitates individual and group learning as well as promotes satisfaction with this type of learning environment over the course of a semester. The present research is different from the previous studies as it is longitudinal in nature, with continuous observations of performance and satisfaction made throughout the entire semester. Previous studies have generally observed learning groups only during the middle and end of the school semester. Collaborative technologies used in previous studies varied from asynchronous textual communication media (e.g., email etc.) to synchronous audiovisual communication media (e.g., desktop videoconferencing) to group support systems that feature group techniques, such as brainstorming (e.g., group decision systems). A distinguished characteristic shared by those studies is that they were intended to contract and compare the effects of different communication media.

An interesting finding of this research from previous studies is that the performances of groups in these two conditions declined and then rebounded about in the middle of the semester. There is one possible explanation for the unexpected findings. According to Gersick (1989), group development follows a punctuated equilibrium model. Groups alternated relatively stable periods of activity. Transitions from one period to another were punctuated by significant changes in group member behavior, which in turn are triggered by the realization of time pressure and the deadlines. The poor performance of both groups in the third session and rebound in the fourth session might be due to students' awareness of the approaching of the end of the semester.

This paper comprises the introduction of the study. Next, the review of the literature which consists of the discussion of problem statement. It is followed by the methodology that covers conceptual framework and research design. The second last section deals with results and discussion. The paper ends with summary and conclusion that covers contribution, limitation and future prospects for this study.

2. Literature Review

Cooperative learning is defined as a group process in which students acquire knowledge, skills, and attitudes by actively participating in solving academic problems (Alavi, 1994; Brandon & Hollingshead, 1999). Compared to the traditional instructor-centered lecture

method, the use of collaborative learning methods can significantly promote positive academic and affective outcomes among students (Brandon & Hollingshead, 1999). Positive effects of cooperative learning may include improvements in academic achievement, the generation of more ideas and solutions, higher self-esteem, more positive attitudes toward school, as well as promoting the ability to work cooperatively (Slavin, 1991). Research in CSCL is intended to amplify these benefits with the use of information technology (Alavi, 1994), while eliminating common time and space constrains that are found in traditional face-to-face (FtF) classroom settings (Brandon & Hollingshead, 1999).

For instance, in a study involving MBA students, Alavi (1994) found that computer support significantly affects the following aspects: perceived skill development, self-reported learning, learning interest, evaluation of classroom experience, and the evaluation of classroom exercises. Furthermore, students supported with collaborative technologies had significantly better learning outcomes than did students in traditional classrooms. It should be noted, however, that it is not clear which features of the system (VisionQuest^{TM}) that was used in the study caused the increase in performance. Furthermore, it is not clear whether the performance was accumulated or not, since the study reported no significant difference in the midterm exam, while reporting significant differences in the final exam.

Similar affective and academic outcomes are partially supported by other research (Hiltz, 1993; Hiltz & Wellman, 1997). These studies found that students in CM conditions had equal or better mastery of the subject material than those in traditional FtF settings. However, these positive outcomes are believed to be subject to a number of contingent and moderating factors. For example, there may exist some interaction between the subject matter and the communication modes. This interaction between subject matter and communication mode is further exemplified by Marttunen (1992). In a study comparing learning performance and argumentation skills in CM and FtF environments, Marttunen found that students in traditional FtF classroom formats had better learning outcomes, while CM groups developed better argumentation skills.

Furthermore, a field study by Althaus (1997) examined the effectiveness of supplementing traditional FtF discussions with computer-mediated discussions (CMD). In this study, the majority of CMD students had a positive experience with the CMD system and a perceived better mastery of course materials. Moreover, research has shown that when group problem solving is computer mediated, communications become more task oriented with clearer role expectations, while face-to-face communications are more cohesive and personal (Jonassen & Kwon, 2001). They further investigated that computer-mediated group decisions more closely resembled the general problem-solving process of problem definition, orientation, and solution development as group interaction progressed, while the face-to-face group interactions tended to follow a linear sequence of interactions. Krejns, Kirschner and Jochems (2003) examine the social interactions which determine how groups develop, how sound social spaces characterized by group cohesion, trust, respect and belonging are established, and how a sense of community of learning is established. Additionally, CMD students performed better on final examinations and written assignments, which is consistent with the findings of Alavi (1994) and Hilt (1993), but is different from Martunen (1992). Furthermore, between the midterm and final written examinations, CMD students improved more than other students. However, CMD students attended class more regularly and were more active in classroom discussions.

Thus, it is not clear based on previous studies whether the CMD medium improved learning or other factors such as higher motivation, attendance, and/or discussion induced the better academic performance. These studies suggest that CM learning environments appear to enhance the effectiveness of learning; however, how effectively CM environments enhance learning is subject to various contingent factors. In addition to these factors, it is not clear which features within CM learning environments have the greatest effect on learning effectiveness. The purpose of this paper is to look into learning performance, perceived learning performance and satisfaction between CSCL and FTFCL groups for the entire semester. The present study is different from previous studies as it focuses on learning performance and satisfaction over an entire semester.

3. Methodology and Model

3.1 Theoretical Framework: Hypotheses and Variables

The theoretical foundation of this research is adapted from the descriptive model of computer-supported cooperative learning (Brandon & Hollingshead, 1999). This model suggests that in addition to being subject to various contingent factors, the effectiveness of learning is bounded by the type of technology and style of instruction. This study was intended to examine how collaborative technology facilitates learning by investigating the effects of communication media on the performance of learning over time. The performance of learning consists of two parts: academic and affective outcomes. Academic outcomes refer to the mastering and perceived mastering of learning materials, while affective outcomes refer to subjectively assessed satisfaction with the learning process.

Academic outcomes are typically the focus of evaluation when comparing CM to FtF learning environments (Hiltz, 1993). The majority of previous research (Alavi, 1994; Althaus, 1997; Hiltz, 1993; Hiltz & Wellman, 1997) suggests that students in CM environments tend to have better mastery of learning materials. Research by Alavi (1994) and Althaus (1997) further indicate that students in CM groups have significantly higher performance for final exams than students in FtF groups, but no significant differences in midterm exams. Possible explanation for this finding can be found in communication research. Hollingshead, McGrath, and O'Connor (1993) assert that the performance of group members working together is affected by the level of their familiarity with the communication medium. This suggests that students in CM groups would not perform as well as their counterparts in FtF groups until they become familiar with the medium. As the semester proceeds, students in CM groups should become more proficient with the use of the CM medium and, consequently, their performances should improve. This proficiency might be further strengthened, as suggested by Adaptive Structuration Theory (Poole & DeSanctis, 1989), by students' adaptation of technology structures. It is believed this proficiency, in turn, will improve students' learning performance over time.

Summary of hypotheses regarding learning performance as follows:

H1: Learning performance differences between CSCL and FTFCL groups will be consistently significant during the entire semester.
H1a: There will be no significant learning performance difference in the early sessions between CSCL and FTFCL groups.
H1b: CSCL groups will perform significantly better than FTFCL group in the later sessions.

In addition to objective learning performance, perceived learning performance is another area considered by researchers in this area. Studies by Alavi (1994) and Althaus (1997) found that computer support has a significant effect on perceived learning performance because students in CM groups felt that they were exposed to diverse perspectives and various ideas. However, as found by many researchers in the area of CM communication, in early sessions this advantage might be offset by the fact that CM participants need more time to finish their assignments (Bordia,1997). Consequently, the perception of better learning performance is gradual.

H2: Perceived learning performance differences between CSCL and FTFCL groups during the entire semester will be consistently significant.

H1a: There will be no significant perceived learning performance difference in the early sessions between CSCL and FTFCL groups.

H1b: CSCL groups will perform significantly better than FTFCL group in the later sessions.

Students in FtF environments tend to be more satisfied with the process than students in CM environments (Benbunan & Hiltz, 1999). The lower level of satisfaction in CM groups might be attributed to the lack of visual cues, such as facial expression and members' unfamiliarity with the medium (Hollingshead, McGrath, and O'Connor,1993). However, members in CM environments tend to indulge in more task-oriented conversation (Bordia,1997), thus promoting greater achievement, which in turn may positively affect satisfaction with the learning process (Kahai & Cooper, 1999). Additionally, as suggested by the Adaptive Structural Theory (Poole & DeSanctis,1989) students in CM groups over time might adapt structures in the medium to fit the context of their learning environment in a way that best suites them. As a result, the difference in satisfaction between CM and FtF groups may diminish over time.

H3: No consistently significant differences in group member satisfaction will be found between CSCL and FTFCL groups for the entire semester.

H3a: Group member satisfaction with CSCL environment will be lower than those with the FTCL environment in early sessions.

H3b: There will be no significant difference in satisfaction between CSCL groups and FTFCL groups in later sessions.

3.2 Measuring Variables

The dependent variable – learning effectiveness – is comprised of two components: subjective evaluation and learning benefits (Hiltz, 1993). Learning benefits here refers to academic performance as well as students' perceived learning performance. Another possible benefit might include greater convenience and greater access to educational resources and improved quality of education (Hiltz, 1993). Academic learning performance was measured by students' quiz scores, group reports, and their final grades. Perceived learning performance was measured by items adopted from previous research (Alavi, 1994; Hiltz, 1994). The subjective, evaluative part of learning effectiveness consists of satisfaction with the group meeting environment. The satisfaction measure was derived from Olaniran (1996) which measured group satisfaction within CM and FtF environments.

3.3 Participants

One hundred and nineteen undergraduate students enrolled in three sections of a one semester-long course on Production and Operations Management participated in this study. Students were randomly assigned to either the CMCL condition or the FTFCL condition. Each condition consisted of 20 groups. Each group consisted of three, randomly assigned members (except one CMCL group which had 2 group members) —59 students in the CSCL condition and 60 students in the FTFCL condition. All three sections were taught by the same instructor with the same textbook, teaching materials, coverage, examinations, and requirements. Participation in the study was one of two options available to fulfill the partial requirement of the course.

3.4 Research Design

The dependent variable – learning effectiveness – was comprised of two components: the actual learning of the students and their subjective evaluation of the learning process. The academic learning performance was measured by students' quiz scores. Perceived learning performance was measured by items adopted from previous research (Alavi,1994). The perceived learning performance measured the subjects' estimate of how much they learned within different environments.

The subjective, evaluative part of learning process refers to students' satisfaction with the group-meeting environment. The satisfaction measure used in this study was derived from Olaniran (1996), which measured group satisfaction within CM and FtF environments.

3.5 Learning Cases

To assess the degree of learning for both conditions in this study, six cases were used. These cases were taken and modified from the textbooks of Production and Operations Management by Stevenson (2014) and by Render and Heizer (2015). Each case described a scenario in which the decision-maker needed to make a plan or reach a decision—which would be considered a decision-making task according to McGrath's Typology of Tasks (1993).

The cases included the background of the scenario, the problems and/or the opportunity the decision maker faces, and the requirements for an acceptable and feasible solution. Also, two or three questions were included in each case to guide students' discussion. Those questions were general enough for team member to propose various ideas and directional in nature in that multiple solutions were possible.

3.6 Procedure

The experiments were conducted biweekly. No specific job divisions were assigned to the individual team members. The meetings of CSCL groups were held in a computer laboratory with 24 PCs, each of which was equipped with a synchronous communication program (ICQ ™). Subjects in the CM groups were introduced to the operation of ICQ and were briefed as to the purpose and procedures of the research.

The collaborative learning process used in this study was adapted from Student Team-Achievement Division (STAD) (Alavi,1994). The meetings lasted fifty minutes and proceeded as follows: Each team member studied the case on his/her own for fifteen

minutes and took notes of his/her ideas about the case. In the following thirty-five minutes, team members discussed the case, exchanged their ideas, and reached their conclusion about the case. At end of each experiment, CSCL groups were required to save their discussion, including discussion threads and conclusion. No specific instructions regarding task allocation were given. Thus, team members might take turns to write up the report.

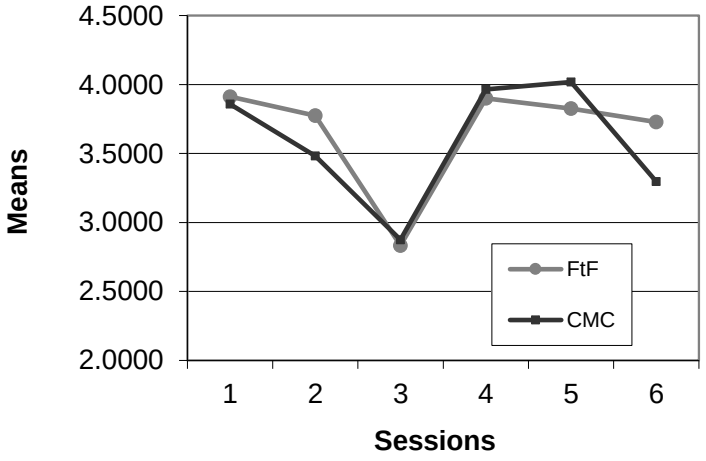
4. Results and Discussion

Multivariate repeated measures analysis of variance was performed on three dependent variables: performance (H1), perceived performance (H2), and satisfaction (H3). A MANOVA repeated measures procedure was used to analyze the data. Where interaction effects were found, further analysis was performed on the dependent variables in the early or later sessions. The results of analyses were presented in this section where appropriate.

4.1 Performance

Learning performance was measured with quizzes consisting of multiple-choice questions. The questions were to test students' mastery and application of concepts used in the case. H1 predicted that learning performance differences between CSCL and FTFCL groups during the entire semester would be consistently significant. This hypothesis was supported [$F(5, 34) = 12.66$, $p < .00$]. This is consistent with previous studies which have found little differences in performance between CM and FTFCL groups in the early stages of group development. However, it was also hypothesized that CSCL groups, after adjusting to their environment, would increase their level of performance and outperform the FTFCL groups in later sessions. Despite this outcome, except for the last session, the CSCL groups did out-perform their counterpart in the FTFCL environment. Yet, as seen in Figure 1, there was little consistency in performance between the CSCL and FTFCL groups. There are two possible explanations for the unexpected finding. One possibility is that, as Gersick (1989) suggests, groups develop following a punctuated equilibrium model. That is, groups in this study alternated relatively stable periods of activity. However, transitions from one period to another were punctuated by significant changes in group-member behavior, triggered by such things as the realization of time pressure and deadlines. The poor performance of both groups in the third session and the rebound in the fourth session might be due to students' awareness of the approaching of the end of semester. Another possibility is that while the measurement instrument was designed to evaluate students' mastery of concepts and principles; the nature of several topics was relatively quantitative. In other words, the nature of the topic had greater effect on the performance than the medium itself.

Figure 1: Profile plot of learning performance over time

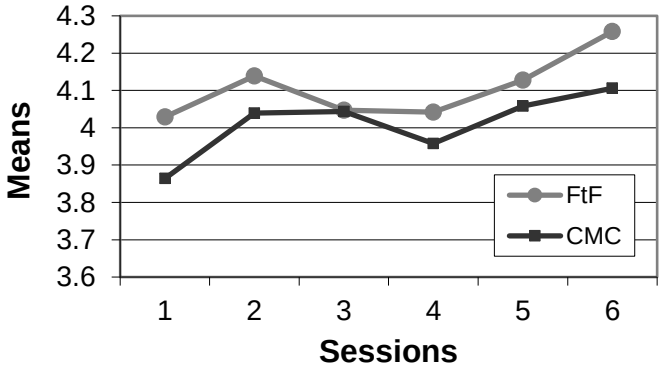


4.2 Perceived Performance

Perceived performance was measured after each group session, using a three-item semantic differential scale with a reliability of (Cronbach's α) of 0.89. H2 predicted that perceived learning performance differences between CSCL and FTFCL groups during the entire semester would be consistently significant. This hypothesis was supported [$F(5, 34) = 2.729$, $p < 0.04$].

Figure 2 shows, perceived performance in both the CSCL and FTFCL groups are generally increasing, with FTFCL groups for the most part having higher levels of perceived performance. This suggests that over time, both groups become accustom to their learning environment and consequently develop a greater confidence in their performances. However, it is believed that the FTFCL groups start off with and generally continue to have greater perceptions of learning performance because of the more immediate feedback, as well as greater range of cues that are associated with FtF environments as opposed to CM environments. This result, however, is different from previous studies e.g., (Alavi,1994 & Brandon, 1999). The discrepancy might be caused by different levels of technological support and modes of communication between this study and others. In the Alavi (1996) study, collaborative technology support of level 2 was used, while the present study adopted level 1 technology support. The novelty and sophistication of level 2 collaborative technology might significantly affect subjects' perception. Furthermore, asynchronous communication mode of the medium adopted in Althaus's (1997) study gave students more time to contemplate issues and others' perspectives before they responded. As a result, online subjects would perceive more positively their learning performance than their counterpart without computer support.

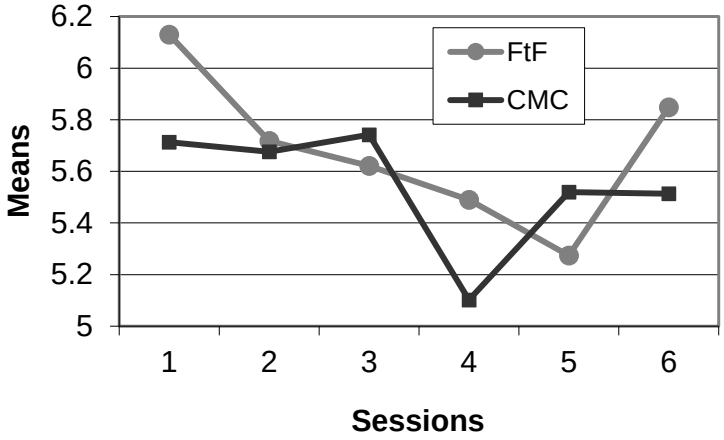
Figure 2: Profile plot of perceived performance over time



4.3 Satisfaction

Satisfaction with the learning process was measured after each group session, using a seven-item semantic differential scale, adapted from Olaniran [18]. A Cronbach Alpha Coefficient of 0.90 for the scale was obtained. H3 stated that no consistently significant differences in group member satisfaction would be found between CSCL and FTFCL groups for the entire semester, which was supported [F (5. 34) = 5.416, p < .001]. The profile plot of satisfaction over time Figure 3 indicates that the differences in satisfaction between groups were not consistently significant. However, after the second session, the FTFCL and CSCL groups had no consistent pattern. The cause for this discontinuity needs further investigation. Combined with the increasing pattern in the first three sessions, it seems fair to say that in general, CSCL groups were gradually satisfied with the electronic medium, as suggested by Adaptive Structural Theory (Poole, 1989).

Figure 3: Profile plot of satisfaction over time



5. Summary and Conclusions

The strength of the study lies in its continuous multiple measurements of students' learning performance over the course of one semester. Multiple measurements provide a basis for evaluating the effects of time and to its interaction with technology support on academic performance and affective outcomes. This would resolve the issue of whether the effect of technology support on learning is transient or sustainable. Just like similar research in this

area, a decision over the trade-off between rigor and realism must be made. Because the study was conducted over a period of twelve weeks, the time was long enough for students to become acquainted with each other outside the experimental sessions. Positive or negative relationships developed from this acquaintance affect students' performance and satisfaction as cited in the previous studies.

This study compared a traditional, FtF cooperative learning environment to computer-supported cooperative learning environment for differences in students' learning performance. To do this, this study recurrently measured academic performance and subjective assessment of satisfaction with the learning environments during the course of one semester. The results showed that the learning performance differs across media over time. However, the difference in learning performance was not consistently significant. In general, FtF groups were more satisfied with the communication environment than their counterpart in the CM environment. Yet, this difference in satisfaction between two environments diminished over time. Finally, students in the FtF environment consistently perceived higher learning performance than CM groups, although the differences were not all statistically significant. Most of the studies in the past have cited that students perform better in computer mediated environment compared to face to face environment. This study did find that students' in general perform better in a face to face environment compared to computer mediated environment. The study adopted a technology with very limited features. Future research could take into account the effect of technology level by incorporating it as a factor.

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