Improving the Performance of Online Learning Teams - A Discourse analysis

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ABSTRACT

This paper compares the processes of Face-To-Face (FTF) teams and Online Learning Teams (OLTs) and proposes methods to improve the performance of OLTs. An empirical study reviewed the performance of fifteen FTF teams and OLTs and their communication patterns were coded by the TEMPO system developed by Futoran et al. (1989) in order to develop a discourse analysis for each team. The results confirmed that FTF teams outperformed OLTs and identified four approaches to improve the performance of OLTs: (1) Posting well-organized information; (2) Increasing "process gain" activities and decreasing "process loss" activities; (3) Instructions and facilitation to promote the discussion of process and content equally and facilitate better communication patterns; (4) Minimizing members' absences. These are reviewed and practical solutions proposed.

Keywords: Online Learning teams, Face-to-Face teams, Team Performance, TEMPO, Discourse Analysis

1. BACKGROUND INTRODUCTION

Computer networks are changing the way that people and organizations work and communicate (Anderson & Shane, 2002). This has led to a trend where increasingly teams do not work face-to-face (FTF) but interact via a computer-mediated communication system (Driskell & Radtke, 2003). This is evidenced particularly in the education sector with widespread use of online learning and online learning teams (OLTs). While findings of past studies comparing the performance of OLTs and traditional FTF teams vary, it is generally found that OLTs do not outperform FTF teams. In the absence of FTF communication, teams find it difficult to establish intimacy and feelings of bonding and so generally show lower degrees of satisfaction with their quality of decision making (Valacich & Sarker, 2002; Warkentin et al., 1997). For example, Warkentin et al. (1997) studied OLTs versus FTF teams in a web-based conference system and found that the performance of OLTs was lower than FTF teams. Many research studies also support this result (Galegher & Kraut, 1994; Straus 1997), with only a few reporting the contrary or little difference (Sharda et al., 1988; Burke & Chidambaram, 1996; Jones et al., 2005).

Where there appears to be consensus is that significant challenges need to be overcome for OLTs to achieve better levels of performance:

Communication obstacles: Working efficiency tends to be lower since by the very nature of online meetings team members find it difficult to interact simultaneously and hence cannot interrupt or direct meetings successfully. This means it takes longer to understand various viewpoints and, when a collision of ideas occurs, it is extremely time consuming to reach a conclusion (Anderson & Shane, 2002).

It is difficult to build social relationships: Cohesion among members in OLTs is generally weak (Anderson & Shane, 2002) and it is often difficult to build trust (Kirkman et al., 2002). It is easy for some members to contribute nothing and let others carry their workload while the remaining members may feel angry, frustrated and dissatisfied resulting in the team being less productive. Many researchers have suggested that without regular FTF meetings, it is hard for people to feel significantly intimate to build social relationships (Robey et al., 2000; Maznevski & Chudoba, 2000).

The misuse of communication technology: The misuse of communication technology can further break down relationships (Anderson & Shane, 2002; Kirkman et al., 2002). OLT members frequently experience misunderstandings and misinterpretations of messages while working with each other. In addition, online systems may

overemphasize technical skills and underemphasize interpersonal and teamwork skills. All these issues may lead to lower levels of performance and satisfaction in OLTs.

Moore (1989) identified three kinds of interaction for on-line learning: learner-content, learner-instructor, learner-learner. Among them, interaction of students seems to be one of the most influential factors of online learning (Swan, 2001). A study by Fulford and Zhang (1993) suggests that students' perceptions of interaction are important indicators of their satisfaction with instruction. Similar studies (Picciano, 1998; Jiang & Ting, 2000) also found that students' perceived learning experience was directly related to the amount of discussion.

FTF communication is still the norm for effective collaboration and allows members to see, hear, receive messages and give feedback in "real time". However, FTF meetings are rarely available in a virtual collaboration environment, and this necessarily leads to fewer social cues (Short et al., 1976) and less information richness (Daft et al., 1987) for OLTs. Traditional communication theories, such as Social Presence Theory (Short et al., 1976) and Media Richness Theory (Daft et al., 1987), consider the rich availability of social cues in face-to-face meetings and support this natural communication method for all group working. However, Walther's (1996) hyperpersonal communication theory asserts that in a virtual environment, while deficient in face-to-face meetings, teams are still able to adapt to this new environment and achieve high levels of performance. Indeed, Harasim (1990) noted that students perceived on-line discussion as a fairer evaluation method. This may be due to the fact that asynchronous discussion affords students the chance to reflect on others' contributions. Furthermore, Eastmond (1995) states that the frequency, timeliness and nature of messages posted on the discussion affect the communication results in CMC.

To compare and validate these theories it is necessary to conduct an experiment using FTF teams and OLTs where the only difference is the lack of face-to-face meetings. This comparison will allow us to identify the influence and role of face-to-face meetings and methods to improve the performance of OLTs.

Many comparative studies in this area focus on quantitative methods using questionnaires or statistical analysis of data gathered through laboratory experiments (Straus, 1997; Benbunan-Fich et al., 2001; Valacich & Sarker, 2002). Fewer focus on qualitative methods to compare both (Espinosa et al., 2006; Nandhakumar & Baskerville, 2006) despite a call for more qualitative research in the IS field (Chen & Hirschheim, 2004). This study employed both quantitative and qualitative approaches over a three-year period although this paper describes only the qualitative part and reports on the results.

2. RESEARCH METHODOLOGY

2.1 Subjects
"Information Systems I" is a foundation, semester-based unit for full-time and part-time business undergraduate students comprising two weekly sessions of a two-hour lecture and one-hour tutorial respectively. The unit draws students from nine different degrees and classes are scheduled over five different sessions both as day and evening classes. The unit aims to make students fully conversant with the role and place of information systems and technology in business. It includes four assessments: case study, lab work, business essay and final exam. The case study, which is a group writing assignment, was designed by the researchers to operate over a four-week period. Students were grouped into teams of four and had to cooperate as a systems advisory team to a small business and produce a final report before the deadline.

To affect the comparison between FTF teams and OLTs, different semester cohorts were used. The first semester was conducted in a wholly FTF environment with a total of 45 teams while the second semester was conducted in a completely online learning setting with a total of 55 teams. In both groups the female proportion was slightly higher than male and age ranged between 17 and 36, with similar demography. The detailed procedures are explained below.

2.2 Procedures
2.2.1 FTF teams
45 teams with four members each were assigned randomly at the beginning of the case study. After the first-hour lecture, students gathered in the assigned discussion rooms with tape recorders and were required to record their conversations during their meetings over one hour. After discussion, they returned the tape recorders and tapes to the researchers. This lasted over four weeks before students had to finalize and submit their assignments. After marking the assignments, all teams were categorized as excellent, moderate or poor performance. From these categories, fifteen teams were selected: five groups with an excellent performance; five groups with moderate performance; and five groups with a poor performance. The discourse recorded in the tapes became the material of analysis using the TEMPO coding system.

2.2.2 OLTs
In the online learning setting, 55 teams with four members each were pre-assigned and discussion boards, built in a Networked Learning Environment Courseware System, Blackboard, were created for each team. Each team comprised of members drawn from different classes and unfamiliar with each other. Students were told that any communication methods other than discussion board, such as FTF meetings, email, MSN, SMS and phone calls were prohibited. Students had to login and enter their group discussion board and complete all discussions online over the four-week period. A similar set of fifteen teams as for FTF teams was selected for further analysis. The discourse in the discussion board became the material of analysis.

2.2.3 Coding the discourses
The TEMPO coding system by Futoran et al. (1989) was used to code the discourses and includes two categories: production function and non-production function. The former includes four sub-categories that represent group performance: "Propose content" contributes to the task content (e.g., proposing task solutions, generating ideas for the task product, executing steps in the group's task);

"Propose process" contributes to group process (e.g., proposing group goals, setting strategies and actions); "Evaluate content" contributes to the monitoring and evaluation of task content; and "Evaluate process" contributes to the monitoring and evaluation of group processes. The latter reflects the activities that are not related to the group's implementation of its production functions but involve personal or interpersonal content. Using categorisations from Powell et al. (2004), production function categories were regarded as task dimensions while non-production function categories were regarded as social dimensions in this study.

In order to draw the communication patterns, a code and number were assigned to each category as shown in Appendix 1. These codes (pp1, pp2...) are used in Nvivo to code the discourses and form the frequency tables, and the numbers (1,2,3...) are used to draw the communication patterns chronologically. The coding rules are based on the purposes of the discourse. For example, the discourse would be coded as "pp1" if group members discussed the goals during a period of time. The researchers coded independently and Cohen's Kappa statistic between the researchers was 0.74, which is well above the 61% level suggested by Fleiss (1981).

2.2.4 Analysis

The frequency tables and communication patterns were created and analysed for both sets of FTF and OLTs with a view to determining how a better performance could be achieved. From this comparison and the researchers' observations throughout the process, four approaches to improve the performance of OLTs were proposed.

3. COMPARING THE ASSIGNMENTS OF FTF TEAMS AND OLTS

The first consideration was to identify whether the performance of OLTs was worse than FTF teams and overall, this was found to be the case with lower average grades. Additionally the researchers noted two major differences in assignments:

(1) The structure of OLTs' assignments was looser
The questions within the case study are consequential and relate to each other, requiring the later questions to incorporate results from earlier ones. OLTs' showed loose couplings without a tight connection between each question.

(2) The inconsistency ratio was higher
There was a higher ratio of inconsistency between the results and arguments for all questions in OLTs' assignment. For example, a conclusion could be to adapt system A in question 1, but system B was applied in question 2. This implies less effective communication within the OLTs and carelessness in regard to other members' parts.

4. ANALYSIS OF THE DISCOURSE

The frequency tables were used to analyse the discourse and to provide clues to explore the focus of team activities while the zigzag diagram, drawn to visualize the communication patterns allows investigation of the structure and process of team communication.

4.1 Analysis of the Discourse of FTF Teams
4.1.1 Summary of Discourse of FTF groups
Appendix 2 shows the summary of the discourse of fifteen FTF teams (ranked by performance). From Appendix 2, it can be found:

Longer discussion time and more information exchange affect the performance positively.

From the two columns: time and codes, the excellent and moderate performance groups had slightly longer discussion time and exchanged more information than the poor performance groups. But from the column: codes/times, there is no significant difference between the three groups as the sub-averages of each group were almost the same (1.57~1.59). Teams exchanged similar amounts of information per minute regardless of excellent, moderate and poor performance groups.

(2) FTF teams focused on content more than process
From the two columns: p_total and c_total, the latter is higher than the former and accounts for 50% of the codes. FTF teams focused more on content discussion than process discussion. However, there is no significant difference between excellent, moderate and poor performance groups in respect of the proportion of p_total and c_total. This implies that the amount of discussion (content or process) does not affect the performance.

(3) The amount of social activities does not reflect the degree of performance

By observing the column: np_sub, team 9 had the highest proportion of social activities (43%) but only performed moderately. Team 11 had the second highest percentage of social activities (40%) but was placed in the poor performance group. However, team 3 with an excellent performance had the lowest proportion of social activities. From these figures, it can be implied that social activities have no strong relationships with the group performance.

4.1.2 The Communication Pattern of FTF
The communication patterns of fifteen FTF teams were drawn by the TEMPO system and Appendix 3 shows an example from FTF team 3. X-axis stands for time (four-week recordings) and Y-axis shows the codes from 1 to 20. Each point represents the group's focus during a short time. For example, this group focused on a "process propose" activity at the beginning, then moved to a "process evaluate" activity. After linking all points together, the communication pattern can be easily observed.

From reviewing these fifteen FTF team communication patterns, some findings evolve as below:
(1) There is no fixed successive discussion pattern but well-organized communication can lead to a better performance. Teams 1 and 3 (in the excellent performance group) had well-organized communication. They focused on one topic at a time only moving to the next topic when consensus had been reached. A similar phenomenon can be also found in teams 5, 6 and 10 (in moderate performance group). However, there is no extremely regular or fixed communication pattern in these groups rather it can be found that the "process" and "content" interlaced. Well-organized communication resulted from full participation and strong leadership.
(2) More "process gain" activities leads to higher

performance. The discourse analysis showed that a better performance resulted where team members were willing to help each other and gave time towards the development of ideas, insights and strategies. These "process gain" behaviors kept the groups more cohesive and motivated. For example, team members would arrive on time for the meetings, felt embarrassed if they were not well prepared, encouraged and helped each other when upset, and even became good friends in the end. This happened in teams 2 and 4 (both belonged to the excellent group), despite a lack of well-organized communication. As a result, the proportion of social activities in these two teams was higher than others in the excellent performance group, and accounts for 25% and 29% respectively.

(3) Social loafing (Free rider) accounts for the biggest proportion of the "process loss" behaviors affecting the performance. Some members opted to act as a "free rider", allowing other members to do all the work. They shirked responsibility and either kept silent in the meetings or were absent from meetings. The "free rider" members provoked a chain reaction of de-motivation and discouragement among other members and further affected the group performance.

This phenomenon can be found extensively in the teams with poor performance and some teams with moderate performance. There was little evidence, however, of egocentrism or competition and so, if there were someone who could take charge of the team management (including the distribution of jobs, direction leading ...etc), they would happily accept this.

4.2 Analysis of the Discourse of OLTs
4.2.1 Summary of The Discourse of OLTs
Appendix 4 shows the summary of the postings of OLTs in the discussion boards (ranked by performance). From Appendix 4, it can be found:

Teams with more discussion had better levels of performance. Comparing the postings (column: posts) of the three groups (excellent/moderate/poor performance), it can be seen that the groups with excellent and moderate performance had more postings than the groups with poor performance. Moreover, the code quantities (column: codes) of the groups with excellent and moderate performance are higher than the group with poor performance. But there is no evidence to suggest that postings with more content (with higher ratio of codes/posts) would cause higher performance. One exception was team 6 with the highest number of codes (213) but yet, only in the moderate performance group. It would appear from an analysis of content that competition between the members caused this process loss. The members did their best to contribute and kept on posting new ideas and advising others but to excess - they each believed that their ideas were best and had continual arguments about the assignment with constant revision. They rarely reached conclusions and many "broken end" discussion threads resulted.

Groups that focused on "process" and "content" equally had better performance. By observing the two columns "p_total" and "c_total", it can be seen that the groups focusing on both process and content equally had better

performance. In the poor performance groups, they paid more attention to process instead of content. A possible reason was poor time management when they spent too much time on discussing how to do and distribute the jobs and not enough time on the actual tasks.

Non-production activities (social activities) accounted for a smaller proportion of time when compared with FTF groups. Non-production codes ("np_sub" column) just accounted for 10~20 percentage for each team showing that OLTs focused more on task activities. However there is no evidence showing any relationship between the quantity of non-production activities and group performance.

4.2.2 The Communication Pattern of OLTs
The communication patterns of fifteen teams were drawn by the TEMPO system and Appendix 5 shows an example from OLT 1. The members focused on "Non-production" activity at the beginning, then moved to a "Process-propose" activity.

By observing these fifteen OLTs communication patterns, some conclusions can be drawn below:

Best communication pattern is
process→content→process→content

In the groups with excellent and moderate performance, there was a tendency towards a regular pattern. Firstly, members discussed the processes needed to proceed to the case study. This included the distribution of the tasks, the means of communication and the frequency needed to check the discussion board. This was followed by a discussion of content and where to retrieve information of quality and how to make document amendments. Next, some process issues might arise, such as where members missed some interactions because of travel or sickness. In this case, members had to re-discuss or re-arrange the allocation of the tasks

From the description above, a communication pattern can be drawn: process→content→process→content. This pattern can be observed in groups with better or moderate performance. On the contrary, teams with poor performance did not display this pattern.

It was found that the pattern is similar to the Punctuated Equilibrium Model (Gersick, 1988): members discussed the process in the beginning and started to work; then they went back to review and change the process at the midpoint transition and finish the task in the second working period. The process finished in the end transition. Figure 1 shows this pattern against the Punctuated Equilibrium Model.
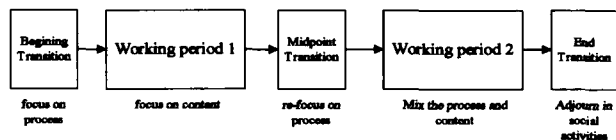

Figure 1 A better communication pattern for OLTs using the Punctuated Equilibrium Model

"Interlaced communication" diminished the efficiency of communication. From the analysis of OLTs discourse, there was a communication pattern of "interlaced communication" that interfered with the efficiency of

communication. This was made more noticeable in the discussion board environment where more "interlaced communication" directly affected communication efficiency.

An example of "interlaced communication" follows:

# Poster	Contents
1 A	i say 10 each! i rekon we desereved it!:) im not being hot headed, but we did WELL:)
2 B	can u all please check it so far for any final corrections, i will finish it off completly tommorow morning!! so dont stress, but any ideas, pleas throw at me!
3 B	yeah i agree.
4 C	Hi B, I'll revise it and put it in the file exchange. If anyone has problems you are welcome to post and I will try my best.
5 D	Yes, I agree that we all get 10

From these postings, the third and fifth posts responded to the first post while the fourth post responded to the second post. Responders replied in an interval of two or more than two postings instead of responding to the next posting. In this situation, a discussion topic was often terminated inexplicably instead of fully discussed (became "broken ended"). The lack of immediate response to communication made it more difficult to continue conversation and to develop conclusions.

The more "process gain" activities the group had, the higher the performance: The amounts of postings during the initial period are important for OLTs. At the commencement of the discussion, members did not know each other and felt nervous and adrift. However, these negative emotions could be eliminated through frequent postings. This centered on discussion of process where rapid and abundant responses to postings facilitated an efficient distribution of jobs or the process of how to do the tasks. If the process was confirmed and agreed by all members quickly, the group had an excellent beginning. In the following stages, similar to FTF teams, "process gain" behaviors kept the group moving on to the completion of the tasks.

5. METHODS TO IMPROVE THE PERFORMANCE OF OLTS

5.1 The Differences Between FTF and OLTs
The following summarises the differences between both teams according to the results of data analysis:

Communication in OLTs is comparatively more difficult than in FTF. It is found that a better communication pattern for OLTs is process →content →process →content, but there is no obvious communication pattern observed for FTF. "Interlaced communication" phenomenon may interfere with effective communication in the virtual environment but it does not appear in the FTF environment.

5.2 Issues That Differentiate between FTF Teams and OLTs' Performance
Communication is the key issue to differences found in the

analysis of performance between FTF and OLT groups. Suggested reasons are as follow:

The communication model in OLTs is inefficient: Absence of face-to-face communication in a virtual environment does hinder the flow and speed of exchanging information. The slow speed of typing and lack of real-time response made it hard for OLT members to exchange information as rapidly as in face-to-face meetings. Further, "interlaced communication" causes real obstacles to effective communication and causes frustration resulting in difficulties in reaching conclusions for OLTs.

In efficient communication caused poor collaboration Difficult communication results in poor collaboration, such as in the distribution of jobs and for conflict resolution. Additionally, some members were absent from groups causing interruption in task processes and even group disorder.

5.3 Methods to Improve the Performance of OLTs
Accordingly, we suggest the following methods to improve the performance of OLTs:

Posting well-organised information: Although the speed and flow of information exchanged in OLTs may be slow, the communication method (discussion board) of OLTs still has certain advantages. Time delay in communication can allow members to think and reflect on logical arguments. Well-organised and rich-content postings can overcome defects in communication. When OLT members posted to the discussion board, it was found that the postings were better arranged than in a face-to-face conversation. In spite of lower levels of information exchange, postings contained better quality information due to prior reflection. In addition, these postings can be read repeatedly and searched to facilitate more logical discussion and promote meaningful information exchange.

To ensure well-organised postings, training is required on how to use the systems and how to post effectively. A study by Warkentin and Beranek (1999) examined the role of training in OLTs and found that training has positive links to team performance. Participants were introduced to a bulletin board system "MeetingWeb" to learn communication skills by "posting" messages in a hierarchical manner (threaded discussion). They were also introduced to "rules of netiquette" and given examples of abbreviation to assist in effective communication and to avoid misunderstanding and misinterpretations. For example, "BTW" means by the way; "FWIW" represents for what it is worth. They were also instructed not to type comments which might be regarded as inflammatory. Another study by Tan et al. (2000) applied dialogue technique to develop a team mental model on electronic communication practices and resulted in better communication and improved performance.

Increasing "process gain" activities and decreasing "process loss" activities: Providing instructions and guidance to facilitate "process gain" activities is also crucial, such as encouraging the members to post more (even irrelevant content), to provide fast response to others' ideas and to be willing to help others.

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"Interfaced communication" causes "process loss" to a certain degree and training for using the discussion board effectively could be the best method to solve this problem. Social loafing also causes "process loss" and asking OLT members to sign a group contract in order to increase the sense of honour and responsibility could be a way to solve the issue. Furthermore, a study by Dineen (2005) found that social loafing is lower in fluid teams than in stable teams. He explained that members tend to be on "better behaviour" and more inhibited in the presence of strangers. Thus, a mechanism to rotate team members across different projects could keep the teams fluid and reduce social loafing.

Instructions and facilitation to promote the discussion of process and content equally and facilitate better communication patterns: OLTs can obtain better performance if their communication starts from the discussion of the process, followed by the discussion of content, goes back to the discussion of process next and ends at the discussion of content. This pattern not only focuses on both process and content but also enables members to review steps and procedures to adapt to unexpected events and gain a better performance in a limited project time.

The solution is to provide clear instructions before the start and align the facilitators (Casper-Curtis, 2002) or instructors (Swan, 2001) to guide members to form structured communication patterns. Rourke et al. (2001) describe three forms of interaction in an on-line learning environment: interaction with content, interaction with instructors and interaction with classmates. Among them, interaction with instructors has been validated to positively relate to students' learning outcomes (Picciano, 1998; Swan, 2001; Jones et al., 2005). Instructors in traditional FTF classrooms are able to give immediate social assistance and task guidance and educational researchers have found that instructors' verbal and nonverbal behaviours can reduce psychological distance and lead to a better learning result (Christophel, 1990; Rodriguez et al., 1996). However, lack of physical contact and immediate feedback in a virtual environment leads to less capability to represent the social presence. Thus, instructors are able to form only a "hyper-personal" social presence (Walther, 1996) and the relationships between instructors and OLT members are more inclined towards those essential for task guidance. Hiltz (1994) asserts that instructors in virtual environments have three duties: cognition, affection and management. From our observations, management of the OLT process is the crucial function for instructors and relates to five major responsibilities as proposed by Alexander (2002): setting of the goals, preparation of documents, confirmation of each member's situation and availabilities, management of time and techniques and the guidance of the processes.

Minimising members' absences: Members' absence from the group discussion affected the performance severely. It not only lowered the group morale but also disrupted group collaboration and led to poorer or incomplete outcomes. Beer and Slack's (2005) study also supports this finding.

There are two issues to consider here and the first was rather surprising. OLT members did not feel guilty when they missed discussions and this appears to relate to their lack of strong relationships. Thus, they do not feel sorry or embarrassed if they have not finished their part or are absent in the discussion. One solution to the problem is to ask members to sign a group contract and hence increase the sense of honour and responsibility. Another more obvious cause is the difficulty in coordinating members' schedules. In practice, OLT members always gather together temporarily and each member has his specific job to do but somehow the 'virtual' environment means that members feel they can afford to change schedules more easily and 'catch up' out of time. Coordinating members' schedule is a tough task and many members vanished for a period of time because they had other (more) important things to do. There are two issues regarding this: one is the length of missing time and another is if other members have been informed. The longer the time the member leaves the more serious effect on the outcomes. While it is hard to control the length of members' missing time, it could be solved according to a collaboration model proposed by Qureshi et al. (2006).

Qureshi et al. (2006) used grounded theory to build a collaboration model for OLTs. The data was collected from 21 distributed OLTs comprising of students from Erasmus University in Netherlands and City University in Hong Kong over a period of three months. Observations by the researchers and logs of electronic collaboration system (eRoom) were analysed to form the model shown in Figure 2.
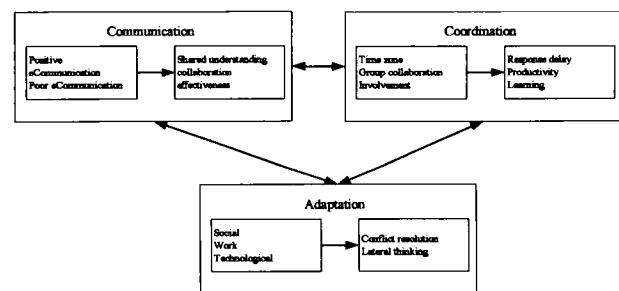

Figure 2 Model of collaboration (From Qureshi et al., 2006)

This model includes three categories: communication, adaptation and coordination. Communication includes the actions that not only pass information to other members but also allow members to understand and utilise this information. Coordination represents how members have to overcome the boundaries to share ideas and outcomes through three project stages: planning, sourcing and execution. Adaptation is the group learning process across three dimensions: social activities, tasks and technologies. OLT members adapt themselves to the virtual environment to solve conflicts. These three categories interact reciprocally and affect each other. This model suggests that collaboration of members is improved by exchanging information on each member's schedule. A penalty system could be introduced for excess absence and so reducing the influence of any member leaving.

6. CONCLUSIONS

This study adapted the TEMPO system to create frequency tables and zigzag communication patterns to convert

intangible, hard-to-observe and hard-to-analyse discourse into visible, easy-to-analyse and meaningful figures and diagrams. From these, it is far easier to discern the hidden patterns in both process and content distribution underlying the discourse. The study has therefore identified a new approach and a well documented and structured method to investigate the issues in OLTs or small group research. Further, the discourse analysis has provided us with some clear indicators of processes which can lead to more effective communication patterns and, in turn, to more effective outputs. These have been identified under four different categories. Most on-line learning courses are based on discussion boards, and lecturers or instructors can refer to the proposed approaches to assist in setting up the composition of OLTs, training members to participate more effectively, resolve conflicts and improve the overall students' performance in group assignments with increased levels of satisfaction.

7. LIMITATIONS AND FUTURE RESEARCH

There are a number of limitations in this research. Firstly, the environment of this research was confined to a specific unit and the task was designed for this unit and so the results may not be strictly generalizable. Secondly, while students were advised not to employ other communication means in addition to FTF meetings (FTF) and Blackboard discussion board (OLTs) it is possible that they may have used email, SMS, Instant Messenger (IM) and telephone to communicate additionally. This uncontrollable phenomenon may have produced bias and affected the results.

Future research should include study of the impact of new technologies such as Blog and Instant Messenger (IM) and the interaction of several technologies in a number of different 'real life' scenarios. Furthermore, more longitudinal studies are required combining both qualitative and quantitative analyses.

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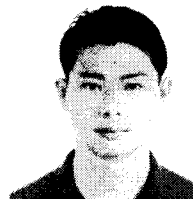
Janice Burn is a Professor in the School of Management at Edith Cowan University, having previously held similar positions in UK, Canada, and Hong Kong. She researches and has published widely in the areas of Strategic Systems, E-Commerce and Virtual Organisations. She now lives in France and enjoys the life of a 'Virtual Professor'.

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**Appendix 1 TEMPO Coding System (drawn from Futoran et al., 1989, p. 219)**

Production Function Categories (Task dimension)

Item	Code	Number	Item	Code	Number
Content			**Process**		
Propose					
New-task content	cp1	7	Goals	pp1	1
Prior	cp2	8	Strategies	pp2	2
Dictate	cp3	9	Acts	pp3	3
Evaluate					
Agree with/accept	ce1	10	Agree with/accept	pe1	4
Clarify/modify	ce2	11	Clarify/modify	pe2	5
Disagree	ce3	12	Disagree	pe3	6
Reject/Veto	ce4	13			
Non-production Function Categories (Social dimension)					
Task digression	npt	14	React to experiment	npr	17
Personal comments	npp	15	Digressions	npd	18
Interpersonal comments	npi	16	Uninterpretable	npu	19

Appendix 2 The summary of the frequency distribution and percentage of the discourse of FTF teams

Team no	Per	Time (min)	Codes	Codes/ Time	pp_sub	pe_sub	p_total	cp_sub	ce_sub	c_total	np_sub
1	Exc	105	131	1.25	34(26%)	22(17%)	56(43%)	42(32%)	21(16%)	63(48%)	12(9%)
2	Exc	65	71	1.09	14(20%)	10(14%)	24(34%)	13(18%)	16(23%)	29(41%)	18(25%)
3	Exc	125	211	1.68	44(21%)	34(16%)	78(37%)	79(37%)	39(18%)	118(56%)	15(7%)
4	Exc	70	147	2.1	13(9%)	23(16%)	36(24%)	33(22%)	35(24%)	68(46%)	43(29%)
5	Exc	80	137	1.71	24(18%)	26(19%)	50(36%)	32(23%)	35(26%)	67(49%)	20(15%)
Sub/Average		89	139.4	1.57	129(19%)	115(16%)	244(35%)	199(29%)	146(21%)	345(49%)	108(15%)
6	Mod	100	155	1.55	18(12%)	17(11%)	35(23%)	44(28%)	39(25%)	83(54%)	37(24%)
7	Mod	72	102	1.42	17(17%)	6(6%)	23(23%)	21(21%)	14(14%)	35(34%)	44(43%)
8	Mod	75	133	1.77	17(13%)	13(10%)	30(23%)	47(35%)	45(34%)	92(69%)	11(8%)
9	Mod	77	178	2.31	24(13%)	29(16%)	53(30%)	41(23%)	31(17%)	72(40%)	53(30%)
10	Mod	115	103	0.89	15(15%)	71(11%)	162(24%)	48(47%)	12(12%)	60(58%)	22(21%)
Sub/Average		87.8	134.2	1.59	91(14%)	71(11%)	162(24%)	201(30%)	141(21%)	342(51%)	167(25%)
11	Poor	110	206	1.87	35(17%)	23(11%)	58(28%)	73(35%)	35(17%)	108(52%)	40(19%)
12	Poor	67	105	1.57	20(19%)	20(19%)	40(38%)	25(24%)	17(16%)	42(40%)	23(22%)
13	Poor	65	131	2.01	17(13%)	23(18%)	40(31%)	49(37%)	25(19%)	74(56%)	17(13%)
14	Poor	75	81	1.08	22(27%)	19(23%)	41(51%)	16(20%)	9(11%)	25(31%)	15(19%)
15	Poor	75	104	1.39	18(17%)	16(15%)	34(33%)	33(32%)	12(12%)	45(43%)	25(24%)
Sub/Average		78.4	125.4	1.58	112(18%)	101(16%)	213(34%)	196(31%)	98(16%)	294(47%)	120(19%)

Per: Performance (excellent/moderate/poor), codes/time: how many codes per minute, pp_sub: sub-total of Process-Propose, pe_sub: sub-total of Process-Evaluate, p_total: total of Process, cp_sub: sub-total of Content-Propose, ce_sub: sub-total of Content-Evaluate, c_total: total of Content, np_sub: Non-production categories

**Appendix 3 A communication pattern example of FTF team 3**
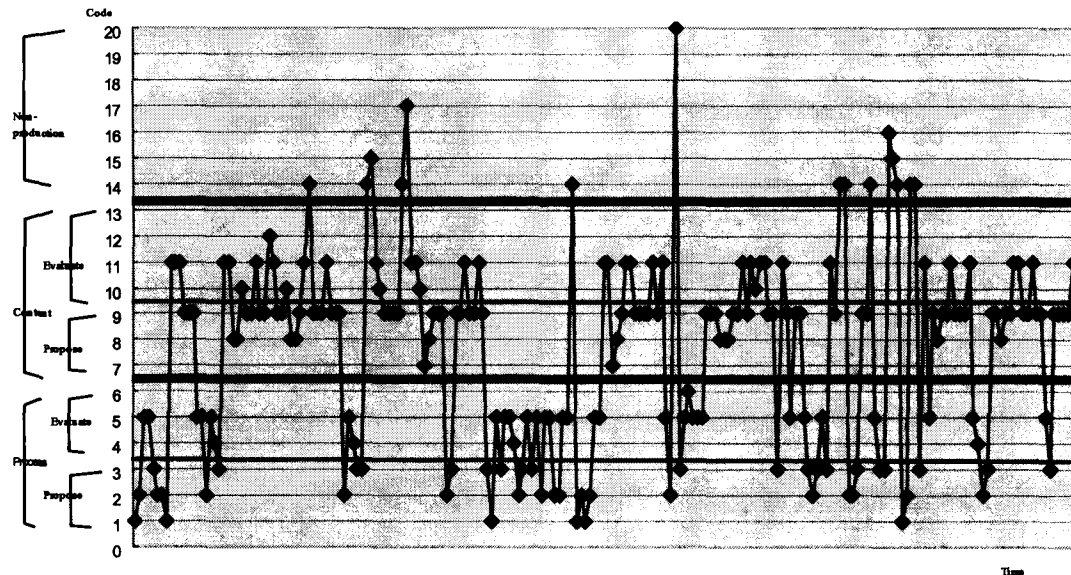
Appendix 4 The summary of the frequency distribution and percentage of the postings of OLTs

Team no	per	posts	codes	codes/posts	pp_sub	pe_sub	p_total	cp_sub	ce_sub	c_total	np_sub
1	Exc	172	181	1.05	53(29%)	35(19%)	88(49%)	32(18%)	31(17%)	63(35%)	30(17%)
2	Exc	103	155	1.50	36(23%)	25(16%)	61(39%)	46(30%)	34(22%)	80(52%)	14(9%)
3	Exc	77	84	1.09	26(31%)	16(19%)	42(50%)	26(31%)	10(12%)	36(43%)	6(7%)
4	Exc	72	101	1.40	24(24%)	13(13%)	37(37%)	26(26%)	26(26%)	52(51%)	12(12%)
5	Exc	58	63	1.09	14(22%)	10(16%)	24(38%)	14(22%)	19(30%)	33(52%)	6(10%)
Sub/Average		96.4	116.8	1.23	153(26%)	99(17%)	252(43%)	144(25%)	120(21%)	264(45%)	68(12%)
6	Mod	213	241	1.13	34(14%)	27(11%)	61(25%)	85(35%)	90(37%)	175(73%)	5(2%)
7	Mod	114	148	1.30	28(19%)	32(22%)	60(41%)	24(16%)	24(16%)	48(32%)	40(27%)
8	Mod	114	141	1.24	41(29%)	30(21%)	71(50%)	23(16%)	24(17%)	47(33%)	23(16%)
9	Mod	112	113	1.01	32(28%)	26(23%)	58(51%)	23(20%)	21(19%)	44(39%)	11(10%)
10	Mod	75	105	1.40	157(21%)	142(19%)	299(40%)	172(23%)	177(24%)	349(47%)	100(13%)
Sub/Average		125.6	149.6	1.22	22(21%)	27(26%)	49(47%)	17(16%)	18(17%)	35(33%)	21(20%)
11	Poor	71	89	1.25	23(26%)	17(19%)	40(45%)	18(20%)	27(30%)	45(51%)	4(4%)
12	Poor	62	81	1.31	34(42%)	20(25%)	54(67%)	7(9%)	9(11%)	16(20%)	11(14%)
13	Poor	46	59	1.28	21(36%)	19(32%)	40(68%)	5(8%)	9(15%)	14(24%)	5(8%)
14	Poor	34	45	1.32	19(42%)	10(22%)	29(64%)	4(9%)	5(11%)	9(20%)	7(16%)
15	Poor	25	34	1.36	7(21%)	8(24%)	15(44%)	11(32%)	6(18%)	17(50%)	2(6%)
Sub/Average		47.6	61.6	1.31	47(34%)	37(27%)	84(61%)	20(14%)	20(14%)	40(29%)	14(10%)

Per: Performance (excellent/moderate/poor), pp_sub: sub-total of Process-Propose, pe_sub: sub-total of Process-Evaluate, p_total: total of Process, cp_sub: sub-total of Content-Propose, ce_sub: sub-total of Content-Evaluate, c_total: total of Content, np_sub: Non-production categories

Appendix 5 Communication pattern of OLT team 1

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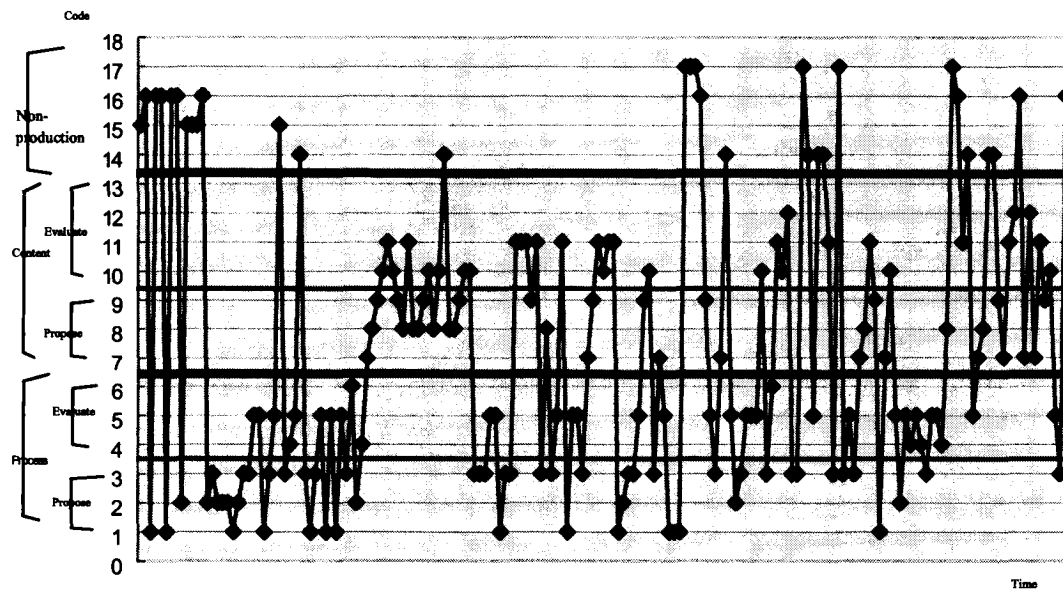
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