CHAPTER 4

DATA ANALYSIS AND RESULTS

4.1 Introduction

This chapter presents the findings in relation to the four research questions posed in Chapter 1.

Data obtained from the pretest and posttest, and the reading scores before and after OC were used to investigate the effects of OC on the reading performance of ESL students. Data from the online transcripts obtained from the RAP website, and ESL students' written assignments were used to answer research questions regarding the patterns of interaction. The patterns of interaction would reveal the process through which co-construction of knowledge occurs. The discussion threads captured online facilitated the study of the evolution and development of the patterns of interaction. Data from the online discussion shed light on the group processes that brought about the convergence of shared meanings during interaction. Online transcripts were collected and a content analysis was conducted for patterns of interaction, focusing on the following four phases of interaction i.e. Phase I: Sharing of information; Phase II: Discovering the inconsistency of ideas, concepts or statements; Phase III: Negotiating for meaning/ Co-constructing knowledge; and Phase IV: Making agreement statements/Applying newly-constructed knowledge. Each interactive phase is characterized by specific operations which may occur at each stage. The analysis focused on the interactive dynamics as they occur among the participants. A content

analysis on the online transcripts was carried out whereby the messages were broken down into units of meaning (Henri, 1992). These units of meanings were then classified according to predetermined categories of an adapted version of the Interactive Analysis Model (Appendix J) which was based on Gunawardena et al. (1997) and Sringam and Geer's (2001) models. This method takes a dynamic and process-oriented approach to interaction. By concentrating on individual and group functioning, the method was aimed at highlighting the dynamics of peer group interaction for examining the co-construction of knowledge. The data revealed the patterns of interaction that ESL learners exhibited when collaborating online, thereby answering the remaining three research questions.

The data were analyzed to answer the following research questions:

1 What are the effects of online collaboration on reading performance of ESL students?

2 What is the pattern of interaction demonstrated by ESL students when they collaborate online?

3 What are differences in the patterns of interaction when ESL students work on different reading tasks collaboratively online?

4 What is the nature of the relationship between the patterns of interaction and the reading performance of ESL students when they collaborate online?

Both quantitative and qualitative procedures were used in addressing the four research questions. Qualitative analyses involved identifying and coding nine sets of online discussions for patterns of interaction using predetermined categories based on an adapted version of the Interactive Analysis Model (Gunawardena et al. 1997; Sringam & Greer, 2001). The online contributions were taken from three groups when they collaborated on the reading tasks of Previewing and Predicting, Identifying Sentence Patterns and Paraphrasing. Then the results of the qualitative analyses were quantitatively analyzed to look for patterns of interaction. The pretest and posttest results, and the reading scores before and after collaboration were also quantitatively analyzed to investigate the effects of collaboration on ESL students' reading performance.

This chapter presents the quantitative results of the findings and the major findings. The quantitative results are presented in four sections, which correspond to the four research questions addressed in this study. The first section compared the pretest and posttest performance of ESL students. It also compared the reading scores of ESL students before and after OC. Paired samples t-tests were carried out to investigate the effects of OC on the reading performance of ESL students at both the individual and the group levels.

The second section explores the patterns of interaction demonstrated when ESL students collaborated online. This included investigating the frequencies, percentages and instances of operations generated by ESL students during online discussions. Each interactive phase is characterized by specific operations. Secondly, the differences in

the operations generated by interactive phases were also considered. For these purposes both descriptive and inferential statistics were employed.

The third section examines the differences in the patterns of interaction demonstrated by ESL students when they worked on different reading tasks during OC. At first, comparisons between the frequencies and percentages of operations generated from the three different reading tasks were carried out. Particular attention was paid to differences in the frequencies of overall operations generated and the frequencies of operations generated by interactive phases. Then, comparisons were carried out between the differences in the operations generated by interactive phases between the three reading tasks.

The fourth section investigates the nature of the relationship between patterns of interaction demonstrated by ESL groups and their reading performance. The analyses were geared towards determining if there was a correlation between the frequency of overall operations demonstrated and the overall reading scores of the groups. Further analysis was carried out to determine if there was a correlation between the overall reading scores and the operations demonstrated by interactive phases. Moreover, to discover which operation was positively or negatively correlated with reading performance, a measure of correlation was carried out between the frequency of operations used and overall reading performance.

The fifth section comprises the major findings whereby the results of the quantitative analyses were combined with qualitative data from the online transcripts and ESL students' written assignments.

4.2 Online collaboration and reading performance

This section presents the findings of the effects of online collaboration on the reading performance of college ESL students. To answer this question, two sets of data were analysed. First, a paired samples t-test was carried out on the individual ESL students' mean scores for both the pretest and posttest. This was followed by a paired samples t-test on the groups' mean scores for the pretest and posttest. Then a paired samples t-test was carried out on the individual ESL students' mean scores for reading which were obtained before and after online collaboration. This was subsequently followed by a paired samples t-test on ESL groups' mean scores for reading before and after online collaboration.

4.2.1 Performance of individuals in the pretest and posttest

The pretest and posttest scores of individual ESL students were used to examine the effects of OC on the reading performance. The same set of questions was used in both the pretest and posttest. The results in Table 4.1 show the overall total mean scores for the pretest and posttest, and the mean scores for the pretest and posttest by question. ESL students' overall total mean scores for the pretest and posttest were 13.73 and 19.48 respectively. An examination of the means suggests that the average scores were higher in the posttest.

The results in Table 4.1 also show that out of a total of 12 questions, the mean scores for 11 questions in the posttest were higher than the mean scores for the pretest.

The only exception was question 8 which had a higher mean score in the pretest (.84) compared to the mean score in the posttest (.75). This means that ESL students performed better in almost all the questions in their posttest with the exception of question 8.

Table 4.1

Individual ESL students' mean scores for pretest and posttest by question

Question	Test	Mean	SD	Std Error Mean
Question 1	Pretest	3.14	1.07	.20
	Posttest	3.93	.77	.14
Question 2	Pretest	1.80	1.09	.21
	Posttest	3.79	.763	.14
Question 3	Pretest	.68	.82	.15
	Posttest	1.05	.59	.11
Question 4	Pretest	.25	.59	.11
	Posttest	.78	.568	.11
Question 5	Pretest	2.41	.82	.15
	Posttest	2.57	.59	.11
Question 6	Pretest	.54	.51	.09
	Posttest	.60	.49	.09
Question 7	Pretest	.88	.52	.09
	Posttest	1.48	.55	.10
Question 8	Pretest	.84	.81	.15
	Posttest	.75	.59	.11
Question 9	Pretest	.71	.84	.16
	Posttest	.88	.81	.15
Question 10	Pretest	1.30	.89	.17
	Posttest	1.68	.63	.12
Question 11	Pretest	.29	.71	.13
	Posttest	.95	.96	.18
Question 12	Pretest	.91	.91	.17
	Posttest	1.04	.72	.14
Overall total	Pretest	13.73	4.56	.86
	Posttest	19.48	3.07	.58

N= 28

The paired samples t-test in Table 4.2 reveals a significant difference in the overall total mean scores for the pretest and posttest, [t = 7.75, p = .000]. The mean difference between the posttest and pretest was 5.75. This was due to the fact that the mean posttest score (M= 19.48) was significantly higher than the mean pretest score (M=13.73). Therefore, this shows that OC has resulted in a highly significant overall increase in the individual students' performance in this study.

The results of the paired samples t-test also reveal significant differences in the mean pretest and posttest scores, for question 1[t =4.93, p =.000]; question 2 [t =8.59, p =.000]; question 3 [t =2.38, p = .03]; question 4 [t =3.69, p =.000]; question 7 [t=4.07, p =.000]; question 10 [t =1.92, p =.07]; and question 11 [t =3.92, p =.000]. The mean difference between the pretest and posttest for questions 1-4, 7, 10 and 11 were .79, 1.98, .38, .54, , .63, .38, and .66 respectively. The mean posttest scores were higher than the mean pretest scores for all these seven (7) questions.

However, there were no significant differences in the pretest and posttest scores for question 5 [t = .95, p =.35]; question 6 [t = .63, p = .54]; question 8 [t = -.47, p =.64]; question 9 [t = .72, p =.48]; and question 12 [t = .65, p =.52]. The mean difference between the pretest and posttest for questions 5, 6, 8, 9 and 12 were .16, .07, -.09, .14, and .13 respectively. With the exception of question 8, the mean pretest scores of the other questions were higher than the mean posttest scores. Thus, this shows that in this study, OC has a positive effect on the individual students' reading performance for most of the questions but not all.

Table 4.2

T-test results comparing individual ESL students' posttest and pretest mean scores by question

Question	Mean	SD	Std Error Mean	*t*-value	Sig. (2-tailed)
Question 1					
Posttest & Pretest	.79	.84	.16	4.93	.000**
Question 2					
Posttest & Pretest	1.98	1.22	.23	8.59	.000**
Question 3					
Posttest & Pretest	.38	.83	.16	2.38	.03*
Question 4					
Posttest & Pretest	.54	.77	.15	3.69	.000**
Question 5					
Posttest & Pretest	.16	.89	.17	.95	.35
Question 6					
Posttest & Pretest	.07	.60	.11	.63	.54
Question 7					
Posttest & Pretest	.63	.81	.15	4.07	.000**
Question 8					
Posttest & Pretest	-.09	1.00	.19	-0.47	.64
Question 9					
Posttest & Pretest	.14	1.05	.20	.72	.48
Question 10					
Posttest & Pretest	.38	1.03	.20	1.92	.07*
Question 11					
Posttest & Pretest	.66	.89	.17	3.92	.000**
Question 12					
Posttest & Pretest	.13	1.02	.19	.65	.52
Posttest & Pretest Total	5.75	3.92	.74	7.75	.000**

N= 28

*significant level at $p < .05$ **very significant level at $p < .01$

The results in Tables 4.1 and 4.2 suggest that in this study, OC has resulted in a highly significant increase in the overall individual students' reading performance.

However, in terms of performance by question, the results show that OC has resulted in a significant increase in their performance for most of the questions with the exception of five (5).

4.2.2 Performance of groups in the pretest and posttest

Whilst Tables 4.1 to 4.2 above provide evidence that in this study, OC was effective in increasing the individual student's performance, it is equally important to examine the effects of OC on group performance. To do this, a paired samples t-test was carried out on the ESL groups' overall total mean scores for the pretest and posttest. The overall total mean scores of the groups in the pretest and posttest were 13.73 and 19.49 respectively as shown in Table 4.3.

A closer analysis of the groups' performance by question reveals that they obtained higher mean scores in the posttest compared to the pretest for all the questions except for question 8. For this question, ESL groups had higher mean scores for the posttest (.84) compared to the posttest (.75).

The paired samples t-test in Table 4.4 shows the effects of OC on ESL groups' overall total mean scores and the mean scores by question. The mean difference between the overall total pretest and posttest scores was 5.75. This was due to the fact that the overall total mean posttest score (M=19.49) was higher than the mean pretest score (M=13.73). The paired samples t-test below shows a significant difference between the overall total mean scores of the pretest and posttest, [t = 12.07, p =.000].

This shows that in this study, OC has significantly increased the overall group performance.

Table 4.3

ESL groups' mean scores for posttest and pretest by question

Question	Test	Mean	SD	Std Error Mean
Question 1	Pretest	3.14	.42	.16
	Posttest	3.93	.29	.11
Question 2	Pretest	1.80	.54	.21
	Posttest	3.79	.35	.13
Question 3	Pretest	.68	.38	.14
	Posttest	1.05	.36	.14
Question 4	Pretest	.25	.25	.09
	Posttest	.79	.27	.10
Question 5	Pretest	2.41	.41	.15
	Posttest	2.57	.35	.13
Question 6	Pretest	.54	.30	.11
	Posttest	.61	.20	.07
Question 7	Pretest	.86	.20	.07
	Posttest	1.48	.25	.10
Question 8	Pretest	.84	.09	.04
	Posttest	.75	.29	.11
Question 9	Pretest	.71	.50	.19
	Posttest	.86	.60	.23
Question 10	Pretest	1.30	.42	.16
	Posttest	1.68	.26	.10
Question 11	Pretest	.29	.39	.15
	Posttest	.95	.36	.14
Question 12	Pretest	.91	.27	.10
	Posttest	1.04	.19	.07
Overall total	Pretest	13.73	.57	.21
	Posttest	19.49	1.03	.39

N= 7

Table 4.4 which shows the paired samples t-test on the groups' mean scores by question reveals significant differences in the mean scores of the pretest and posttest for five (5) questions which were question 1[*t* =4.21, p = .006]; question 2 [*t* =8.42, p =.000]; question 4 [*t* =3.73, p =.010]; question 7 [*t*=4.41, p =.005]; and question 11 [*t* =3.37, p=.015]. The mean difference between the pretest and posttest for the questions 1, 2, 4, 7, and 11 were .79, 1.98, .54, .63, and .66 respectively. The mean posttest scores were higher than the mean pretest scores for all these questions.

However, there were no significant differences in the pretest and posttest scores for question 5 [*t* = .99, p =.362]; question 6 [*t* = .60, p =.569]; question 8 [*t* = -.74, p=.489], question 9 [*t* = .67, p =.529]; question 10 [*t* =1.64, p =.151]; and question 12 [*t*= 1.11, p =.309]. The mean difference between the pretest and posttest for questions 5, 6, 8, 9, 10 and 12 were .16, .07, -.09, .14, .38 and .13 respectively. The results show that the mean pretest score was higher than the mean posttest score for question 8 (-.09). The results for question 3 [*t* =1.94, p =.100] show that there was no change between the mean scores for the pretest and posttest. On the whole, the results of the paired samples t-test by question indicate that the effects of OC on ESL groups' performance were mixed.

To summarize, the results of the paired samples t-test in Table 4.4 show a significant difference in the overall total mean pretest and posttest scores of ESL groups indicating that in this study, OC improved the overall performance of ESL groups. However, the results of paired samples t-test by question show that there were significant differences in the mean scores of the pretest and posttest for some questions

only, suggesting that the effects of OC on ESL groups' reading performance was mixed.

Table 4.4

T-test results comparing ESL groups' posttest and pretest mean scores by question

Question	Mean	SD	Std Error Mean	*t*-value	Sig. (2-tailed)
Question 1					
Posttest & Pretest	.79	.49	.19	4.21	.006**
Question 2					
Posttest & Pretest	1.98	.62	.24	8.42	.000**
Question 3					
Posttest & Pretest	.38	.51	.19	1.94	.100
Question 4					
Posttest & Pretest	.54	.38	.14	3.73	.010**
Question 5					
Posttest & Pretest	.16	.43	.16	.99	.362
Question 6					
Posttest & Pretest	.07	.31	.12	.60	.569
Question 7					
Posttest & Pretest	.63	.38	.14	4.41	.005**
Question 8					
Posttest & Pretest	-.09	.32	.12	-.74	.489
Question 9					
Posttest & Pretest	.14	.57	.21	.67	.529
Question 10					
Posttest & Pretest	.38	.60	.23	1.64	.151
Question 11					
Posttest & Pretest	.66	.52	.20	3.37	.015**
Question 12					
Posttest & Pretest	.13	.30	.11	1.11	.309
Posttest & Pretest Total	5.75	1.26	.49	12.07	.000**

N= 7

*significant level at $p < .05$ **very significant level at $p < .01$

4.2.3 Performance of individuals in reading tasks before and after online collaboration

The previous sections show that in this study, OC was generally effective in improving ESL students' performance in the posttest particularly at the individual level. At the group level the results were mixed. The overall total mean scores of ESL groups showed significant improvements but in some questions only. The pretest and posttest results show ESL students' performance at the beginning and the end of the semester.

To examine the effects of OC on ESL students' reading performance on a weekly basis, data from the reading tasks were analyzed. Individual ESL students' scores for the different reading tasks before and after collaboration were analyzed. This was done by first comparing ESL students' overall total mean scores for all the reading tasks before and after OC. Then, the students' mean scores by different reading task before and after collaboration were examined.

Table 4.5 shows the individual ESL students' overall total mean scores for all reading tasks and the mean scores by reading task before and after OC. As was explained in Chapter 3, the total marks scored for the reading tasks was 90 marks as there were nine reading tasks, with each task scored upon 10 marks. The results show that the individual ESL students' overall total mean scores for all the reading tasks before and after collaboration were 64.54 and 77.03 respectively. This shows that in this study, the overall total average reading scores were higher after OC.

Table 4.5

Individual ESL students' mean scores by reading task before and after online collaboration

Reading tasks	Before/After collaboration	Mean	SD	Std Error Mean
Vocabulary	Before	7.52	1.29	.24
	After	9.93	.178	.03
Previewing & Predicting	Before	7.85	1.35	.26
	After	8.86	1.01	.19
Identifying Main Ideas	Before	6.04	1.75	.33
	After	7.96	1.18	.22
Distinguishing between Fact & Opinion	Before	6.75	1.14	.22
	After	7.79	.89	.17
Understanding Sense Relationships within & between Sentences	Before	7.20	.94	.18
	After	8.64	1.24	.23
Making Inferences	Before	7.75	1.21	.23
	After	8.43	.88	.17
Paraphrasing	Before	6.71	2.57	.49
	After	9.00	1.19	.22
Identifying Writer's Attitude	Before	7.18	.94	.18
	After	7.86	.59	.11
Identifying Sentence Patterns	Before	7.64	1.67	.32
	After	8.57	.96	.18
Overall total	Before	64.54	5.68	1.07
	After	77.03	3.43	.65

N= 28

The efficacy of OC on ESL students' performance in this study can be further affirmed by examining the mean scores by reading tasks before and after collaboration. Table 4.5 shows that the individual student's mean scores before and after collaboration were 7.52 and 9.93 for Vocabulary; 7.85 and 8.86 for Previewing and Predicting; 6.04

and 7.96 for Identifying Main Ideas; 6.75 and 7.79 for Distinguishing between Fact and Opinion; 7.20 and 8.64 for Understanding Sense Relationships within and between Sentences; 7.75 and 8.43 for Making Inferences; 6.71 and 9.00 for Paraphrasing; 7.18 and 7.86 for Identifying Writer's Attitude; and 7.64 and 8.57 for Identifying Sentence Patterns. This shows that the average reading scores for all the reading tasks were higher after OC.

The results of the paired samples t-test in Table 4.6 reveal a significant difference in the overall total mean scores before and after OC, [t=10.85, p =.000]. The mean difference between the pretest and posttest was 12.49. This was because the overall total mean score after collaboration (M=77.03) was significantly higher than the overall total mean score before collaboration (M= 64.54). Hence, this implies that OC has resulted in a significant increase in the individual students' overall reading performance in this study.

The results of the paired samples t-tests also reveal significant differences in the mean scores for Vocabulary [t = 10.05, p =.000]; Previewing and Predicting [t = 4.49, p =.000]; Identifying Main Ideas [t = 6.05, p = .000]; Distinguishing between Fact and Opinion [t = 4.15, p = .000]; Understanding Sense Relationships within and between Sentences [t = 5.37, p = .000]; Making Inferences [t = 2.51, p = .018]; Paraphrasing [t = 4.63, p = .000]; Identifying Writer's Attitude [t = 2.98, p = .006]; Identifying Sentence Patterns [t = 2.48, p = .020]. The mean difference between the reading scores before and after collaboration were 2.41 for Vocabulary; 1.01 for Previewing and Predicting; 1.92 for Identifying Main Ideas; 1.04 for Distinguishing between Fact and Opinion; 1.44 for Understanding Sense Relationships within and between Sentences; .69 for

Making Inferences; 2.29 for Paraphrasing; .68 for Identifying Writer's Attitude; and .93 for Identifying Sentence Patterns. All these confirm that OC in this study has resulted in the improved reading performance of the individual ESL students when they worked on different reading tasks.

Table 4.6

T-test results comparing individual ESL students' mean scores by reading task before and after online collaboration

Reading task (After-Before)	Mean	SD	Std Error Mean	*t*-value	Sig. (2-tailed)
Vocabulary	2.41	1.27	.24	10.05	.000**
Previewing & Predicting	1.01	1.19	.22	4.49	.000**
Identifying Main Idea	1.92	1.68	.32	6.05	.000**
Distinguishing between Fact & Opinion	1.04	1.33	.25	4.15	.000**
Understanding Sense Relationships within & between Sentences	1.44	1.42	.272	5.37	.000**
Making Inferences	.69	1.43	.27	2.51	.018**
Paraphrasing	2.29	2.61	.49	4.63	.000**
Identifying Writer's Attitude	.68	1.19	.23	2.98	.006**
Identifying Sentence Patterns	.93	1.98	.37	2.48	.020*
Overall total (After & Before)	12.49	6.09	1.15	10.85	.000**

N= 28

*significant level at $p < .05$ **very significant level at $p < .01$

4.2.4 Performance of groups in reading tasks before and after online collaboration

The results of the paired samples t-test in Tables 4.6 above confirm that the individual student's performance improved after OC. Nevertheless, to examine the

effects of OC on group performance, a paired samples t-test was carried out on ESL groups' overall total mean scores of the reading tasks before and after collaboration. Table 4.7 shows ESL groups' mean scores by reading task before and after OC. The results show that the overall total mean scores for reading before and after collaboration were 64.54 and 77.03 respectively as shown in Table 4.7.

Table 4.7

ESL groups' mean scores by reading task before and after online collaboration

Reading task	Before/After collaboration	Mean	SD	Std Error Mean
Vocabulary	Before	7.56	.59	.22
	After	9.93	.189	.07
Previewing & Predicting	Before	7.85	.89	.31
	After	8.86	1.07	.40
Identifying Main Idea	Before	6.04	.98	.37
	After	7.96	1.25	.47
Distinguishing between Fact & Opinion	Before	6.76	.80	.30
	After	7.79	.95	.36
Understanding Sense Relationships within & between Sentences	Before	7.19	.45	.17
	After	8.64	1.31	.49
Making Inferences	Before	7.57	.75	.28
	After	8.43	.932	.35
Paraphrasing	Before	6.75	1.05	.39
	After	9.00	1.26	.48
Identifying Writer's Attitude	Before	7.18	.45	.17
	After	7.86	.63	.24
Identifying Sentence Patterns	Before	7.65	.44	.17
	After	8.57	1.02	.38
Overall total	Before	64.54	2.44	.92
	After	77.03	3.64	1.38

N= 7

So far in this study, quantitative analyses have shown that OC has a positive effect on both individual and groups' overall performances. Nevertheless, it is important to examine whether the groups' mean scores for the different reading tasks improved after OC. Table 4.7 shows that ESL groups' mean scores before and after collaboration were 7.56 and 9.93 for Vocabulary; 7.85 and 8.86 for Previewing and Predicting; 6.04 and 7.96 for Identifying Main Ideas; 6.76 and 7.79 for Distinguishing between Fact and Opinion; 7.19 and 8.64 for Understanding Sense Relationships within and between Sentences; 7.57 and 8.43 for Making Inferences; 6.75 and 9.00 for Paraphrasing; 7.18 and 7.86 for Identifying Writer's Attitude; and 7.65 and 8.57 for Identifying Sentence Patterns. The results reveal that the mean scores were higher for the different reading tasks after collaboration.

Table 4.8 shows the t-test results comparing ESL groups' mean scores by reading task before and after OC. The mean difference between the overall total mean scores before and after OC was 12.49, a result of the difference between the overall total mean score after collaboration (M = 77.03) and the overall total mean score before collaboration (M = 64.54). The paired samples t-test shows a significant difference in the overall total mean score for reading [t = 9.82, p = .000). What this means is that in this study, OC has a positive effect on the overall performance of ESL groups.

Table 4.8

T-test results comparing ESL groups' mean scores by reading task before and after online collaboration

Reading task	Mean	SD	Std Error Mean	*t*-value	Sig. (2-tailed)
Vocabulary (After-Before)	2.37	.54	.20	11.63	.000**
Previewing & Predicting (After-Before)	1.00	.44	.17	6.03	.001**
Identifying Main Idea (After-Before)	1.92	.83	.31	6.16	.001**
Distinguishing between Fact & Opinion (After-Before)	1.02	1.07	.40	2.54	.044*
Understanding Sense Relationship within and between Sentences (After-Before)	1.45	1.28	.48	2.99	.024*
Making Inferences (After-Before)	.86	1.20	.46	1.88	.109
Paraphrasing (After-Before)	2.25	1.23	.46	4.84	.003**
Writer's Attitude (After-Before)	.67	.90	.34	1.98	.096
Identifying Sentence Patterns (After-Before)	.93	1.21	.46	2.03	.089
Overall total (After-Before)	12.49	3.36	1.27	9.82	.000**

N= 7

*significant level at $p < .05$ **very significant level at $p < .01$

Table 4.8 which shows the results of the paired samples t-tests reveal significant differences in the mean scores of six (6) of the reading tasks. They were Vocabulary [*t*

= 11.63, p = .000]; Previewing and Predicting [*t* = 6.03, p = .001]; Identifying Main Ideas [*t* = 6.16, p = .001]; Distinguishing between Fact and Opinion [*t* = 2.54, p = .044]; Understanding Sense Relationships within and between Sentences [*t* =2.99, p= .024]; and Paraphrasing [*t* = 4.84, p = .003]. The mean difference between the reading scores before and after collaboration were 2.37 for Vocabulary; 1.00 for Previewing and Predicting; 1.92 for Identifying Main Ideas; 1.02 for Distinguishing between Fact and Opinion; 1.45 for Understanding Sense Relationships within and between Sentences; and 2.25 for Paraphrasing. However, the results reveal that there were no significant differences in the mean scores for Making Inferences [*t*= 1.88, p= .109]; Identifying Writer's Attitude [*t* = 1.98, p= .096] and Identifying Sentence Patterns [*t* = 2.03, p=.089]. This was despite the fact that the mean scores obtained after collaboration were higher than the mean scores obtained before collaboration for all three tasks. The mean difference between the reading scores before and after collaboration were .86 for Making Inferences; .67 for Identifying Writer's Attitude; and .93 for Identifying Sentence Patterns. These results show that in this study OC was effective in improving the performance of ESL groups for some reading tasks but not for the others.

4.2.5 Section summary

In this study, the results of the paired samples t-tests comparing ESL students' mean scores for the pretest and posttest have provided evidence that OC was effective in improving the overall reading performance at both the individual and group levels.

Nevertheless, the results show that OC was successful in improving ESL students' performance for some questions only. This is further confirmed by the results of the paired samples t-tests comparing ESL students' mean scores for the different reading tasks before and after OC. At the individual level, the results showed that there were significant differences in the mean scores for all the reading tasks indicating that ESL individual students' reading performance for all the reading tasks improved after collaboration. Likewise, at the group level, ESL students obtained higher mean scores for all the reading tasks after collaboration compared to the mean scores before collaboration. Nevertheless, out of the nine reading tasks, only six showed significant differences in the mean scores. Three reading tasks did not show significant difference in the mean scores implying that in this study, OC generally has positive effects on the reading performance of ESL students for most of the reading tasks but not all.

4.3 Patterns of interaction during online collaboration

The second research question sought to investigate the patterns of interaction demonstrated by ESL learners during OC. The patterns of interaction would reveal the process of knowledge construction during OC. Data from online discussions produced by groups A, D and E were collected and a content analysis was conducted to answer this question. The analysis was conducted in two parts. Quantitative analysis comprised descriptive statistics using frequencies and percentages of predetermined instances of interactive phases of the online discussion, and inferential statistics using Friedman analysis of variance by ranks and Wilcoxon signed-rank test. Descriptive analysis was

conducted on the online transcripts of the three groups to establish the patterns of interaction for each reading task using predetermined categories of an adapted version of the Interactive Analysis Model (Gunawardena et al., 1997; Sringam & Geer, 2001). The online transcripts were obtained when the groups worked on selected reading tasks assigned during the semester. Data from the online discussions were analyzed for interactive dynamics focusing on the following four predetermined phases of interaction i.e. Phase I: Sharing of information, Phase II: Discovering the inconsistency of ideas, concepts or statements, Phase III: Negotiating for meaning/ Co-constructing knowledge, Phase IV: Making agreement statements/ Applying newly-constructed meaning. This is a process-oriented approach to interaction which focused on group functioning, thereby highlighting the dynamics of peer group interaction.

4.3.1 Frequencies, percentages and instances of operations used

This section presents the findings based on the coding of the online transcripts, which looked at the patterns of interaction of ESL groups. For this purpose, an adapted version of the Interactive Analysis Model (Gunawardena et al., 1997; Sringam & Geer, 2001) was used (refer to Appendix J). The adapted version of the Interactive Analysis Model comprised four phases i.e. Phases 1 to IV. Furthermore, each phase is characterized by certain operations. There were six (6) operations in Phase I, three (3) operations in Phase II, four (4) operations in Phase III, and two (2) operations in Phase IV.

Out of the seven groups in this study, the online transcripts of three groups i.e. groups A, D and E were analyzed. In addition, the online discussions on the three reading tasks of Previewing and Predicting, Identifying Sentence Patterns and Paraphrasing were used for this purpose. The discussions for these reading tasks were carried out during the second, seventh and ninth week respectively. The rationale for the selection of the groups (refer to 3.3.2) and the reading tasks (refer to 3.5.3) for analyses were discussed in Chapter 3.

Table 4.9 displays the frequency and percentage of operations of groups A, D and E during their online discussions on the three selected reading tasks. The 15 operations from the adapted version of the Interactive Analysis Model were also ranked in order of frequency, with the lowest frequency being assigned the rank of 1 and the highest frequency the rank of 15.

The analyses reveal that the total number of operations generated by ESL groups was 756. Out of the 15 operations, the most dominant operation used by the groups was “Expressing a statement of observation or opinion”, which made up 22.88% (Freq=173). This was followed by “Expressing a statement of agreement from one or more other participants” with 14.68% (Freq=111). The least used operation was “Integrating or accommodating metaphors or analogies” which made up only 0.4% (Freq =3). There was also a tie in the use of the operations “Applying new knowledge” and “Identifying areas of agreement or overlap among conflicting concepts” which made up 2.12% (Freq=16) each.

Table 4.9

Frequency, percentage and rank-order of operations of ESL students on the reading tasks of Previewing and Predicting, Identifying Sentence Patterns and Paraphrasing

Rank-order	Operations	Frequency (Freq)	Percentage (%)
15	Expressing a statement of observation or opinion	173	22.88
14	Expressing a statement of agreement from one or more other participants	111	14.68
13	Challenging others to engage in group discussion.	87	11.50
12	Asking and answering questions to clarify details of statements	82	10.85
11	Defining, describing, or identifying a problem	59	7.80
10	Identifying and stating areas of disagreement	49	6.48
9	Restating the participants' position, and advancing arguments or considerations supported by references	41	5.42
8	Asking and answering questions to clarify the source and extent of disagreement	34	4.50
7	Corroborating examples provided by one or more participants	26	3.44
6	Negotiating or clarifying the meaning of terms	21	2.78
5	Summarizing of agreement	20	2.65
4	Proposing and negotiating new statements embodying compromise, co-construction	18	2.38
2.5	Applying new knowledge	16	2.12
2.5	Identifying areas of agreement or overlap among conflicting concepts	16	2.12
1	Integrating or accommodating metaphors or analogies	3	0.40
	Total	756	100.00

As was mentioned above, the 15 operations were classified into four main phases which comprised Phase I: Sharing of information, Phase II: Discovering the inconsistency of ideas, concepts or statements, Phase III: Negotiating for meaning/ Co-constructing knowledge, and Phase IV: Making agreement statements/ Applying newly-constructed meaning (Appendix J).

4.3.2. Frequencies, percentages and operations by interactive phase

Table 4.10 shows the four interactive phases and the respective operations generated by ESL students. In addition, the frequency and percentage of operations used by interactive phase are also presented. Of the four phases, the phase that generated the highest number of operations was Phase I: Sharing of information, comprising 71.15% (Freq=538) followed by Phase II: Discovering Inconsistency among Ideas, Concepts, or Statements, at 16.40% (Freq=124). The phase that generated the least operations was Phase IV: Making Agreement Statement(s)/Applying Newly-Constructed Meaning at 4.77% (Freq=36). The descriptive data in percentages suggest that there were differences in ESL students' use of operations.

To confirm these differences statistically, the Friedman analysis of variance by ranks was applied on the overall frequency in the operations used by interactive phase (see Table 4.11). The resulting value of χ_r^2 was statistically significant, $\chi_r^2 = 25.584$; df= 3.0, p= .000.

Table 4.10

Frequency, percentage of operations by interactive phase for the reading tasks of Previewing and Predicting, Identifying Sentence Patterns and Paraphrasing

Interactive Phase/Operations	Freq	% (Type)	% (Phase)
Phase I: Sharing of Information			
A. Expressing a statement of observation or opinion	173	32.16	
B. Expressing a statement of agreement from one or more other participants	111	20.63	
C. Corroborating examples provided by one or more participants	26	4.83	
D. Asking and answering questions to clarify details of statements	82	15.24	
E. Defining, describing, or identifying a problem	59	10.97	
F. Challenging others to engage in group discussion.	87	16.17	
Total	538	100	71.15
Phase II: Discovering Inconsistency among Ideas, Concepts, or Statements			
A. Identifying and stating areas of disagreement	49	39.52	
B. Asking and answering questions to clarify the source and extent of disagreement	34	27.42	
C. Restating the participants' position, and advancing arguments or considerations supported by references	41	33.06	
Total	124	100	16.40
Phase III: Negotiating for Meaning/Co-Constructing Knowledge			
A. Negotiating or clarifying the meaning of terms	21	36.21	
B. Identifying areas of agreement or overlap among conflicting concepts	16	27.59	
C. Proposing and negotiating new statements embodying compromise, co-construction	18	31.03	
D. Integrating or accommodating metaphors or analogies	3	5.17	
Total	58	100	7.67
Phase IV: Making Agreement Statement(s)/Applying Newly-Constructed Meaning			
A. Summarizing of agreement	20	55.56	
B. Applying new knowledge	16	44.44	
Total	36	100	4.77
Overall Total	756	100	100.00

Table 4.11

Results of the Friedman analysis of variance by ranks comparing operations by interactive phase

Phase I: Sharing of information	Phase II: Discovering the inconsistency of ideas, concepts or statements	Phase III: Negotiating for meaning/ Co-constructing knowledge	Phase IV: Making agreement statements/ Applying newly-constructed meaning	χ_r^2	df	p
538 (71.16%)	124 (16.40%)	58 (7.67%)	36 (4.77%)	25.584**	3.0	.000

*significant level at $p < .05$ **very significant level at $p < .01$

To further determine the nature of these differences, the Wilcoxon signed-rank test was used. The analysis as shown in Table 4.12 reveals that in general ESL students employed significantly more operations in Phase I (Freq = 538) than Phase II (Freq = 124) at $p< .05$ ($z = -2.666$, $p =.008$). Likewise, ESL students employed notably more operations in Phase I (Freq = 538) than Phase III (Freq = 58) at $p< .05$ ($z = -2.666$, $p= .008$) and Phase IV (Freq = 36) at $p< .05$ ($z = -2.666$, $p = .008$). In the same way, ESL students employed significantly more operations in Phase II (Freq = 124) as compared to that of Phase III (Freq = 58) at $p< .05$ ($z = -2.530$, $p= .011$) and Phase IV (Freq = 36) at $p< .05$ ($z = -2.670$, $p = .008$). Similarly, there is significant difference in the use of operations in Phase III (Freq=58) and Phase IV (Freq = 36) at $p< .05$ ($z = -2.144$, $p = .032$).

Table 4.12

Results of the Wilcoxon signed-rank test comparing operations by interactive phase

Interactive Phases	Freq (%)	Phase I	Phase II	Phase III	Phase IV
Phase I: Sharing of information	538 (71.16%)		z=-2.666** (p= .008)	z=-2.666** (p= .008)	z =-2.666** (p= .008)
Phase II: Discovering the inconsistency of ideas, concepts or statements	124 (16.40%)			z=-2.530** (p= .011)	z= -2.670** (p= .008)
Phase III: Negotiating for meaning/ Co-constructing knowledge	58 (7.67%)				z= -2.144* (p= .032)
Phase IV: Making agreement statements/ Applying newly-constructed meaning	36 (4.77%)				

*significant level at p < .05 **significant level at p < .01

An examination of the frequency data on the use of operations under each interactive phase reveals some interesting results. Under Interactive Phase I: Sharing of information, the foremost operation used was “Expressing a statement of observation or opinion” with 32.16% (Freq = 173) of the total operations demonstrated. The frequency of this operation was very much higher than the frequencies of the other operations in Phase I. This was followed by “Expressing a statement of agreement from one or more other participants” at 20.63% (Freq =111) in Phase I. In Phase II, “Identifying and stating areas of disagreement” was the most frequently used operation with 39.52%

(Freq=49). The frequency of this operation was also higher than the rest of the operations demonstrated in Phase II. The operation that registered the second highest frequency in Phase II was “Restating the participants' position, and advancing arguments or considerations supported by references” with 33.06% (Freq=41). In Phase III, the most dominant operation demonstrated was “Negotiating or clarifying the meaning of terms” with 36.21% (Freq=21) while “Proposing and negotiating new statements embodying compromise, co-construction” was second with 31.03% (Freq =18). The least used operation in Phase III was “Integrating or accommodating metaphors or analogies” with 5.17% (Freq =3). For Phase IV the most frequently used operation was “Summarizing of agreement” with 55.56% (Freq=20) followed by “Applying new knowledge” at 44.44% (Freq =16).

4.3.3 Section summary

The findings suggest that in general, ESL students had a tendency to use the operations “Expressing a statement of observation or opinion” and “Expressing a statement of agreement from one or more other participants”. This observation is corroborated by the frequency data in Table 4.10, which displays the frequency and percentage of operations demonstrated by ESL students when working on the three selected reading tasks. “Expressing a statement of observation or opinion”, “Expressing a statement of agreement from one or more other participants”, “Challenging others to engage in group discussion” and “Asking and answering questions to clarify details of statements” were ranked the highest (15^{th}), the second highest (14^{th}), the third highest

(13th) and the fourth highest (12th) respectively in the overall operations used (Table 4.9). All these four operations made up 59.91% (Freq = 453) of the overall operations generated by ESL groups in their discussions. In fact, all these four were Phase I operations. As was mentioned earlier in Chapter 3 (refer to 3.5.3.1), Phase I and II of the Interactive Analysis Model represented lower mental functions whereas Phase III and IV represented higher mental. Therefore, this means that in this study, ESL students were generally engaged in behaviour at the elementary phase of interaction during OC.

4.4 Patterns of interaction and reading tasks

This section sought to find out if there was a difference in the patterns of interaction when ESL students worked on different reading tasks during OC. This was done by examining the operations used when ESL students worked on three selected reading tasks. Data from the online transcripts produced by groups A, D and E when they worked on three different reading tasks were collected and a content analysis was conducted to answer this question. Both quantitative and qualitative analyses were carried out. The former made use of two non-parametric statistical techniques, the Friedman analysis of variance and the Spearman rank-order correlation. The Friedman analysis of variance was used to make comparisons on the frequency of operations demonstrated between the three different reading tasks. The focus was on the differences in the frequency of overall operations demonstrated and the frequency of operations by interactive phase. The Spearman rank-order correlation was used to

determine the relationship in the overall pattern of operations demonstrated between the three reading tasks. For qualitative analyses, the online transcripts were examined to gather additional evidence to support the quantitative analyses.

4.4.1 Frequency and percentage of operations used

Table 4.13 shows the frequency and percentage of overall operations used by ESL students when they worked on the reading tasks of Previewing and Predicting, Identifying Sentence Patterns and Paraphrasing. The frequency and the percentage of each phase were also presented. Moreover, it provides the results of the Friedman analysis of variance, comparing the use of operations between the three reading tasks. The frequency data indicate that overall, the groups employed the most number of operations for the reading task of Identifying Sentence Patterns (Freq=299), followed by Paraphrasing (Freq=282) and the least number of operations for Previewing and Predicting (Freq=175). However, the Friedman analysis of variance reveals that the difference in the total number of operations used between the three different reading tasks was statistically not significant at $p>.05$ ($\chi_r^2=4.667$, df=2, p=.097).

The differences in the total number of operations used by phase were similarly not significant. In Phase I, ESL students generated the most number of operations for Identifying Sentence Pattern (Freq=222) compared to Paraphrasing (Freq=208) and Previewing and Predicting (Freq=108). However, the result of the Friedman analysis of variance shows that the difference in Phase I was not significant at $p>.05$ ($\chi_r^2=4.667$, df=2, p= .097). In Phase II, the highest number of operations used was in Paraphrasing

(Freq=48), compared to Identifying Sentence Pattern (Freq=40) and Previewing and Predicting (Freq=36). However, the result of the Friedman analysis of variance shows that the difference in Phase II was not significant at p >.05 (χ_r^2= .545, df= 2, p= .761). The highest number of operations generated for Phase III was Previewing and Predicting (Freq=20) compared to Identifying Sentence Pattern (Freq=19) and Paraphrasing (Freq=19). The result of the Friedman analysis of variance indicates that the difference in Phase III was also not significant at p >.05 (χ_r^2= .200, df= 2, p= .905). Finally, for Phase IV, Identifying Sentence Pattern (Freq=18) had the highest number of operations compared to Previewing and Predicting (Freq=11) and Paraphrasing (Freq=7). The result of the Friedman analysis of variance also shows that the difference in Phase IV was not significant at p >.05 (χ_r^2= 2.364, df= 2, p= .307). These results suggest that the quantity of operations used did not differ in the three reading tasks.

Table 4.13

Results of the Friedman analysis of variance comparing operations between different reading tasks

Interactive Phase/ Operations	Previewing and Predicting	Identifying Sentence Patterns	Paraphrasing	χ_r^2	df	p
Phase I	108 (61.71%)	222 (74.25%)	208 (73.76%)	4.667	2	.097
Phase II	36 (20.57%)	40 (13.38%)	48 (17.02%)	.545	2	.761
Phase III	20 (11.43%)	19 (6.35%)	19 (6.74%)	.200	2	.905
Phase IV	11 (6.29%)	18 (6.02%)	7 (2.48%)	2.364	2	.307
Total	175 (100%)	299 (100%)	282 (100%)	4.667	2	.097

*significant level at p < .05

The analyses were aimed at determining whether there was a difference in the total number of operations used by ESL groups when they worked on the three different reading comprehension tasks. The statistical results indicate that there was no significant difference between the three different reading tasks in terms of the frequency of overall operations used, and in the frequency of operations used by interactive phase.

4.4.2 Operations used by interactive phase between different reading tasks

To gain further insight into the use of operations for all three reading tasks, subsequent data analyses focused on the operations used by interactive phase. More specifically, the analyses attempted to determine whether there was a similar pattern in the use of operations between the three reading tasks. Table 4.14 shows the frequency, percentage and rank-order of different operations by interactive phase generated for the three different reading tasks. The results of the Spearman rank-order correlation between Previewing and Predicting and Identifying Sentence Patterns are presented in Table 4.15. Meanwhile Table 4.16 and Table 4.17 show the results of the Spearman rank-order correlation between Previewing and Predicting and Paraphrasing; and Identifying Sentence Patterns and Paraphrasing. The results of Tables 4.14 - 4.17 are discussed according to the four interactive phases.

Based on the data shown in Table 4.14, it was found that the most frequently used operation in Phase I for the task of Previewing and Predicting was “Expressing a statement of agreement from one or more other participants”, which accounted for

29.63% (Freq=32) of the total operations used in this phase. This was followed by "Expressing a statement of observation or opinion" at 21.30% (Freq=23). The least used operation in this phase was "Corroborating examples provided by one or more participants" which constituted 6.48% (Freq=7) of the total operations in Phase I.

On the other hand, for the task of Identifying Sentence Patterns, the most used operation in Phase I was "Expressing a statement of observation or opinion", accounting for 27.48% (Freq=61) of the total operations used. This was followed by "Expressing a statement of agreement from one or more other participants" which represented 22.07% (Freq=49) of the total operations used. The least used operation for this task was "Corroborating examples provided by one or more participants", which was 6.31% (Freq=14).

For the task of Paraphrasing, the most frequently used operation in Phase I was "Expressing a statement of observation or opinion", which accounted for 42.79% (Freq=89). This was followed by "Challenging others to engage in group discussion" at 22.60% (Freq=47). The least used operation was "Corroborating examples provided by one or more participants" at 2.40% (Freq=5).

Table 4.14

Frequency, percentage and rank-order of operations for Previewing and Predicting, Identifying Sentence Patterns and Paraphrasing

	Previewing and Predicting			Identifying Sentence Patterns			Paraphrasing		
Interactive Phase/ Operations	Freq	%	Rank-order	Freq	%	Rank-order	Freq	%	Rank-order
Phase I: Sharing of Information									
A. Expressing a statement of observation or opinion	23	21.30	5	61	27.48	6	89	42.79	6
B. Expressing a statement of agreement from one or more other participants	32	29.63	6	49	22.07	5	30	14.42	4
C. Corroborating examples provided by one or more participants	7	6.48	1	14	6.31	1	5	2.40	1
D. Asking and answering questions to clarify details of statements	20	18.52	4	44	19.82	4	18	8.65	2
E. Defining, describing, or identifying a problem	12	11.11	2	28	12.61	3	19	9.13	3
F. Challenging others to engage in group discussion.	14	12.96	3	26	11.71	2	47	22.60	5
Total	108	100		222	100		208	100	
Phase II: Discovering the inconsistency of ideas, concepts or statements									
A. Identifying and stating areas of disagreement	12	33.33	2	13	32.5	2	24	50	3
B. Asking and answering questions to clarify the source and extent of disagreement	3	8.33	1	19	47.5	3	12	25	1.5
C. Restating the participants' position, and advancing arguments or considerations supported by references	21	58.33	3	8	20	1	12	25	1.5
Total	36	100		40	100		48	100	
Phase III: Negotiating for meaning/ Co-constructing knowledge									
A. Negotiating or clarifying the meaning of terms	4	20	2	8	42.10	4	9	47.37	4
B. Identifying areas of agreement or overlap among conflicting concepts	6	30	3	6	31.58	3	4	21.05	2.5
C. Proposing and negotiating new statements embodying compromise, co-construction	9	45	4	5	26.32	2	4	21.05	2.5
D. Integrating or accommodating metaphors or analogies	1	5	1	0	0	1	2	10.53	1
Total	20	100		19	100		19	100	
Phase IV: Making agreement statements/Applying newly-constructed meaning									
A. Summarizing of agreement	7	63.64	2	10	55.56	2	3	42.86	1
B. Applying new knowledge	4	36.36	1	8	44.44	1	4	57.14	2
Total	11	100		18	100		7	100	

Tables 4.15 - 4.17 examine the relationship between rank scores on operations used between the three reading tasks. The results of the Spearman rank-order correlation for Phase I are discussed. Table 4.15 shows that there was a significant correlation between Previewing and Predicting and Identifying Sentence Patterns for Phase I at $p<.05$ ($N = 6$; $r_s = .866$; $p = .019$). This suggests that the pattern of operations used in Phase I was similar between them. However, the result of the Spearman rank-order correlation in Table 4.16 shows that there was no significant relationship in the operations used between Previewing and Predicting and Paraphrasing for Phase I at $p>.05$ ($N = 6$; $r_s=.600$; $p = .208$). The result in Table 4.17 also shows that there was no significant relationship in the operations used between Identifying Sentence Patterns and Paraphrasing for Phase I at $p>.05$ ($N= 6$; $r_s=.600$; $p= .208$). This means that the pattern of operations used in Phase I was different between Previewing and Predicting and Paraphrasing; and between Identifying Sentence Patterns and Paraphrasing.

Table 4.15

Results of the Spearman rank-order correlation comparing the patterns of operations used by phase between Previewing and Predicting and Identifying Sentence Patterns

Interactive Phase	N	r_s	p
Phase I	6	.886**	.019
Phase II	3	-1.000**	.000
Phase III	4	.200	.800
Phase IV	2	1.000**	.000

*significant level at $p<.05$ ** very significant level at $p<.01$

In Phase II, the most frequently used operation for Previewing and Predicting was “Restating the participants' position, and advancing arguments or considerations supported by references”, which made up 58.33% (Freq = 21) of the operations used. This was followed by “Identifying and stating areas of disagreement” which constituted 33.33% (Freq = 12) of the total operations used in this phase. The least used operation was “Asking and answering questions to clarify the source and extent of disagreement” which made up 8.33% (Freq=3) of the total operations used in Phase II.

For Identifying Sentence Patterns, the operation that was used most frequently was “Asking and answering questions to clarify the source and extent of disagreement” which form 47.5% (Freq=19) of the total operations used in this phase. The least number of operation used was “Restating the participants' position, and advancing arguments or considerations supported by references”, which stood at 20% (Freq = 8) of the operations used in this phase.

Unlike the earlier two reading tasks, the highest number of operations generated for Paraphrasing was “Identifying and stating areas of disagreement” which constituted 50% (Freq = 24) of the total operations used in this phase. Interestingly, there was a tie between the operations used for Paraphrasing which were “Asking and answering questions to clarify the source and extent of disagreement” and “Restating the participants' position, and advancing arguments or considerations supported by references”, which represented 25% (Freq = 12) of the operations used respectively in this phase.

The result of the Spearman rank-order correlation in Table 4.15 shows that there was a negative significant correlation in Phase II between Previewing and Predicting

and Identifying Sentence Patterns at p<.05 (N= 3; r_s= -1.000; p= .000). This means that the pattern of operations used between the two tasks was the opposite of each other. However, Table 4.16 shows that there was no correlation between Previewing and Predicting and Paraphrasing at (N= 3; r_s= .000; p= 1.000). Similarly, the result of the Spearman rank-order correlation in Table 4.17 shows that there was no correlation between Identifying Sentence Patterns and Paraphrasing at (N= 3; r_s= .000; p= 1.000). These results seem to imply that in Phase II, the pattern of operations used was neither similar nor different between Identifying Sentence Patterns and Paraphrasing; and between Previewing and Predicting and Paraphrasing.

Table 4.16

Results of the Spearman rank-order correlation comparing the patterns of operations used by interactive phase between Previewing and Predicting and Paraphrasing

Interactive Phase	N	r_s	p
Phase I: Sharing of information	6	.600	.208
Phase II: Discovering the inconsistency of ideas, concepts or statements	3	.000	1.000
Phase III: Negotiating for meaning/ Co-constructing knowledge	4	.316	.684
Phase IV: Making agreement statements/Applying newly- constructed meaning	2	-1.000**	.000

*significant level at p<.05 ** very significant level at p<.01

In Phase III, the most used operation for Previewing and Predicting was "Proposing and negotiating new statements embodying compromise, co-construction" which was 45% (Freq= 9) followed by "Identifying areas of agreement or overlap

among conflicting concepts" at 30% (Freq=6) and "Negotiating or clarifying the meaning of terms" at 20% (Freq =4). The least used operation for Previewing and Predicting was "Integrating or accommodating metaphors or analogies" at 5% (Freq=1).

For Identifying Sentence Patterns, the most frequently used operation was "Negotiating or clarifying the meaning of terms" at 42.1% (Freq=8) followed by "Identifying areas of agreement or overlap among conflicting concepts" at 31.58% (Freq=6). However, no operation was generated for "Integrating or accommodating metaphors or analogies".

For Paraphrasing, "Negotiating or clarifying the meaning of terms" recorded the highest number of operation used at 47.37% (Freq=9). There was a tie between the operations "Identifying areas of agreement or overlap among conflicting concepts" and "Proposing and negotiating new statements embodying compromise, co-construction" at 21.05% (Freq=4) respectively. The least number of operation generated was again that of "Integrating or accommodating metaphors or analogies" at 10.53% (Freq=1). This result is similar to that of Previewing and Predicting and Identifying Sentence Patterns.

The result of the Spearman rank-order correlation in Table 4.15 shows that there was no significant correlation in Phase III between Previewing and Predicting and Identifying Sentence Patterns at $p>.05$ ($N = 4$; $r_s = .200$; $p = .800$). The result in Table 4.16 similarly shows that there was no significant relationship between Previewing and Predicting and Paraphrasing at $p>.05$ ($N= 4$; $r_s= .316$; $p= .684$). In the same way, the result of the Spearman rank-order correlation in Table 4.17 shows that there was no

significant correlation between Identifying Sentence Patterns and Paraphrasing p>.05 (N= 4; r_s= .949; p= .051). All these results imply that the patterns of operations used between the three reading tasks were different in Phase III.

Finally, in Phase IV, the highest number of operation generated for Previewing and Predicting was “Summarizing of agreement” which made up 63.64% (Freq =7) of the total number of operations used. This was followed by “Applying new knowledge” which stood at 36.36% (Freq =4).

For Identifying Sentence Patterns, “Summarizing of agreement” registered the highest number of operation used at 55.56% (Freq=10) followed by “Applying new knowledge” which stood at 44.44% (Freq=8).

For Paraphrasing, the most number of operation generated was “Applying new knowledge” at 57.14% (Freq=4) followed by “Summarizing of agreement” which stood at 42.86% (Freq=3). The pattern of operations used for Phase IV was similar between Previewing and Predicting and Identifying Sentence Patterns. However, the pattern of operations used for Paraphrasing in Phase IV was different from the other two.

The result of Spearman rank-order correlation in Table 4.15 shows that there was a significant relationship in the operations used between Previewing and Predicting and Identifying Sentence Patterns in Phase IV at p<.05 (N = 2; r_s = 1.000; p = .000). This seems to imply that the pattern of operations used was similar between Previewing and Predicting, and Identifying Sentence Patterns for Phase IV. The results in Table 4.16 and Table 4.17 show that there were negative significant relationship in the operations used between Previewing and Predicting and Paraphrasing, and between Identifying Sentence Patterns and Paraphrasing. Both results stood at p<.05 (N = 2; r_s =

-1.000; p = .000) respectively. This means that the patterns of operations used between Previewing and Predicting and Paraphrasing; and Identifying Sentence Patterns and Paraphrasing were the opposite of each other.

Table 4.17

Results of the Spearman rank-order correlation comparing the patterns of operations used by interactive phase between Identifying Sentence Patterns and Paraphrasing

Interactive Phase	N	r_s	p
Phase I: Sharing of information	6	.600	.208
Phase II: Discovering the inconsistency of ideas, concepts or statements	3	.000	1.000
Phase III: Negotiating for meaning/ Co-constructing knowledge	4	.949	.051
Phase IV: Making agreement statements/Applying newly- constructed meaning	2	-1.000**	.000

*significant level at p<.05 ** very significant level at p<.01

4.4.3 Section summary

In summary, it can be concluded that there was no significant difference in the overall total number of operations used when ESL students worked on different reading tasks. There was also no difference in terms of the patterns of operations used by interactive phase for each reading task. Statistically, there was no evidence to show that there was significance in the difference, although there were differences in the

frequency of overall operations used whereby Previewing and Predicting generated the least number of operations compared to Identifying Sentence Patterns and Paraphrasing. However, the pattern of operations used by interactive phase between Previewing and Predicting and Identifying Sentence Patterns were similar in Phases I, and IV but was the opposite of each other for Phase II. The pattern of operations used by interactive phase between Previewing and Predicting and Paraphrasing, and between Identifying Sentence Patterns and Paraphrasing were only similar in Phase IV in that they were negatively related to each other. The results show that the operations used between Previewing and Predicting and Paraphrasing, and between Identifying Sentence Patterns and Paraphrasing were different in Phases I, II and III.

4.5 Patterns of interaction and reading performance

To examine the nature of the relationship between patterns of interaction and the reading performance of ESL groups, three analyses were carried out using the Spearman rank-order correlation. The first analysis attempted to determine whether there was a correlation between the frequency of overall operations demonstrated and the overall reading scores of the groups. The purpose was to establish if the total number of operations generated was related to the overall reading performance. The second analysis attempted to establish whether there was a correlation between the operations used by interactive phase and the overall reading scores. This was to identify which interactive phase was related either positively or negatively with the overall reading performance. The third analysis was to investigate the correlation between the

frequency of operations demonstrated and overall reading scores. This was to determine which operation was positively or negatively correlated with reading performance.

4.5.1 Reading performance between different reading tasks

To understand the nature of the relationship between operations used and reading performance, the reading scores of ESL students were examined. The reading performance of the ESL groups was measured by the reading scores they obtained when they submitted their reading assignments after collaborating online. The reading scores obtained from the 12 students in groups A, D and E on Previewing and Predicting, Identifying Sentence Patterns and Paraphrasing were used for this purpose. As was explained in Chapter 3 (refer to 3.5.3.2.3), for each reading task, the reading scores of the 12 students in groups A, D and E were added together to arrive at the overall reading score for that reading task. A sample copy of group D's marked assignment is shown in Appendix Q.

The descriptive data in Table 4.18 indicate that there was not much difference in the overall reading scores between the three reading tasks i.e. Previewing and Predicting (Mean= 9.333, SD= .985), Identifying Sentence Pattern (Mean= 8.333, SD =1.231) and Paraphrasing (Mean= 9.333, SD= .985). Moreover, the results of the Friedman analysis of variance comparing operations between the three reading tasks, confirmed that the difference was not significant overall (Table 4.13). The overall result of the Friedman analysis of variance was $p>.05$ ($\chi_r^2 = 4.667$, df= 2, p= .097). In

addition, there was no significant correlation between the four interactive phases as well.

Table 4.18

Means and standard deviations (in parentheses) of the reading scores by reading tasks

Previewing and Predicting	Identifying Sentence Patterns	Paraphrasing
9.333	8.333	9.333
(.985)	(1.231)	(.985)

It can be seen in Table 4.18 that the mean reading score for Previewing and Predicting was 9.333 (SD = .985) compared to Identifying Sentence Patterns at 8.333 (1.231) and Paraphrasing at 9.333 (.985). However, the results of the Kruskal-Wallis test in Table 4.19 show that there was a significant relationship between the scores of the three reading tasks at $p<.05$ ($N=12$, $\chi_r^2 = 8.93$, $p = .012$). This means that there was a difference in the performance of ESL students when they worked on the three selected reading tasks.

Table 4.19

Results of the Kruskal-Wallis test (mean rank) comparing the reading scores of Previewing and Predicting, Identifying Sentence Patterns and Paraphrasing

Previewing and Predicting	Identifying Sentence Patterns	Paraphrasing	χ_r^2	df	p
21.83	21.83	11.83	8.93*	2	.012

*significant level at $p<.05$

4.5.2 Frequency of operations used and reading performance

To investigate the nature of the relationship between the overall operations used by interactive phase and reading performance, the analysis first of all determined whether there was a correlation between the frequency of overall operations used and the overall reading performance. The purpose was to establish whether the total number of operations used was related to ESL groups' reading performance. Secondly, an analysis of the relationship between the frequency of operations used by interactive phase and overall reading performance was carried out. This was done to identify which interactive phase was correlated either positively or negatively with reading performance. Thirdly, the relationship between the frequency of operations used and the overall reading performance was examined. The aim was to determine which operation was positively or negatively correlated with reading performance. Separate analyses were conducted for different reading tasks.

The results in Table 4.20 show that there was no significant correlation between the frequency of overall operations used and the scores for Previewing and Predicting at $p > .05$ ($N = 3$, $r_s = .866$, $p = .333$). There were also no significant correlations between the frequency of operations used in Phase I, Phase II and Phase IV and the scores for Previewing and Predicting at $p > .05$ ($N = 3$, $r_s = .866$, $p = .333$) respectively. There was no correlation between the frequency of operations used for Phase III and the scores for Previewing and Predicting at ($N = 3$, $r_s = .000$, $p = 1.000$). This suggests that in this study, the overall total number of operations used for Previewing and Predicting was

not related to the groups' reading performance. Likewise, ESL students' reading performance was not related to the frequency of the operations used for Phase I, Phase II and Phase IV.

The pattern of relationship between the operations used and reading performance for Identifying Sentence Patterns was similar to the pattern of relationship between the Previewing and Predicting performance and the operations used. There was no significant correlation between the frequency of overall operations used and the scores for Identifying Sentence Patterns at $p > .05$ ($N = 3$, $r_s = -.866$, $p = .333$). Similarly, there were no significant correlations between the operations used and the scores for Identifying Sentence Patterns in Phase I at $p > .05$ ($N = 3$, $r_s = -.866$, $p = .333$), Phase III and Phase IV which were at $p > .05$ ($N = 3$, $r_s = .500$, $p = .667$) respectively. There was no correlation between the scores for Identifying Sentence Patterns and the operations used in Phase II at ($N = 3$, $r_s = .000$, $p = 1.000$). Based on the statistical results in this study, it is therefore, suggested that the performance for Identifying Sentence Patterns was not related to the frequency of overall operations used nor the frequency of operations used by interactive phase.

The pattern of relationship between the performance for Paraphrasing and the operations used was similar to Identifying Sentence Patterns. There was no significant correlation between the overall operations used and the scores for Paraphrasing at p p> .05 ($N = 3$, $r_s = -.866$, $p = .333$). In addition, there was no significant correlation between the Paraphrasing scores and the operations used in Phase I at $p > .05$ ($N = 3$, $r_s = -.866$, $p = .333$), Phase III and IV at $p > .05$ ($N = 3$, $r_s = -.500$, $p = .667$) respectively. Like Identifying Sentence Patterns, there was no correlation between the frequency of

operations used and the scores for Paraphrasing in Phase II at (N= 3, r_s= .000, p= 1.000). The results indicate that the performance for Paraphrasing was not related to the frequency of the overall operations used nor were they related to the frequency of operations used by interactive phase.

Table 4.20

Results of Spearman rank-order correlation between reading scores and frequency of operations used: Overall operations used by interactive phase

Interactive Phase/ Operations		Previewing and Predicting Scores	Identifying Sentence Patterns Scores	Paraphrasing Scores
Phase I: Sharing of information	rs	.866	-.866	-.866
	p	(.333)	(.333)	(.333)
Phase II: Discovering the inconsistency of ideas, concepts or statements	rs	.866	.000	.000
	p	(.333)	(1.000)	(1.000)
Phase III: Negotiating for meaning/ Co-constructing knowledge	rs	.000	.500	-.500
	p	(1.000)	(.667)	(.667)
Phase IV: Making agreement statements/ Applying newly-constructed meaning	rs	.866	.500	-.500
	p	(.333)	(.667)	(.667)
Overall	rs	.866	-.866	-.866
	p	(.333)	(.333)	(.333)

*significant level at p < .05

In order to further understand the nature of the relationship between reading performance and the operations used, Spearman rank-order correlation coefficients

between ESL students' frequency of operations used and the reading scores were computed for each interactive phase. Table 4.21 shows the results of the Spearman rank-order correlation between the operations used in Phase I and the reading scores for Previewing and Predicting, Identifying Sentence Patterns and Paraphrasing.

In Phase I, the results show that there was only one significant correlation between the scores of Previewing and Predicting and the frequency of operations used in terms of frequency at $p<.05$. The scores for Previewing and Predicting had a significant positive correlation with the operation "Corroborating examples provided by one or more participants" ($N=3$, $r_s= 1.000$, $p= .000$). This means that when ESL groups generated a higher number of the Phase 1 operation "Corroborating examples provided by one or more participants", they tended to obtain higher scores for Predicting and Previewing.

The results also show that there was no significant correlation between the frequency of operations used in Phase I and the scores for Identifying Sentence Patterns. This suggests that the performance for Identifying Sentence Patterns was not related to the frequency of the operations used in Phase I.

The results of the Spearman rank-order correlation indicate that there were significant positive correlations between the scores for Paraphrasing and the frequency of two operations which were "Expressing a statement of agreement from one or more other participants" at $p<.05$ ($N=3$, $r_s= 1.000$, $p= .000$) and "Asking and answering questions to clarify details of statements" at $p<.05$ ($N=3$, $r_s= 1.000$, $p= .000$). There was also a negative significant correlation between the scores for Paraphrasing and the frequency of operation "Corroborating examples provided by one or more participants"

at p<.05 (N=3, r_s= -1.000, p= .000). This suggests that ESL groups obtained higher scores for Paraphrasing when they generated a higher number of operations for "Expressing a statement of agreement from one or more other participants" and "Asking and answering questions to clarify details of statements". However, they got higher scores when they generated a lesser number of the operation "Corroborating examples provided by one or more participants".

Table 4.21

Results of Spearman rank-order correlation between reading scores and frequency of operations used in Phase I: Sharing of Information

Phase I: Sharing of Information		Previewing and Predicting Scores	Identifying Sentence Patterns Scores	Paraphrasing Scores
Expressing a statement of observation or opinion	rs	.500	-.866	-.866
	p	(.667)	(.333)	(.333)
Expressing a statement of agreement from one or more other participants	rs	.866	-.500	1.000**
	p	(.333)	(.667)	(.000)
Corroborating examples provided by one or more participants	rs	1.000**	-.866	-1.000**
	p	(.000)	(.333)	(.000)
Asking and answering questions to clarify details of statements	rs	.866	-.866	1.000**
	p	(.333)	(.333)	(.000)
Defining, describing, or identifying a problem	rs	.866	-.866	-.866
	p	(.333)	(.333)	(.333)
Challenging others to engage in group discussion.	rs	-.500	.866	-.866
	p	(.667)	(.333)	(.333)

*significant level at p < .05 **very significant level at p < .01

In contrast to the correlation results in Phase I, a different pattern of relationship between the reading scores and the operations used was discovered in Phase II. Table 4.22 shows the results of the Spearman rank-order correlation between the reading scores and the operations used in Phase II for Previewing and Predicting, Identifying Sentence Patterns and Paraphrasing.

Table 4.22

Results of Spearman rank-order correlation between reading scores and frequency of operations used in Phase II: Discovering the inconsistency of ideas, concepts or statements

Phase II: Discovering the inconsistency of ideas, concepts or statements		Previewing and Predicting Scores	Identifying Sentence Patterns Scores	Paraphrasing Scores
Identifying and stating areas of disagreement	rs	.866	1.000**	-1.000**
	p	(.333)	(.000)	(.000)
Asking and answering questions to clarify the source and extent of disagreement	rs	.500	.500	.500
	p	(.667)	(.667)	(.667)
Restating the participants' position, and advancing arguments or considerations supported by references	rs	.866	.500	.000
	p	(.333)	(1.667)	(1.000)

*significant level at $p < .05$ **very significant level at $p < .01$

Table 4.22 shows that there was no significant correlation at all between the scores for Previewing and Predicting and the operations used in Phase II. This suggests

that the Previewing and Predicting performance was not related to the frequency of the operations used in Phase II.

There was a positive significant correlation between the scores for Identifying Sentence Patterns and the operation “Identifying and stating areas of disagreement” at $p<.05$ ($N=3$, $r_s= 1.000^*$, $p= .000$) in Phase II. Likewise, there was a negative significant correlation between the scores for Paraphrasing and the operation “Identifying and stating areas of disagreement” at $p <.05$ ($N=3$, $r_s= -1.000^*$, $p= .000$). Besides that, it was found that there was no correlation between the score for Paraphrasing and the operation ‘Restating the participants' position, and advancing arguments or considerations supported by references’ at ($N=3$, $r_s= .000$, $p= 1.000$). This implies that in this study, ESL groups’ Paraphrasing score was not related to the frequency of that operation.

Table 4.23 presents the Spearman rank-order correlation results in Phase III between the different reading scores and the frequency of the operations. As can be seen in this phase, there was a negative significant correlation between the Previewing and Predicting scores and the operation “Negotiating or clarifying the meaning of terms” at $p<.05$ ($N=3$, $r_s= -1.000$, $p= .000$). Similarly, negative significant relationships were seen between Paraphrasing scores and the operations “Identifying areas of agreement or overlap among conflicting concepts” and “Proposing and negotiating new statements embodying compromise, co-construction” at $p<.05$ ($N=3$, $r_s= -1.000$, $p= .000$). These results seem to imply that ESL groups’ performance improved when they generated less of these operations. It is also noted that no results were generated between the Identifying Sentence Patterns scores and the operation ‘Integrating or

accommodating metaphors or analogies'. This is because ESL students did not generate the use of this Phase III operation in their discussion for the task of Identifying Sentence Patterns.

Table 4.23

Results of Spearman rank-order correlation between reading scores and frequency of operations used in Phase III: Negotiating for meaning/Co-constructing knowledge

Phase III: Negotiating for meaning/Co-constructing knowledge		Previewing and Predicting Scores	Identifying Sentence Patterns Scores	Paraphrasing Scores
Negotiating or clarifying the meaning of terms	rs	-1.000**	.500	-.866
	p	(.000)	(.667)	(.333)
Identifying areas of agreement or overlap among conflicting concepts	rs	.866	.866	-1.000**
	p	(.333)	(.333)	(.000)
Proposing and negotiating new statements embodying compromise, co-construction	rs	.500	-.500	-1.000**
	p	(.667)	(.667)	(.000)
Integrating or accommodating metaphors or analogies	rs	.500	X	-.500
	p	(.667)	X	(.667)

*significant level at $p < .05$ **very significant level at $p < .01$

Table 4.24 presents the results of the Spearman rank-order correlation in Phase IV between the reading scores and the operations used. The results show that there was a significant correlation between Previewing and Predicting scores and the operation "Summarizing of agreement" at $p < .05$ ($N=3$, $r_s= 1.000$, $p= .000$). This means that when ESL groups generated a higher number of the Phase IV operation "Summarizing

of agreement", they tended to obtain better Previewing and Predicting scores. The results in Table 4.24 show that the reading performance for Identifying Sentence Patterns and Paraphrasing were not related to the frequency of any of the operations used in Phase IV.

Table 4.24

Results of Spearman rank-order correlation between comprehension scores and frequency of operations used in Phase IV: Making agreement statements/Applying newly-constructed meaning

Phase IV: Making agreement statements/ Applying newly-constructed meaning		Previewing and Predicting Scores	Identifying Sentence Patterns Scores	Paraphrasing Scores
Summarizing of agreement	rs	1.000**	.500	.500
	p	(.000)	(.667)	(.667)
Applying new knowledge	rs	.500	.500	-.500
	p	(.667)	(.667)	(.667)

*significant level at $p < .05$ **very significant level at $p < .01$

4.5.3 Section summary

To summarize, the analyses on the relationship between the operations used and the reading performance reveal that ESL groups' overall reading performance was not related to the frequency of the overall operations generated for Previewing and Predicting, Identifying Sentence Patterns and Paraphrasing.

The results also show that there was no significant relationship between the reading performance and the operations used by phase. ESL groups' Previewing and

Predicting scores were not positively related to the frequency of operations used in Phases I, II and IV. There was no correlation between the reading scores and Phase III. In comparison, the performance in Identifying Sentence Patterns and Paraphrasing was not related to the frequency of operations used in Phases I, III and IV. In Phase II, there was no correlation between the Identifying Sentence Patterns and Paraphrasing scores and the operations used.

In terms of operations used by interactive phase, ESL groups' reading performance for Previewing and Predicting was positively related to the frequency of operation for "Corroborating examples provided by one or more participants" in Phase I. In addition, there was a positive relationship between the scores for Paraphrasing and the operations "Expressing a statement of agreement from one or more other participants" and "Asking and answering questions to clarify details of statements". This means that the ESL groups performed better when they generated more of these operations. However, ESL groups reading performance for Paraphrasing was negatively related to the operation "Corroborating examples provided by one or more participants" in Phase I. This means that the groups performed better when they generated less of the operation. Apart from that, ESL groups' reading performance for Identifying Sentence Patterns showed no positive relationship with the frequency of operations used in Phase I.

ESL groups performed better for Identifying Sentence Patterns when they generated more of the operation "Identifying and stating areas of disagreement" in Phase II. In contrast, the groups performed better for Paraphrasing when they used less of the operation "Identifying and stating areas of disagreement" in Phase II. In general,

ESL groups' performance was not related to frequency of most of the operations generated in Phase II.

For Phase III, there were three negative significant relationships between ESL groups' performance and the operations used. The first was between the scores for Previewing and Predicting and the operation "Negotiating or clarifying the meaning of terms". The others were between the scores for Paraphrasing and the operations "Identifying areas of agreement or overlap among conflicting concepts" and "Proposing and negotiating new statements embodying compromise, co-construction". These results indicate that ESL groups performed better when they used less of these operations. There was an instance where no results were generated. It was between the scores for Identifying Sentence Patterns and the operation "Integrating or accommodating metaphors or analogies". This was because ESL groups did not generate any of this operation in their discussion.

Phase IV also showed that there was only one positive relationship between the scores for Previewing and Predicting and the operation "Summarizing of agreement". No other significant relationship was found between the other scores and the operations.

In conclusion, the analyses of the results on the relationship between the patterns of interaction and the reading performance show that on the whole, the frequency of the overall operations generated by ESL groups was not related to their reading performance. However, the analyses on the results of operations used by interactive phase reveal that there were ten significant relationships between some operations and the reading performance. Nevertheless, it was observed that different

sets of operations were significantly related to the performance for different reading tasks. All these results further reinforce the earlier findings that there were some significant relationships between ESL groups' reading performance and the frequency of the operations used. However, it has to be reiterated that the results are applicable to this study only.

4.6 Major findings

This section presents the major findings gathered from the content analysis of the online transcripts of three ESL groups. Each ESL group consisted of four students of mixed English language proficiency. The findings were supported by both qualitative and quantitative data. Qualitative data were derived from the online discussions of the three ESL groups. A content analysis was carried out on the online discussions to identify the operations used during OC for the selected reading tasks. At the same time, findings were also derived from the qualitative analysis of ESL groups' written assignments to compare similarities or differences in the individual and group work.

Quantitative methods were used to investigate the four research questions. Firstly, this study examined the effects of OC on the reading performance of ESL students. For this purpose, data were obtained from the pretest and posttest reading comprehension scores of ESL students. In addition, the scores obtained before and after online discussion for each of the reading tasks were also used. Secondly, this study investigated the patterns of interaction demonstrated by ESL students during OC.

Thirdly, it looked at the differences in the patterns of interaction when ESL students worked on different reading tasks collaboratively online. Finally, quantitative methods were also used to determine the nature of the relationship between the patterns of interaction and the reading performance of ESL students during OC. To answer the second, third, and fourth questions, data from the online transcripts of three ESL groups were analyzed quantitatively.

4.6.1 Online collaboration and reading performance

The major findings on online collaboration and reading performance among ESL students are presented in two sections. The first looked at the reading performance of ESL students in the pretest and posttest. The second examined the reading performance of ESL students before and after collaborating online.

4.6.1.1 Performance in the pretest and posttest

As mentioned in Chapter 3 (refer to 3.4.1), the same set of questions was used for both the pretest and posttest. Paired samples t-tests carried out on the pretest and posttest of ESL students illustrated that the students showed significant improvements in their posttest results at both the individual level [t = 7.75, p = .000] as well as at the group level [t (6) = 12.07, p= .000] (refer to Table 4.2, p. 149, and Table 4.4, p. 153). At the individual level, 27 out of 28 students or 96.43% registered improvements in

their scores ranging from 1 to 15 marks. Only one student obtained the same marks for both the pretest and posttest.

Table 4.25 shows the range of improvements of ESL students for the reading comprehension pretest and posttest. A breakdown of the improvements of the students showed that 17.86% or five students registered an improvement of between 11-15 marks. Another nine students or 32.14% recorded improvements of between 6-10 marks. 13 students or 46.43% registered improved scores of between 1-5 marks. This means that in this study, almost all the students performed better in the posttest except for one student whose pretest and posttest scores remained unchanged.

Table 4.25

Range of improvement of ESL students for pretest and posttest

Range of improvement (Marks)	Low	(%)	Average	(%)	High	(%)	N	(%)
15 to 11	5	17.86	-	-	-	-	5	17.86
10 to 6	3	10.70	6	21.43	-	-	9	32.14
1 to 5	4	14.29	5	17.86	4	14.29	13	46.43
0	-	-	-	-	1	3.57	1	3.57
Total	12	42.85	11	39.29	5	17.86	28	100

It is interesting to note that all the five students who recorded an improvement of between 11-15 marks for the posttest were the low English language proficiency students. Of the nine students who recorded improved scores of between 6 to 10 marks, three were of low English language proficiency and the other six were of average

proficiency. Out of the nine who registered an improved score of between 1 to 5 marks, four were of low English language proficiency, five were of average English language proficiency and four were of high English language proficiency. The student whose scores remained unchanged was a high English language proficiency student.

A closer scrutiny of the results shows that those who recorded the highest improvements in their posttest were the low English language proficiency students. Out of a maximum score of 30 marks, these low proficiency students scored less than 12 marks in their pretest. However, they registered the highest increase in their posttest scores ranging between 11 to 15 marks. The average proficiency students obtained scores of between 15 to 20 marks in their pretest. In the posttest, they posted improved scores of between 5 to 8 marks. However, the high proficiency students, who scored above 20 marks in their pretest, posted the least increase in their posttest scores ranging between 1 to 5 marks. It has to be noted that no student obtained less marks in their posttest.

Seven (7) mixed ability groups were formed from the intact ESL class of 28 students. A high English language proficiency student was distributed to five groups since there were only five (5) students who were of high proficiency. Two average proficiency students were assigned to groups which did not have a high proficiency student. The low proficiency students were then distributed to the seven groups.

From the results, it is found that the low and average proficiency students in the groups were the ones who benefited the most from OC in terms of recording the highest improvements in their posttest scores. Although the high proficiency students in the groups did show some improvements in their posttest marks, the improvements

recorded were marginal compared to those obtained by the low and average proficiency students. This clearly suggests that the low and average proficiency students have gained substantially from the high proficiency members in their groups.

A good example can be seen in group A which consists of Prinze (low proficiency), Winnie (high proficiency), Cibi (average proficiency), and Nuraini (low proficiency). Both Prinze and Nuraini, who were low proficiency students, had improved scores of 15 and 9.5 marks respectively. Prinze had a pretest score of two marks and a posttest score of 17 marks. Nuraini had a pretest score of 11.5 marks and a posttest score of 21 marks. Meanwhile Cibi, an average proficiency student, obtained 17.5 marks in the pretest and 23 marks in the posttest. This means that Cibi improved by 5.5 marks. In contrast, Winnie, a high proficiency student, did not record any change in her marks. She registered 20.5 marks in both the pretest and posttest. This trend was repeated in each of the groups whereby the low proficiency members in the groups performed remarkably better in the posttest as compared to the high proficiency students.

However, an analysis of the results of the pretest and posttest by question demonstrated that ESL students showed improvements only in certain questions. The same set of questions, which comprised 12 questions, was used for both the pretest and posttest. As mentioned earlier, ESL students showed significant improvements in the posttest overall total scores at the individual level (refer to Table 4.2). Out of the 12 questions, students showed significant improvements in the pretest and posttest scores for seven (7) questions, i.e. questions 1, 2, 3, 4, 7, 10 and 11. However, the results in Table 4.2 also reveal that there were no significant differences in the pretest and

posttest scores for questions 5, 6, 8, 9 and 12. Out of the 12 questions, 11 questions had higher mean posttest scores except for question 8 which had a higher mean pretest score. Nevertheless, on the whole, this study shows that OC has a positive effect on the individual students' reading performance for most of the posttest questions.

The results in Table 4.4 show that OC improved the overall posttest performance of ESL groups. Nevertheless, further analysis shows that ESL groups recorded significant improvements for five (5) questions after OC. They were for question 1, 2, 4, 7 and 11. There were no significant differences in the mean scores of the pretest and posttest for questions 5, 6, 8, 9, 10 and 12. The mean pretest score for question 8 was higher than the mean posttest score. There was no change in the mean scores between the pretest and posttest for question 3. On the whole, the results of the paired samples t-test by question indicate that the effects of OC on ESL groups' performance are mixed in this study.

The 12 questions in the pretest and posttest which tested ESL students' reading comprehension skills, were categorized based on Bloom's Taxonomy (1956) to further discriminate the questions for the levels of the cognitive domain (Appendix F). Bloom's Taxonomy describes progressively the higher levels of the cognitive domain from factual information at the knowledge level to judgment and rating of information at the evaluation level (Appendix E).

Based on Bloom's Taxonomy of cognitive domain, the majority of ESL students showed significant improvements in answering questions which were at a lower cognitive level (refer to Table 4.2 and 4.4). They recorded improvements in question 1 (Understanding Sense Relationships within and between Sentences),

question 2 (Vocabulary), questions 7 (Distinguishing between fact and opinion) and 11 (Identifying Main Ideas). These questions fell in the comprehension category of Bloom's Taxonomy. Comprehension is in the second lowest category of the six.

ESL students also showed improved performance in question 4 (Making Inferences) which fell in the application category (Table 4.2 and Table 4.4). However, they did not record improved performance in question 8, another question on application. In fact, ESL students posted lower scores for the posttest compared to the pretest for this question. Application is third in the category, which is midway in the hierarchy of the six categories.

Meanwhile, the t-test results for questions 3, and 10, which were questions that required the ability to analyze, showed that there were significant improvements in ESL students' individual performance (Table 4.2). However, there were no significant improvements in questions 6 and 9 at the individual levels. Similarly, ESL groups did not show significant improvements for questions 6, 9 and 10. There was no change in their performance for question 3, which was also a question on analysis. The ability to analyze lies fourth in the six categories.

There was no significant difference in the t-test results for question 5, which was a question that required the ability to synthesize for both individual and group performance (Tables 4.2 and Table 4.4). Synthesis is fifth in the six categories.

Lastly, at the top of the hierarchy is evaluation. Question 12 required students to evaluate. The results showed that there were no significant improvements in ESL students' performance at both the individual and group levels. This illustrates that there were no significant differences in ESL students' performance as the questions moved

from the lower to the higher levels of the cognitive domain. It seems to suggest that ESL students did not show significant improvements when answering questions which required more abstract and higher order thinking skills. Therefore, this implies that in this study, OC is beneficial to the majority of the ESL students, albeit at the lower levels of the cognitive domain.

4.6.1.2 Performance in reading tasks before and after online collaboration

Whilst the previous section discussed the effects of OC on the pretest and posttest reading performance of ESL students, this section will discuss ESL students' reading performance before and after OC. The reading performance was measured by the total scores obtained by ESL students when they completed the nine (9) reading tasks before and after collaboration. ESL students completed the same reading tasks twice, first individually and then as a group.

The results of the t-tests in Table 4.6 (p. 157) and Table 4.8 (p. 160) reveal that ESL students showed significant improvements in their overall reading performance at both the individual and group. Table 4.6 also shows that at the individual level, students showed significant improvements for all the reading tasks i.e. Vocabulary, Previewing and Predicting, Identifying Main Ideas, Distinguishing between Fact and Opinion, Understanding Sense Relationships within and between Sentences, Making Inferences, Paraphrasing, Identifying Writer's Attitude and Identifying Sentence Patterns. At the group level, the results showed that ESL groups showed significant improvements in all the reading tasks except for Making Inferences, Identifying

Writer's Attitude and Identifying Sentence Patterns. This shows that in this study, OC on the whole is effective in improving the students' individual performance. However, the results are mixed for group performance.

Based on Bloom's Taxonomy of cognitive domain, the reading task of Making Inferences and Identifying Sentence Patterns required application and analysis skills respectively. Application is third and analysis is fourth in the cognitive hierarchy. The reading task on Identifying Writer's Attitude required evaluation which is at the highest hierarchy in Bloom's Taxonomy of cognitive domain (refer to Appendix E). This means that in this study, OC is effective in improving ESL students' performance but mainly at the lower cognitive levels.

Table 4.26 shows the range of improvements of ESL students by reading task after collaboration. As can be seen, all ESL students showed better performance albeit with varying degrees of improvements. The breakdown in Table 4.26 shows that the low proficiency students benefited the most from OC. Out of the three students (10.7%) who registered the highest increase in their scores of between 21-25 marks after collaboration, two were of low proficiency (7.14%) and one student (3.58%) is of average proficiency. Seven students (25%) registered an increase of between 16-20 marks. Five of them were of low proficiency (17.86%), one was of average proficiency (3.58%) and one of high proficiency (3.58%). Out of the six students (21.44%) who registered improved scores of between 11-15, two were of low proficiency (7.14%), three were of average proficiency (10.71%) and one (3.58%) of high proficiency. Ten students (35.72%) obtained increased scores of 6-10 marks. Out of these, three students (10.71%) were of low proficiency, four students (14.27%) were of average proficiency

and three (10.71%) were of high proficiency. Two of the average proficiency students (7.14%) had improved scores of less than 5 marks. All these show that even though OC has positive effects on the performance of ESL students, the low proficiency students were the ones who benefited the most. This further affirms the earlier findings in the previous section that the low proficiency students performed remarkably better in the posttest after collaboration.

Table 4.26

Range of improvement of ESL students by reading task before and after collaboration

Range of improvement (Marks)	Low	(%)	Average	(%)	High	(%)	N	(%)
21 to 25	2	7.14	1	3.58	-	-	3	10.7
16 to 20	5	17.86	1	3.58	1	3.58	7	25
11 to 15	2	7.14	3	10.71	1	3.58	6	21.44
6-10	3	10.71	4	14.27	3	10.71	10	35.72
Less than 5		-	2	7.14	-	-	2	7.14
Total	12	42.85	11	39.28	5	17.87	28	100

4.6.1.3 Section summary

In this study, the overall findings in this section show that ESL students benefited from OC at both the individual and group levels. This is confirmed by the results of the paired samples t-tests for the pretest and posttest. Furthermore, this was verified by the results of the paired samples t-tests comparing ESL students' results for the different reading tasks before and after collaboration. However, a close scrutiny of

the data showed two important points. First, that OC is beneficial to the majority of the ESL students, albeit at the lower cognitive levels. Second, the low proficiency and average proficiency students in the groups were the ones who benefited the most from OC in terms of recording the highest improvements in the reading scores.

4.6.2 Patterns of interaction during online collaboration

This section presents the patterns of interaction demonstrated by ESL students when they collaboratively worked on selected reading tasks. The investigation of the patterns of interaction is to examine the process of co-construction of knowledge during OC. The findings were derived from analyzing the transcripts of the online discussion threads taken from three groups when they worked on the reading tasks of Previewing and Predicting, Identifying Sentence Patterns and Paraphrasing. The data were analyzed qualitatively for the interactive dynamics focusing on the following four predetermined phases of interaction i.e. Phase I: Sharing of information; Phase II: Discovering the inconsistency of ideas, concepts or statements; Phase III: Negotiating for meaning/ Co-constructing knowledge; and Phase IV: Making agreement statements/Applying newly-constructed meaning. There were altogether 15 operations, which were classified under these four phases. There were six operations in Phase I, three in Phase II, four in Phase III and two in Phase IV (refer to Table 4.10). These operations were used for the qualitative analysis whereby the interactions of each group were analyzed to understand the degree to which behaviour under each phase was evident. The major findings of this research question are presented in five sections. The

first section looked at the overall patterns of interactive behaviour demonstrated by ESL students during OC. The second, third, fourth and fifth sections examined the four phases of interaction i.e. Phase I- Phase IV.

4.6.2.1 Overall patterns of interactive behaviour

Qualitative analysis of ESL students' online transcripts shows that the overall number of operations used was 756 for all three reading tasks (refer to Table 4.9, p. 165). The key finding of the qualitative analysis was that the dynamics of interaction which show knowledge construction was evident when ESL students collaborated online. The qualitative data show that ESL students were engaged in all four phases of interaction when collaborating online; albeit with differing frequencies in the use of the operations (refer to Table 4.10, p. 167).

Of the four phases of interaction Phase I: Sharing of information registered the highest frequency of operations used at 71.15% (Freq=538). This was followed by Phase II: Discovering the inconsistency of ideas, concepts or statements phase with a frequency of operations used at 16.4% (Freq=124). The third was in Phase III: Negotiating for meaning/ Co-constructing knowledge with a frequency of operation type used at 7.67% (Freq=58). The least used operations were in Phase IV: Making agreement statements/Applying newly-constructed meaning with a frequency of operations used at 4.77% (Freq=36). Despite the differing frequencies of operations used, all four phases of interaction were evident. This suggests that the process of knowledge construction took place.

The data show that most of the interactions occurred in Interactive Phases I and II. Although the dynamics of interaction for the four phases were evident, there was evidence to suggest that limited operations were generated in Phases III and IV. Quantitative analyses of the frequency data also confirmed that differences in the frequency of operations used were significant (refer to Table 4.11, p. 168; and Table 4.12, p. 169). This illustrates that the major concern of ESL students during OC was to share their understanding of the task. Consequently, ESL students' main contributions were mostly in "Expressing a statement of observation or opinion", which made up 22.88% (Freq=173), followed by "Expressing a statement of agreement from one or more other participants" with 14.68% (Freq=111). The third and fourth highest frequency of operations were "Challenging each other to engage in group discussion" with 11.5% (Freq=87) and "Asking and answering questions" to clarify details of statements with 10.85% (Freq=82). As a result, close to 60% of the operations produced by ESL students were from Phase I.

This study used an adapted version of The Interactive Analysis Model, which was developed by Gunawardena et al. (1997). They explained that the Interactive Analysis Model began with phases which could be described as lower mental functions (sharing of information and cognitive dissonance) and then moving on to higher mental functions described (negotiating for meaning/co-constructing knowledge, and making agreement statements/applying newly-constructed meaning). Thus, Phases I and II were described as phases which represented lower cognitive functions whereas Phases III and IV represented phases with higher mental functions. The findings in this study indicate that ESL students tended to interact at the lower levels of interactive

engagements since close to 60% of the operations generated were from Phase I. In addition, these qualitative data suggest that ESL students were primarily concerned with sharing their understanding of the online tasks by employing a variety of operations. The large extent at which they concentrated on sharing, inevitably led to the discovery of conflicting ideas regarding the tasks. However, when they sought to resolve their disagreements so that they could reach a new understanding, they seem to display a limited repertoire of operations to do so. Likewise, they appear to demonstrate a limited range of operations at applying newly-constructed meaning.

These results which show that ESL students were engaged at the lower levels of interactive engagement are similar to the findings in the previous section (refer to 4.6.1), which reveal that as questions moved from the lower to the higher cognitive levels, there were less significant differences in the students' reading performance. It has to be pointed put that an adapted version of the Interactive Analysis Model (Gunawardena at al. and Sringam & Greer) was used to analyze the students' patterns of interaction whereas Bloom's Taxonomy of cognitive domain (1956) was used to categorize the pretest and posttest questions and the reading task questions. Although both are different models, there appears to be some similarity between them. Both the analysis frameworks are arranged in hierarchical order and are used to measure progressively higher levels of cognitive activity. Hence, the results of both the analyses point towards the limited efficacy of OC in this study. Whilst ESL students in this study generally benefited from OC, they were mostly engaged in the lower levels of cognitive engagement.

4.6.2.2 Phase I: Sharing of information

Out of the 756 operations generated during online discussions for the three selected reading tasks, 71.15% (Freq=538) occurred in Phase I: Sharing of information (refer to Table 4.10). This means that almost three-quarters of the operations were concentrated in this phase. The top five operations generated by ESL students were "Expressing a statement of observation or opinion" with 22.88% (Freq=173), "Expressing a statement of agreement from one or more other participants" with 14.68% (Freq=111), "Challenging others to engage in group discussion" with 11.5% (Freq=87), "Asking and answering questions to clarify details of statements" with 10.85% (Freq=82) and "Defining, describing, or identifying a problem" with 7.8% (Freq=59). This can be seen in Table 4.9 (p. 165), which shows the rank-order of operations used by ESL students for the three reading tasks. All these top five operations (ranked 15th- 11th) contribute 67.71% (Freq=512) of the overall operations generated. Furthermore, what is of interest is the fact that all five operations are in Phase I. The prevalent use of Phase I operations is elucidated in the following section, which shows how the three groups discussed the different reading tasks.

The following excerpt taken from Group A's online discussion on Previewing and Predicting, clearly illustrates this tendency to share their understanding of the task first (refer to Excerpt 1). The reading task was to predict the contents of the given topic "College Success" (Appendix H, Task 2). The user names for Group A members were Prinze, Winnie, Cibi and Nuraini. Of these, the former was a male and the others female. Winnie was a high proficiency student, Cibi was of average proficiency while both Prinze and Nuraini were low proficiency students. There are four columns in

Excerpt 1. The first column indicates the user name. The second column shows the time when the message was posted. The third column shows the message. The number written in parentheses, in the message column indicates which part of the message is referred to, and it corresponds to the number indicating the interactive phase and operation used in the fourth column. The code in parentheses indicates the week when the discussion took place, the group which generated the discussion, the reading task and the time of the discussion. Hence, the code (W2/GrpA/PP/15.12-15.17pm) in Excerpt 1 means that the online transcript was taken from Week 2 from group A when they worked on the reading task of Previewing and Predicting. The discussion took place between 15.12 p.m. to 15.17 p.m.

Excerpt 1: (W2/GrpA/PP/15.12-15.17pm)

User name	Time	Message	Interactive phases/ Operations
Cibi :	15.12	college succes. (1) what is the meaning behind the word	Phase I E: Identifying a problem (1)
Prinze :	15.13	(2) I think that the factors of college success are 1. students dicipline is important to motivate them to study in a correct manner....	Phase I A: Expressing an opinion (2)
Cibi :	15.14	(3) Why should student study in the correct manner? (4) Is that have any relation with college success?	Phase I D: Asking question to clarify (3) Phase II B: Asking question to clarify the source of disagreement (4)
Nuraini:	15.14	(5) U think discipline is the most imptnt?	Phase I D: Asking question to clarify (5)
Winnie:	15.14	(6) i think college success not only depend on the student but also the resident staff.the administrator	Phase III C: Proposing new statement embodying compromise (6)

Excerpt 1: (W2/GrpA/PP/15.12-15.17pm), continued

User name	Time	Message	Interactive phases/ Operations
Prinze :	15.15	(7) 2. the environment of the college itself will influence the students attitude in studying..	Phase I A: Expressing an opinion (7)
Cibi :	15.15	(8) yes. i agree with winnie. (9) its not only the student but all the people who connected to the college	Phase I B: Expressing agreement (8) Phase II C: Restating participant's position (9)
Winnie :	15.17	(10) yes.. (11) how the students manage thecollege.the cooperation among themselves etc..(12) so.any other ideas	Phase I B: Expressing agreement (10) Phase II C: Advancing arguments (11) Phase I E: Challenging others to engage in discussion (12)

As can be seen in Excerpt 1, within the first five minutes of the discussion, the students generated 12 operations. Eight out of these 12 operations were directed towards sharing their understanding of the task. This excerpt shows that the students were mainly engaged in Phase I. During the initial stage of the discussion, the students were engaged in expressing their observation and/or opinion regarding the topic. For example, Prinze listed student discipline as the first point for college success, "I think that the factors of college success are 1. students dicipline is important to motivate them to study in a correct manner...." (15.13). Cibi could not see the relationship between students studying in the "correct manner" and "college success". Hence, she sought clarification from Prinze by asking, "Why should student study in the correct manner?" (15.14). In addition, Cibi was able to pinpoint the source of her disagreement by querying Prinze, "Is that have any relation with college success?" (15.14).

Like Cibi, Nuraini also needed clarification on the same issue from Prinze. Hence, the question, “U think discipline is the most imptnt?” (15.14). These questions posed by Cibi (15.14) and Nuraini (15.14) indicated that they were trying to make sense of and understand the ideas raised by Prinze. Unlike Cibi and Nuraini, Winnie’s immediate response to Prinze was “i think college success not only depend on the student but also the resident staff.the administrator” (15.14). Winnie included “resident staff and administrators” to Prinze’s “student discipline” (15.13). She was proposing a new statement embodying compromise between the importance of student discipline (Prinze’s idea) and the importance of college staff and administrators (her contribution). Winnie’s contribution allowed the group in general to explore the topic from a wider perspective.

After Cibi and Nuraini’s questions, Prinze posted, “2. the environment of the college itself will influence the students attitude in studying…” (15.15). Prinze’s message can be seen to achieve two things. First, he managed to include “environment of the college” as the number 2 factor for college success in addition to his first point “student discipline”. The other was in part to respond to Cibi and Nuraini’s questions. This was done by showing the relationship between “students attitude” and the “environment of the college”. Prinze’s attempt to clarify Cibi and Nuraini’ queries seemed rather weak. Nevertheless, it showed that he realized that he had to be clearer in his meaning and he did make some improvements in his next point by explaining how college environment can influence students’ attitude. This seems to suggest that the questions posed by Cibi and Nuraini, and the elaboration from Winnie, triggered Prinze to view the topic from a broader perspective.

More elaboration on the topic was evident when Cibi further restated Winnie's point, "yes. i agree with winnie. its not only the student but all the people who connected to the college" (15.15). Cibi expanded the "people who are responsible for college success" to include all the people who are connected to the college. Winnie advanced her point by providing examples of what she meant i.e. "how the students manage the college, the cooperation among themselves …" (15.17). This shows that students were building upon each other's contribution, suggesting that the process of scaffolding was taking place.

Excerpt 1 shows that the initial stage of discussion was dominated by the sharing of information phase whereby opinions and agreements were expressed and clarification sought. After first identifying the factors responsible for college success (people associated with the college and the environment of the college), the group members explained "how" these factors contributed to college success. As the discussion progressed, more elaborations were posted which enhanced the quality of the discussion. Excerpt 1 also suggests that questions play an important role in the process of knowledge construction. Hence, this sharing of ideas phase enabled ESL students to gain a better understanding of the task. At the same time, it shows that interactive engagements took place in this study because the messages posted were in response to others. This was similar to studies carried out by Schrire (2006) and Hara et al. (2000).

An interesting point that emerged from the analysis of the discussion was that although Cibi and Nuraini queried Prinze on the relationship between "student discipline" and college success, they both seemed to have had completely ignored the

fact that Prinze failed to shed light on their questions. They also failed to pursue Prinze for an answer. Instead, both Cibi and Nuraini picked up from and continued with Winnie's points about students and the facilities being important for college success. It is pertinent to note that these were points with which they agreed. This seems to suggest that during OC, students seem more inclined to discuss points of concurrence rather than to pursue points of disagreement. For that reason, it is not surprising that "Expressing a statement of agreement from one or more other participants" registered the second highest frequency with 14.68% (Freq=111) of the operations used. This is illustrated in Excerpt 2.

Excerpt 2: (W2/GrpA/PP/15.29-15.33pm)

User name	Time	Message	Interactive phases/ Operations
Prinze	15.29	(1) Technological advancement also is the important factors for college success!!	Phase I C: Corroborating examples (1)
Winnie	15.29	(2) yup..facilities is another point.. (3) should be " tip-top" at least for students convenient	Phase I B: Expressing agreement (2) Phase II C: Restating the participant's position (3)
Nuraini	15.29	(4) yeah. a good facilities also a good factor (5) u're right	Phase I B: Expressing agreement (4), (5)
Prinze	15.30	(6) me too	Phase I B: Expressing agreement (6)
Winnie	15.30	(7) library must be equipped by variety of books and references..(8) any other example??	Phase I C: Corroborating examples (7) Phase I E: Challenging others to engage in discussion (8)
Nuraini	15.31	(9) Students discipline, lecturer committments	Phase IV A: Summarizing agreement (9)

Excerpt 2: (W2/GrpA/PP/15.29-15.33pm), continued

User name	Time	Message	Interactive phases/ Operations
Prinze	15.32	(10) all of the classroom must have aircond to make student comfortable to study.	Phase I C: Corroborating examples (10)
Cibi	15.32	prinze. (11) do you think the tech advancement can be include in the facility?	Phase III C: Negotiating the meaning of terms (11)
Prinze:	15.32	(12) Yes,, (13) Such as the computer learning and also the internet services	Phase I B: Expressing agreement (12) Phase I C: Corroborating examples (13)
Cibi	15.32	(14) and the library also	Phase I C: Corroborating examples (14)
Winnie	15.32	(15) Lecturers-some times need to uimport lecturer from outside-overseas maybe. (16) They can share with us yhe different method of learning etc..	Phase I C: Corroborating examples (15)

During the four minute exchange in Excerpt 2, five out of the 15 operations generated show the group members expressing their agreement with each other's views. Such agreement occurred throughout the discussion as can be seen with statements like, "yup..facilities is another point" (Winnie,15.29); "yeah. a good facilities also a good factor" (Nuraini, 15.29); "u"re right" (Nuraini, 15.29); "me too" (Prinze, 15.30); and "Yes" (Prinze, 15.32). These exchanges indicate that the group members were moving towards some form of common understanding towards meaning construction.

In addition, instances of "Corroborating examples provided by one or more participants" were also evident in Excerpt 2. It has to be explained here that in an earlier posting, Winnie wrote that "college should provide adequate facilities to aid the students in their study such as lab computer…". Following that, some of the messages

posted were responses to corroborate Winnie's point about providing adequate facilities which included "technological advancement" (Prinze, 15.29), "library" (Winnie, 15.30; Cibi, 15.32), "all of the classroom must have aircond" (Prinze, 15.32), computer learning and also the internet services" (Prinze, 15.32), and "uimport (import) lecturer" (Winnie, 15.32). These responses suggest that the group members were sharing and building upon their understanding of "adequate facilities" in the process of meaning construction. If the messages posted by Prinze, Winnie and Cibi in Excerpt 2 were viewed on their own, it would seem that they were expressing their opinions. However, when viewed as a totality of interconnected and mutually responsive messages, then these messages were considered corroborating examples. It is, therefore, not surprising that the frequency of the operations "Expressing agreement statements" (Freq=5) and "Corroborating examples" (Freq=6) was similar for this excerpt. This suggests that after having expressed their agreement, group members proceeded to corroborate examples to build upon their understanding of a task towards knowledge construction.

Despite the fact that Excerpt 2 was taken towards the tail end stage of the discussion, the group members were still mostly engaged in Phase I, which was at the lower level of interactive engagements. Out of the 15 operations used, 12 were from Phase I. However, there was an attempt by Nuraini at summarizing the points (Phase IV) towards the closing end of this discussion when she posted, "Students discipline, lecturer commitments" (15.31). This shows that she was trying to summarize the factors that contributed to college success that the group members discussed earlier.

Hence, the two excerpts above provide evidence of the frequent use of operations found in Phase I. This pattern was repeated in the online transcripts of

groups D and E, not only for the reading task of Previewing and Predicting but also for the tasks of Paraphrasing and Identifying Sentence Patterns.

After the online discussion, each group submitted their answers as their group assignment. However, before the discussion group A members submitted their own individual predictions about the topic. Appendix I is a sample copy of group A's written assignment. It shows both the group written answer and the individual answers. Prinze submitted a one sentence answer that included "students discipline", "environment of college" and "technologi". Winnie identified "students own efforts" and "management". Cibi listed "students", "administration" and "library". Lastly, Nuraini specified "lectures", "students" and "environment". The answers submitted by the individuals in group A were brief and lacked elaboration. This contrasted with the group answer. Cibi summarized the group discussion and submitted the group work as instructed (Appendix I). The group answer was more elaborate and comprehensive compared to the individual answers. Three things stood out from Cibi's group assignment. The first was that her answer mirrored the discussion of the group. She was faithful in reporting all the factors for college success according to sequence as it occurred during the online discussion earlier. She first began with students as the first factor for college success, then moved on to the management of the college, followed by the lecturers and lastly the facilities in the college. The choice of words used in Cibi's assignment was reminiscent of Vygotsky's (1978) view on inner speech and Bakhtin's (1986) view that the speech experience of each individual is shaped and developed in continuous and constant interaction with others. It would seem that Cibi's choice of words was based on the words used by the group members which she

appropriated for herself after the discussion. Second, although the group members did not categorize the information during the discussion, Cibi categorized the factors that contributed to college success into students, management of the college, lecturers and college facilities. This was noteworthy as it showed that Cibi was able to make sense of the free flowing information during discussion and to classify the information. Third, Cibi made the connection between the success of students to college success. She went further to explain that students must be disciplined for them to be successful. The fact that Cibi was able to establish the relationship between college success and student discipline shows meaning making. This was because earlier during the discussion Cibi had not understood the relationship between student discipline and college success which required her to seek clarification from Prinze. Although Cibi's answer contained grammatical errors, she nevertheless was able to give a good summary of the group's discussion. This further affirms that the operations in Phase I supported meaning making.

4.6.2.3 Phase II: Discovering the inconsistency of ideas, concepts or statements

Although most of the interaction occurred in Phase I, the transcripts of every online discussion show evidence of Phase II: Discovering the inconsistency of ideas, concepts or statements. Phase II registered a total frequency of 124 operations which represented 16.40% of the overall operations used (refer to Table 4.10, p. 167). The three operations in this phase were "Identifying and stating areas of disagreement", "Asking and answering questions to clarify source of disagreement" and "Restating the

participant's position and advancing arguments or considerations supported by references". In terms of registering the highest frequency of operations used, the three operations in Phase II were ranked 10th to 8th after the top five operations (ranked 11th-15th) in Phase I (refer to Table 4.9, p. 165).

Excerpt 3 taken from the online discussion of Group E, illustrates the operations used in Phase II. Group E members included Winnie_p, Cokolat, Tsunami and Tudung. Cokolat was a high proficiency student, Winnie was of average proficiency while Tsunami and Tudung were low proficiency students. All four were female students. The excerpt was taken when they discussed the reading task of Identifying Sentence Pattern (Appendix H, Task 8, question 3).

> Sentence 3: (Identifying Sentence Patterns)
>
> Think of the hardware in a computer system as the kitchen in a short-order restaurant: It is equipped to produce whatever output a customer (user) requests, but it sits idle until an order (command) is placed.
>
> Appendix H

At the start of the discussion in Excerpt 3, Winnie-p, Cokolat and Tudung identified the sentence pattern as "description" without providing any support. Tsunami swiftly questioned Winnie_p and Cokolat "why description?" (9:53). Although Tsunami did not initially state her answer before she posed the question, it was clear that her answer conflicted with the other two. It was only later that Tsunami revealed that her answer was "comparison" (9:56). As a result, Tsunami sought clarification from the others as to why "description" was the answer. Although only Tsunami disagreed with the others, the majority (the other three members) did not insist that they

were right. Instead, because of this conflict, Winnie_p (9.53) and Tudung (9.55) attempted to explain their answers. It was the discovery of disagreement or tension that precipitated further discussions in the quest to resolve the differences. Smith (1994) observes that tension is the driver for collective processing. Therefore, it was not surprising that "Identifying and stating areas of disagreement" was the most frequently used operation in Phase II at 39.52% (Freq=49) (refer to Table 4.10). This operation was ranked 10th in the overall frequency, percentage and rank-order of operations used (refer to Table 4.9). This was followed by "Restating the participant's position and advancing arguments or considerations supported by references" (ranked 9th) and "Asking and answering questions to clarify source of disagreement" (ranked 8th). This indicates that these two operations were driven by the tension caused by differences in opinion as seen in Excerpt 3. In Excerpt 3, there were 13 operations generated in the six-minute discussion. Three were directed at identifying and stating areas of disagreement. Although the frequency of use of this operation seemed minimal, it played an important role in promoting further discussions aimed at resolving the differences.

Excerpt 3: W9/GrpE/ISP/9.5-9.57pm

User name	Time	Message	Interactive phases/ Operations
Winnie_p	9:51	(1) Q3 is description	Phase I A: Expressing an opinion (1)
Cokolat	9:52	(2) descriptions correct...	Phase I B: Expressing agreement (2)
Tsunami	9:53	(3) why description?	Phase II A: Identifying area of disagreement (3)

Excerpt 3: W9/GrpE/ISP/9.5-9.57pm, continued

User name	Time	Message	Interactive phases/ Operations
Winnie_p	9:53	(4) becoz it describe how output is produced	Phase II B: Answering question to clarify source of disagreement (4)
Tudung	9:54	(5) i agree with liza (Winnie_p) (6) because it is not a comparison isn\'t	Phase I B: Expressing agreement (5) Phase II B: Answering question to clarify source of disagreement (6)
Tudung	9:55	(7) because we explain further abot what is hardware	Phase II C: Advancing considerations supported by references (7)
Cokolat	9:55	(8) tsunami? yours?	Phase I F: Challenging others to engage in group discussion (8)
Tsunami	9:55	(9) we have to think of the hardware in a computer system	Phase II A: Identifying and stating area of disagreement (9)
Tudung	9:56	(10) okay if u said so what is ur answer? tsunami? (11) liza (Winnie_p) what is your answer?	Phase I D: Asking questions to clarify details of statement (10) Phase I F: Challenging others to engage in group discussion (11)
Tsunami	9:56	(12) comparison	Phase II A: Stating area of disagreement (12)
winnie_p	9:57	(13) I\'ve answered already.it is description	Phase II C: Restating participant's position (13)

Excerpt 3 shows that Tsunami's answer conflicted with that of Tudung, Winnie_p and Cokolat. Instead of ignoring Tsunami, the others tried to explain to her how they arrived at their answer. It has to be pointed out that Tsunami's answer "comparison" was the correct answer. The answer "description" given by Tudung, Winnie_p and Cokolat was incorrect. Excerpt 4 shows how the discovery of inconsistency in their answers, led to the unfolding of explanations as to why "comparison" instead of "description" was correct.

Excerpt 4: W9/GrpE/ISP/9.57-10.03pm)

User name	Time	Message	Interactive phases/ Operations
cokolat	9:57	ermmm...(14) how about comparisons? (15) clue word is \"as\"	Phase I A: Expressing an opinion (14) Phase II C: Advancing argument supported by references (15)
cokolat	9:58	(16) think of the....as the kitchen... \"as\"	Phase II C: Advancing argument supported by references (16)
tsunami	9:58	(17) read the note first... about comparison	Phase II C: Advancing argument supported by references (17)
Tudung	9:58	(18) okay but comparison might be right too	Phase I B: Expressing a statement of agreement (18)
cokolat	9:59	(19) what do u think?	Phase I F: Challenging others to engage in group discussion (19)
cokolat	10:00	(20) liza...why u said it is description?	Phase II B: Asking question to clarify source of disagreement (20)
winnie_p	10:00	(21) becoz it describe how an output is produced	Phase II B: Answering question to clarify source of disagreement (21)
tsunami	10:01	(22) description...more or less show a process... (23) this is not about the output	Phase III A: Clarifying the meaning of term (22) Phase II B: Answering question to clarify source of disagreement (23)
cokolat	10:01	(24) its compare the think (sic) of hardware in computer computer with a kitchen in a short order restaurant isn\"t it	Phase II C: Restating position supported by references (24)
tsunami	10:02	(25) tis is about the hardware in a computer system which may have similar function with the kitchen in a short order restaurant	Phase IV A: Summarizing of agreement (25)
Tudung	10:03	(26) i think it sholud (sic) be comparison...	Phase IV B: Applying new knowledge (26)

Because Tsunami's answer conflicted with hers, Cokolat reexamined the sentence and revised her answer to "comparison", for which she provided a reference to

support her answer. She pointed out the clue word for comparison was “as”. The turning point came when Tsunami posted “read the note first... about comparison” (9.58). It has to be explained that while posting their messages, students were able to constantly refer to the RAP website which enabled them to discuss and read the notes on Identifying Sentence Patterns at the same time. Examples of clue words and phrases that indicate the various sentence patterns were provided. Hence, Cokolat and Tsunami were able to provide support to their argument that the answer was “comparison” (which was the correct answer) instead of “description”. Tsunami was also able to explain to Winnie_p why “description” was not the answer because “description...more or less show a process... this is not about the output” (10.01). The explanation seemed to have convinced Tudung that she also agreed that “comparison” (10.03) should be the answer. Excerpt 4 illustrates that collaboration offers students the opportunity to reflect upon each others’ ideas and to reexamine their own. Furthermore, Excerpt 4 shows that learning took place due to collaboration. This was made possible due to the discovery of conflicting ideas which acted as a catalyst to promote interactive engagements.

Excerpts 3 and 4 provide evidence of social interdependence which yielded positive outcomes in students’ understanding of the topic on Identifying Sentence Patterns. The positive outcome being that those who got their answers wrong were able to discover why their answers were wrong and were able to correct themselves. This was clearly demonstrated in Cokolat’s message (9.57) “ermmm...(14) how about comparisons?” It shows that Tsunami’s answer “comparison” triggered Cokolat to think about and mull over her own answer “description”. What was of interest was that Cokolat could explain why “comparison” was the answer “clue word is \”as\”. This

shows that Cokolat came to a new understanding of the problem by interacting with the group's shared knowledge construction. Therefore, in this study, OC promotes active and shared learning whereby the participants were able to transform their understanding and apply newly-constructed meaning.

Furthermore, within Excerpts 3 and 4, there was evidence of the four phases of interaction which is seen as an exercise of co-construction of knowledge. The presence of the sharing phase, the discovery of inconsistency phase, negotiating for meaning phase and applying newly-constructed meaning phase indicate that interaction took place. According to Garrison and Anderson (2003) interaction is considered as the component that defines the educational process and is essential for meaningful learning. Therefore, this suggests that in Excerpt 4, meaningful learning had taken place.

4.6.2.4 Phase III: Negotiating for meaning/Co-constructing knowledge

Of the four phases of interaction, Phase III has the third highest number of operations recorded at 7.67% (Freq=58). This is shown in Table 4.10 (p. 167). There were four operations in this phase. In the overall rank-order of the operations used by ESL students "Negotiating or clarifying the meaning of terms" was ranked 6th, "Proposing and negotiating new statements embodying compromise, co-construction" was ranked 4th, "Identifying areas of agreement or overlap among conflicting concepts" was ranked 2.5, and "Integrating or accommodating metaphors or analogies" was ranked 1 (refer to Table 4.9, p. 165). Therefore, it was not surprising that "Negotiating

or clarifying the meaning of terms" registered the most number of operations used in Phase III with 36.21% (Freq=21). Excerpt 5 below illustrates the process of negotiating for meaning.

Group D comprised Alexandra, a high proficiency student, Jc3yLiana an average proficiency student, and Tarabas and Mulan who were low proficiency students. The reading task on Paraphrasing (Appendix H, Task 7, question 2) was to choose which of the three options given best paraphrased the original sentence. Additionally, they were to explain why they chose their answer. Excerpts 5, 6 and 7 show group D's discussion on question 2.

Question 2 (Paraphrasing)

By making abortions illegal, a country encourages dangerous abortions that kill thousands every year, particularly poor women who cannot afford to travel to a region where abortion is legal.

A Countries that make abortion against the law encourage women to have dangerous abortions, which kill thousands very year, especially poor women who don't have money to go to a place where abortion is legal.
B When a country makes abortion illegal, it discourages abortions which kill thousands a year, especially poor women who can't afford to travel to places where abortions are legal.
C Dangerous abortions, which kill thousands of poor women every year, are caused by a country's making abortion legal.

Appendix H

Excerpt 5: W7/GrpD/Prphr/20.10-20.14pm

User Name	Time	Message	Interactive phases/ Operations
Tarabas	20:10	(1) so, no 2... i vote for A...	Phase I A: Expressing an opinion (1)
Jc3yLiaNa	20:11	(2) no 2 i also think a	Phase I B: Expressing a statement of agreement (2)

Excerpt 5: W7/GrpD/Prphr/20.10-20.14pm, continued

User Name	Time	Message	Interactive phases/ Operations
Alexandra	20:12	(3) ok why they make the abortin illegal is to prevent the particular woman from doing abortion..rite?? it is b i think	Phase II A: Identifying areas of disagreement (3)
Jc3yLiaNa	20:13	(4) yes, (5) it says the country encourage dangerous abortions so that less ppl would do it not because it is illegal but because it is dangerous.. they would be scared do it there... they have to go sumwhere else to do the abortions	Phase I B: Expressing a statement of agreement (4) Phase I C: Corroborating examples provided by one or more participant (5)
Alexandra	20:14	(6) woman that do or did abortion its maybe doont want to deliver their baby due to higher cost and higher consumption nowadays	Phase I A: Expressing an opinion (6)

Excerpt 5 shows the discovery of inconsistency of ideas among group D members. Initially, both Tarabas and Jc3yLiaNa agreed that the answer for question 2 was A (the correct paraphrase). Alexandra disagreed with them. His reason for choosing B was that countries made abortions illegal to prevent women from aborting their babies (20:12). That convinced Jc3yLiaNa to change her answer from “A” to “B”. Her contention was that countries encourage dangerous abortion so that people will be discouraged to abort because it was dangerous. Both Alexandra and Jc3yLiaNa chose their answers based on speculations as to why countries make abortions illegal. In fact, the original sentence did not state the reasons why countries made abortions illegal. Instead, it stated the consequence of making abortion illegal. Hence, both Alexandra and Jc3yLiaNa did not paraphrase the sentence but instead read beyond it.

Excerpt 6: W7/GrpD/Prphr/20.14- 20.18pm

User Name	Time	Message	Interactive phases/ Operations
Alexandra	20:14	(1) in the develope country they allowed abortion due to the increasing in their people that cause higher consumption and higher cost of living by that way decreaseing human will lead to the decrease in consumption	Phase III D: Integrating analogies (1)
Tarabas	20:14	(2) i think no 2 is A....	Phase I A: Expressing an opinion (2)
Mulan	20.14	(3) i agree... no 2 it think a...	Phase I A: Expressing an opinion (3)
Alexandra	20:15	(4) it actuaaly a way of discouraging.. it is actually.	Phase II C: Restating the participant's position (4)
Tarabas	20:15	(5) encourage not discourage..	Phase II A: Identifying areas of disagreement (5)
Alexandra	20:16	(6) no 2 is b. agree??	Phase I A: Expressing an opinion (6)
Mulan	20:17	(7) ooo...*salah* (wrong) la...	Phase II A: Stating disagreement (7)
Jc3yLiaNa	20:18	ehehehe sorri.. (8) i think it's a. and (9) yes i agree with mulan.. (10) it says countries who make it illegal ENCOURAGES DANGEROUS ABORTIONS	Phase IV B: Applying new knowledge (8) Phase I B: Expressing a statement of agreement (9) Phase III B: Identifying areas of agreement (10)

Whereas Excerpt 5 shows the conflict in ideas, Excerpt 6 demonstrates the process of co-constructing knowledge among group D members. Due to the conflicting choices in their answers, the group members proceeded to negotiate for a compromise. In Excerpt 6, Alexandra stood his ground that "B" (20:16) was the answer. However, the others were not convinced that "B" was the answer. Even Jc3yLiaNa who initially agreed with him, realized that "B" was wrong and "A" was the answer. She wrote "it says countries who make it illegal ENCOURAGES DANGEROUS ABORTIONS" (20:18). The fact that she posted part of her message in capital letters indicates that she

could identify the area of agreement. She was applying new knowledge she gained when Tarabas corrected Alexandra "encourage not discourage…" (20:15). In fact, Jc3yLiaNa noted that the result of countries making abortion illegal is the reason for dangerous abortions. It has to be pointed out that in Excerpt 5, Jc3yLiaNa also noted the phrase "encourage dangerous abortions" in her posting but she added "so that less ppl would do it" (20.13) to the phrase "encourage dangerous abortions". In that message, Jc3yLiaNa attributed the idea of intention on the part of the country, i.e. the country encouraged dangerous abortions to prevent people from going for abortion. However, in Excerpt 6, after being prompted by Tarabas, Jc3yLiaNa correctly paraphrased the statement that countries encouraged dangerous abortions by making abortions illegal (20.18). This means that only Alexandra's answer still conflicted with that of Tarabas, Mulan and Jc3yLiaNa. Excerpt 7 shows the negotiating process whereby a compromise was finally reached between Alexandra and the other Group D members.

Excerpt 7: W7/GrpD/Prphr/20.19-20.24pm

User name	Time	Message	Interactive phases/ Operations
Mulan	20:19	(10) i think a...why u think it b?	Phase II B: Asking question to clarify source of disagreement (10)
Tarabas	20:20	(11) ya... thats right...	Phase I B: Expressing a statement of agreement (11)
Alexandra	20:21	(12) it is actually to dicourage poor woman from do abortin because they are not afford to go to the place that abortin is legal.. thats the answer	Phase II C: Restating the participants position and advancing argument supported by references (12)
Mulan	20:22	(13) abortion illegal encourage...not discourage....	Phase II A: Identifying areas of disagreement (13)

Excerpt 7: W7/GrpD/Prphr/20.19-20.24pm, continued

User name	Time	Message	Interactive phases/ Operations
Tarabas	20:22	*aiyaaa... pak cik ni ar....* ok … (14) maybe the country want to dismotivate abortion but… (15) the sentence says it ENCOURAGES dangerous abortin	Phase III B: Identifying areas of overlap among conflicting ideas (14) Phase II A: Identifying area of disagreement (15)
Mulan	20:23	(16) Right Juli … (17) task is paraphraselah …not give reason why abortion illegal. (18) of course when the country make abortion illegal will encourage the people to do dangerous abortion...compare with legal abortion....less cost. (19) legal racing… illegal racing. Which safer?	Phase I B: Expressing a statement of agreement (16) Phase II A: Identifying area of disagreement (17) Phase II C: Restating the participants position and advancing argument supported by references (18) Phase III D: Integrating analogies (19)
Alexandra	20:24	(20) Aiyah, paraphrase. u r right. (21) no 2 is a. illegal= agst the law, particularly=especially.	Phase 1 B: Expressing a statement of agreement (20) Phase IV B: Applying new knowledge (21)

When Mulan and Tarabas questioned Alexandra why he chose "B" as his answer, his response was that abortion was made illegal to discourage abortion (20.21). In reply, Tarabas posted the following, "maybe the country want to dismotivate abortion but …" (20.22). This clearly shows that she could see Alexandra's point of view (identify areas of agreement) but at the same time she also reiterated the fact that the sentence stated that because abortion was made illegal, it encouraged dangerous abortions. Mulan also pointed out, "… task is paraphraselah …not give reason why abortion illegal…" (20.23). Mulan reminded the group that the task was to paraphrase and not to speculate the reasons for making abortion illegal. It was after the explanation that Alexandra was able to see that he needed to paraphrase. Hence, he responded by giving the synonyms of the words in the sentence, "illegal= agst the law,

particularly=especially" (20.24). It can be seen that Alexandra was explicitly referring to Mulan's point that the task was to "paraphrase" when he posted his next message. By providing the synonyms to these words, it shows that Alexandra was applying newly-constructed meaning developed while exploring conflicting ideas. This indicates that Alexandra had come to a new understanding of the task by integrating the knowledge that he already has with the information he obtained from his peers. Additionally, this excerpt also shows evidence of higher levels of cognitive skills such as self-reflection which enabled the successful application of the newly-acquired knowledge.

Excerpts 5, 6 and 7 indicate that after presenting their points of view, the group members tried to negotiate for a common understanding. Consensus building in this case was not limited to negotiating for the meaning of the terms but also included the nature of the task. What is interesting was the process of negotiation continued to take place until some kind of common understanding was derived. No one's opinion was ignored or disregarded, no matter how different it was from the majority. The group seemed focus on achieving a common understanding as they took pains to clarify and explain the reasons for their answers for the benefit of the others with differing views.

Whilst Excerpts 5, 6 and 7 show the movement from the lower to the higher mental functions within the group (as the operations moved from the lower phases to the higher phases of interaction) the same could be observed within a single posting of an individual. For example, the message posted by Mulan (20.23) moved through several phases of interaction (from Phase I to Phase II and Phase III) within a single posting. The movement progressed in sequence through the phases, from the lower to

the higher mental levels. It not only indicates the successive cognitive levels that the individual went through, but also provided evidence of the contribution of the individual to jointly engage in active production of shared knowledge.

This is a clear indication of what Smith (1994) defines as group-mediated cognition, whereby the situation exerts a strong mediating effect on individual and conceptual processes. Without doubt, Alexandra's understanding of the task was influenced by the contributions of the others in the group, a result of the discovery of conflict in their ideas. Smith adds that it is this tension (conflict in ideas) between the individual and the group that provides the energy that drives the form of collective processing. The above excerpt shows how Alexandra was able to apply the "new" information (provided by the other group members) to preexisting structures in his mind and change those structures, showing that knowledge is extended.

Piaget's (1928) theory of cognitive structures clearly describes the process that Alexandra went through. Piaget put forward the idea that the developing mind as constantly seeking equilibrium, whereby the mind is seeking a balance between what is known and what is being experienced. He further explains that this balance is realized by the processes of assimilation and accommodation. The former is the process by which incoming information is changed or modified in the learners" minds so that they can fit it in with what they already know (Alexandra realizing that the task was to paraphrase). The latter, on the other hand, is the process by which learners modify what they already know to take into account new information (Alexandra modified his understanding and applied this new information to paraphrase the vocabulary). The process of assimilation and accommodation results in cognitive development.

The above excerpts show that shared learning experience occurred at two levels, the individual and the social. Learning takes place in a social context and that higher cognitive processes originate from social interactions. The individual modifies his understanding based on the shared constructions with the other group members. The cognitive gain occurs twice through the intermental (social) plane and then through the intramental (individual) plane (Wertsch, 1991). Therefore, Excerpts 5, 6, and 7 illustrate that there exists an interdependence of both the individual and social construction of knowledge (Salomon, 1993; Gunawardena et al., 1997).

4.6.2.5 Phase IV: Making agreement statements/Applying newly-constructed meaning

Table 4.10 (p. 167) shows that of the four phases, Phase IV recorded the least number of operations used with 4.77% (Freq=36). There were two operations in this phase. In the overall rank of the operations used by ESL students "Summarizing of agreement" was ranked 5th followed by "Applying new knowledge" which ranked 2.5 (refer to Table 4.9, p. 165). Table 4.10 shows "Summarizing of agreement" registered the highest number of operations used in Phase IV at 55.56% (Freq=20) compared to "Applying new knowledge" with 44.44% (Freq=16). Excerpt 8 shows the process of making agreement statements/ applying newly-constructed meaning.

This excerpt was taken from group A's online discussion on the task of Previewing and Predicting. They were to predict what to expect from the topic "College Success" (Appendix H, Task 2). Mid-way through the discussion, Winnie suddenly asked the group what college meant (15.25). The source of her confusion was

the term “college”. In UiTM, the local university where the students were studying, the term “college” was used to refer to the hostels where the students were staying. Hence, she associated “college” with “Mawar” (mwr) which means “rose” and “jati” which means “teak wood” which were names of hostels in UiTM. In addition, Winnie was confused over the terms “college” and “university”.

Excerpt 8: W2/GrpA/PP/15.25-15.29pm

User name	Time	Message	Interactive phases/ Operations
Winnie:	15.25	(1) guys college meansd college in universities)mwr..jati) or the univ itself such as uitm.limkok wing..other private colleges??quit confusing..	Phase III A: Negotiating for the meaning of term (1)
Nuraini	15.26	(2) not the hostel	Phase III A: Clarifying the meaning of term (2)
Prinze:	15.26	(3) in my understading the college means universities itself	Phase III A: Clarifying the meaning of term (3)
Nuraini:	15.26	(4) universitycollege	Phase III A: Clarifying the meaning of term (4)
Cibi :	15.26	(5) university	Phase III A: Clarifying the meaning of term (5)
Winnie:	15.27	(6) if that means the college.we should not ignore the lecturers.the way of learning and teachig.the course provided..at least must be recognized by " kementerian" so that in the future it will ensure there is a job relevant	Phase IV B: Applying new knowledge (6)

By writing “if that means college” (15.27) it shows that Winnie had come to a new understanding of the term “college” after her group members gave their definitions. Subsequently, she applied that new understanding/knowledge to expand the list of factors for college success (15.25). She included lecturers, teaching and learning,

kementerian (Ministry of Education) and job relevance to the list. It is interesting to note that although Prinze mentioned that "they (lecturers) have to teach their students with full responsibility and accountability", it was Winnie who first introduced the issue of teaching and learning and linked that to the need for recognition by the Ministry of Education (which is overall in-charge of education in Malaysia) and to future job relevance.

It is evident in the above excerpt that Winnie had taken into account the new information provided by her group members and was able to fit it (the new information) in with her existing cognitive schema. Then she modified what she already knew to take into account the new information and then applied that new information. This process supported Piaget's view that the developing mind is constantly seeking equilibrium, i.e. a balance between what is known and what is currently experienced.

Although the frequency counts for operations used in Phase IV was low, it did not imply that students gained any less from collaboration. It just means that when students use the operations in Phase IV, it frequently marks the conclusion of the discussion. This is especially true for the reading tasks set for this course. Therefore, what is more important than to count the number of times the operations occurred, is the fact that the operations in Phase IV had taken place. This indicates that shared knowledge building had taken place.

4.6.3 Patterns of interaction and reading tasks

The relationship between the patterns of interaction of ESL students and reading tasks was examined by looking at the frequency of operations used when students worked on different reading tasks. Particular attention was paid to the frequency of the overall operations demonstrated and the frequency of operations by interactive phase. In addition, the differences in operations used by interactive phases between different reading tasks were also examined.

4.6.3.1 Frequency and percentage of operations used

Overall, the operations used by ESL students when working on different reading comprehension tasks were different in terms of frequency of overall operations used (refer to Table 4.13, p. 173). The task of Identifying Sentence Pattern generated the highest frequency of operations (Freq=299) compared to Paraphrasing (Freq=282) and Previewing and Predicting (Freq=175). However, the result of the Friedman analysis of variance indicates that the difference in the frequency of overall operations generated by ESL students when they completed different reading tasks was not significant at $p > .05$ ($\chi_r^2 = 4.667$, df = 2, $p = .097$).

In addition, it was found that ESL students' patterns of operations used was relatively different (refer to Table 4.14, p. 176). At first glance, there seemed to be some similarities in the frequencies of operations used. For example, in Phase I, for the tasks of Previewing and Predicting and Identifying Sentence Pattern, ESL students

were more likely to employ the operations “Expressing a statement of agreement from one or more participants” and “Expressing a statement of observation or opinion”. For the task of Paraphrasing, they were likely to use the operations “Expressing a statement of observation or opinion” and “Challenging others to engage in group discussion”. However, all three tasks were less likely to use the operation “Corroborating examples provided by one or more participants”.

In Phase II, for the task of Previewing and Predicting, ESL students tended to use the operation “Restating the participant’s position, and advancing arguments or considerations supported by references”. However, for the task of Identifying Sentence Pattern, the students were more inclined to use the operation “Asking and answering questions to clarify the source and extent of disagreement”. The students had a propensity to employ the operation “Identifying and stating areas of disagreement” for the task of Paraphrasing.

In Phase III, for the task of Previewing and Predicting, they were more likely to use the operation “Proposing and negotiating new statements embodying compromise and co-construction”. For the tasks of Identifying Sentence Patterns and Paraphrasing, they were more liable to employ the operation “Negotiating or clarifying the meaning of terms”. All three groups were less inclined to use “Integrating or accommodating metaphors or analogy” for all three tasks.

In Phase IV, the operation “Summarizing of agreement” was more frequently used for the tasks of Previewing and Predicting and Identifying Sentence Patterns. Although, some of the preferences on the use of the operations were similar, on close

scrutiny, the percentage breakdown for each of these operations used was different. This indicates that the pattern of operations used was different.

The above analyses suggest that in terms of overall operations used, ESL students employed more or less the same number of operations when completing different reading tasks. However, the pattern of operations used was different for the four interactive phases. This suggests that overall, different reading tasks tended to have an effect on ESL students' operations use. The findings of this study are in line with studies carried out by Pellettieri (1996), Pica et al. (1993) and Smith (2003) which showed that task types have an influence on negotiation.

4.6.3.2 Operations used by interactive phase between different reading tasks

The major findings on the patterns of operations used by interactive phase between different reading tasks are presented in three sections. Firstly, it presents the findings comparing the operations used by interactive phase between the reading tasks of the Previewing and Predicting and Identifying Sentence Patterns. Secondly, it compares the operations used by interactive phase between the reading tasks of Previewing and Predicting and Paraphrasing. Lastly, the patterns of operations used by interactive phase between the reading tasks of Identifying Sentence Patterns and Paraphrasing was discussed.

A consistent pattern of operations used by interactive phases between different reading tasks was discovered for the reading tasks of Previewing and Predicting and Identifying Sentence Patterns. They were in Phases I, II, III and IV. Out of the six

operations in Phase I, two had the same rank-order (refer to Table 4.14, p. 176). They were "Asking and answering questions to clarify details of statements" (ranked 4th) and "Corroborating examples provided by one or more participants" (ranked 1st). For Phase II, one out of three operations had the same rank-order, i.e. the operation "Identifying and stating areas of disagreement" was ranked (2nd). Out of four operations in Phase III, two had the same rank-order. They were "Identifying areas of agreement or overlap among conflicting concepts" and "Integrating or accommodating metaphors or analogies" which were ranked 3rd and 1st respectively. In Phase IV, both operations had the same rank-order. They were "Summarizing of agreement" (ranked 2nd) and "Applying new knowledge" (ranked 1st). Therefore, it was not surprising that the Spearman rank-order correlation showed that the pattern of operations used was similar for Phases I and IV (refer to Table 4.15, p. 177).

However, the pattern of operations used was the opposite of each other for Phase II. The ranking for all three operations used between these two tasks were the opposite of each other. The most used operation in Phase II, for Previewing and Predicting was "Restating the participants' position, and advancing arguments or considerations supported by references" (ranked 3rd) as compared to the most used operation for Identifying Sentence Patterns which was "Asking and answering questions to clarify the source and extent of disagreement" (ranked 3rd). Conversely, the least used operation for Previewing and Predicting was "Asking and answering questions to clarify the source and extent of disagreement" (ranked 1st) whereas the most used operation for Identifying Sentence Patterns which was "Restating the participants' position, and advancing arguments or considerations supported by

references" (ranked 1st). There was no significant relationship in the operations used in Phase III despite the fact that two out of four operations had the same rank-order.

In terms of the operations used by interactive phase between Previewing and Predicting and Paraphrasing, there were differences in the pattern of operations used in Phases I and III. There was only one operation "Corroborating examples provided by one or more participants" which shared the same rank-order (ranked 1st) between these two tasks. The other operations in Phase I were ranked differently between the two tasks. Likewise only one operation "Integrating or accommodating metaphors or analogies" out of four in Phase III shared the same rank-order (ranked 1st). No correlation was found for Phase II and there was a negative significant relationship in the operations used in Phase IV (refer to Table 4.16, p. 179).

Likewise, there were differences in the pattern of operations used for the reading tasks of Identifying Sentence Patterns and Paraphrasing in Phases I, and III (refer to Table 4.17, p. 182). This was despite the fact that in Phase I, three out of six operations had the same rank–order. They were "Expressing a statement of observation or opinion" (ranked 6th), "Defining, describing, or identifying a problem" (ranked 3rd) and "Corroborating examples provided by one or more participants" (ranked 1st). In Phase III, two out of the four operations had the same rank-order. They were "Negotiating or clarifying the meaning of terms" (ranked 4th) and "Integrating or accommodating metaphors or analogies" (ranked 1st). Like Phase II, there was no correlation in the use of operations between the two reading tasks. Phase IV shows that the operations used was the opposite of each other.

Out of the three Spearman rank-order correlation carried out between the three selected reading tasks, the results show only five significant relationships (refer to Tables 4.15, 4.16 and 4.17). Out of these five, two were positive correlations and three were negative correlations. Three of the significant relationships were found in Phase IV out of which two were negative correlations. It has to be pointed out that the significant results in Phase IV could be due to the fact that Phase IV only had two operations (N=2). Hence, the chances of r = 1 or -1 is greater than if N > than 2. This means that if one operation was ranked 2nd the other would be ranked 1st. So, this means that in fact, there were only two significant relationships in the pattern of operations used between the different tasks. The patterns of operations used were similar between the tasks of Previewing and Predicting and Identifying Sentence Patterns for Phases I and IV.

From the above analyses, it is therefore suggested that the pattern of operations used by ESL students when working on different reading tasks was comparatively different. This seems to imply that in this study, different reading tasks do dictate the operations used during online discussion.

4.6.4 Patterns of interaction and reading performance

The previous section dealt with the nature of the relationship between ESL students' patterns of interaction and reading tasks during OC. This section looks at the nature of the relationship between ESL students' reading performance and the operations generated.

The results of the Kruskal-Wallis test (refer to Table 4.19, p. 185) showed that there was a significant relationship between the scores of all three different reading tasks at $p<.05$ ($N=12$, $\chi_r^2= 8.93$, $p= .012$). This means that there was a difference in the performance of ESL students when working on different reading tasks.

The results of the correlation analyses on the relationship between operations used and reading performance show that there was no significant correlation between ESL students' reading performance and the frequency of overall operations used (refer to Table 4.20, p. 188). This seems to suggest that the reading performance was not related to the operations used. Additionally, the results suggest that there was no correlation between the frequency of operations used for Phase III and the reading score of Previewing and Predicting; Phase II and the reading score of Identifying Sentence Patterns and Paraphrasing. This means that ESL students' reading scores were not affected whether or not students used these operations. One possible reason why no correlation was found between the reading score for Previewing and Predicting and the operations used in Phase III could be due to task type. Multiple outcomes were possible for the task of Previewing and Predicting which meant that there was no right or wrong answers. Hence, there was little need for the deployment of the operations to negotiate for meaning. However, there was no correlation between Phase II and the reading scores for Identifying Sentence Patterns and Paraphrasing. This could be attributed to the fact that there was only one outcome possible for both these tasks. Hence, once students discovered conflict in their answers, more operations were generated towards getting the one correct answer. Nevertheless, there was no significant correlation between the phases and the reading scores of the three tasks. Therefore, the results in

this study show that the reading performance was not dependent on the overall frequency of operations used.

However, in terms of reading performance and the operations used by interactive phases, there were some positive correlations (refer to Tables 4.21- 4.24, pp. 190, 191, 193 and 194). For Previewing and Predicting, there was a significant relationship between one operation in Phase I "Corroborating examples provided by one or more participants" and the reading score. This means that ESL students obtained higher reading scores when they generated more of this operation. It suggests that students needed to corroborate examples provided by other participants in order to get better scores for Previewing and Predicting which was an open task. Another significant correlation for Previewing and Predicting was found between the operation "Summarizing of agreement" in Phase IV and the reading score. This could be due to the fact that the open task whereby many outcomes were possible required ESL students to generate more of the operations for summarizing agreements. They needed to collate the varied answers to obtain higher scores. However, in Phase III there was a negative relationship between the operation "Negotiating or clarifying the meaning of terms" and the reading score. Students obtained higher scores when they generated less of this operation. The results seem to suggest that students need to generate less of this operation for a task with multiple outcomes.

For Identifying Sentence Patterns, only one operation "Identifying and stating areas of disagreement" from Phase II had significant correlation with the reading scores. This suggests that students obtained higher scores when they used more of this operation. There was only one outcome possible for the task of Identifying Sentence

Patterns. Thus, it was possible that students identified and stated their disagreement when they experienced conflict in their answers. Their ability to identify and state their disagreement could be aided by the RAP notes which they could view during their discussions with their friends. The results did not show significant correlations for Phase III. No results were generated for "Integrating or accommodating metaphors or analogies" because ESL students did not generate any of this operations. Similarly there was no significant correlation for Phase IV.

For Paraphrasing, significant correlations were found in Phase I between the operations "Expressing a statement of agreement from one or more other participants" (positively correlated), "Corroborating examples provided by one or more participants" (negatively correlated), and "Asking and answering questions to clarify details of statements" (positively correlated) and the reading scores. The statistical results prove that the two operations used (which were positively correlated) contributed to higher levels of achievement. The positive correlation between the operations and the reading score could be attributed to the fact that there was only one outcome possible for the task of Paraphrasing. For Paraphrasing, students chose one correct answer from the options given unlike Identifying Sentence Patterns whereby students came up with their own answers. Hence, this could account for the fact that when ESL students chose their answers from the options given, it elicited expressions of agreement from the others. Moreover, this implies that to obtain higher scores for multiple choice questions, students should ask or answer questions to clarify details. Conversely, to gain higher scores, ESL students should use less of the corroborating examples operations.

In Phase II there was a negative correlation between the students' reading score and the operation "Identifying and stating areas of disagreement". Likewise, two operations in Phase III that showed negative relationships with the reading score were "Identifying areas of agreement or overlap among conflicting concepts", and "Proposing and negotiating new statements embodying compromise, co-construction". These negative correlations show that ESL groups performed better when they used less of these operations. It also seems to suggest that these operations were not helpful to get higher scores for multiple-choice questions. There was no correlation between the reading score and the operation "Restating the participants' position and advancing arguments or considerations supported by references."

The statistical results, which show both positive and negative significant correlations between the reading scores of different reading tasks with different sets of operations used, seem to indicate that effective online discussion requires the use of different operations. To collaborate online successfully for the task of Previewing and Predicting, ESL students in this study made use of the operations, "Corroborating examples provided by one or more participants", and "Summarizing of agreement" but less of "Negotiating or clarifying the meaning of terms".

To perform better for the task of Identifying Sentence Patterns, ESL groups used more of the operation "Identifying and stating areas of disagreement". For the task of Paraphrasing, ESL groups showed improved performance when they used more of the operations "Expressing a statement of agreement from one or more other participants" and "Asking and answering questions to clarify details of statements". Moreover, the statistical results show that the performance was better when they used

less of the operations "Corroborating examples provided by one or more participants", "Identifying and stating areas of disagreement", "Identifying areas of agreement or overlap among conflicting concepts", and "Proposing and negotiating new statements embodying compromise, co-construction". The varieties of operations used which relate significantly to the reading scores indicate that during online discussions, ESL students were flexible in their use of operations depending on the online tasks.

4.7 Chapter summary

This section summarizes the major findings based on the research questions posed in this study. The first part sums up the major findings on the effects of OC on ESL students' reading performance. This is followed by a summary of the major findings on the patterns of interaction during OC. Then it provides a brief on the major findings regarding the differences in patterns of interaction when ESL students worked on different reading tasks. The last part presents a summary of the major findings on the nature of the relationship between the patterns of interaction and reading performance.

Firstly, ESL students showed significant improvements in their posttest results as well as their reading scores after OC, at both the individual and group level. Overall, even though all the students except for one (no change), showed improvements in their posttest scores at the individual level, the findings showed that the low proficiency students recorded the highest range of improvements in their posttest scores and reading scores after OC. The average proficiency students recorded the second highest

range of improvements in their scores. This implies that low and average proficiency students gained the most in terms of improved scores from OC.

In terms of improvements in the results of the pretest and posttest by question, the results showed no significant differences in ESL students' scores as the questions moved from the lower to the higher levels of cognitive domain. There were more significant differences in students' scores when they answered questions which required lower levels of cognitive skills. This was corroborated by the results obtained from the students' reading scores after OC. Significant differences were found in scores for reading tasks, which required lower levels of cognitive skills. There were fewer significant differences in scores of reading tasks, which required higher cognitive skills. These results suggest that OC was favourable to the majority of ESL students although at the lower levels of cognitive domain. This means that although on the whole OC improved the reading performance of ESL students, its efficacy is limited.

Secondly, an adapted version of the Interactive Analysis Model was used to analyze the patterns of interaction of ESL students during OC. There were four phases which were characterized by operations. There were altogether 15 operations, six of which were in Phase I, three in Phase II, four in Phase III, and two in Phase IV. In essence, the findings indicate that the process of co-construction of knowledge was evident when ESL students collaborated online. Moreover, ESL students were engaged in all four phases of interaction i.e. they utilized a variety of operations although with differing frequencies.

The operations used by ESL students were dominated by those found in Phase I. This was followed by operations in Phase II. The least used operations were those

found in Phase IV. The adapted version of the Interactive Analysis Model begins with lower mental functions (Phases I and II) and moves on to higher mental functions Phases III and IV). Therefore, differences in the frequency of operations used imply that peer interaction during OC took place, although at the lower levels of engagement. Furthermore, the differences in the frequency of operations used show that ESL students have a limited repertoire of operations to resolve their disagreements. Similarly, they displayed a limited range of operations to apply newly-constructed meaning.

The three dominant operations utilized by the students were “Expressing a statement of observation or opinion”, “Expressing a statement of agreement from one or more other participants” and “Challenging others to engage in group discussion”. These were operations found in Phase I. This suggests that the key concern of ESL students when approaching an online task was directed towards sharing their understanding of the task. In addition, during OC, students tended to pursue points of concurrence rather than points of disagreement. Also, students were mindful of including the other group members in the discussion when they challenge others to engage in group discussions. At the same time, there were increased responses as a result of these challenges, thereby enabling more active participation to take place.

Qualitative findings in Phase II illustrate that ESL students inevitably discovered conflict (tension) when they shared their ideas. Nevertheless, the discovery of conflicting ideas acted as a catalyst that promoted interactive engagements which result in active learning. Without conflict or tension, the discussion would conclude earlier especially if there was tacit agreement. OC also presented opportunities for

students to reflect upon the ideas presented by the others. This was made possible by the fact that students could refer to the earlier discussion which was captured on screen. This enabled students to bridge the gap between what they know and what they have learned resulting in newly-constructed meaning.

The process of negotiating for meaning and making agreement statements was a direct result of the discovery of conflict. Qualitative findings show that whenever there was a conflict, the group members made a concerted effort to resolve it. The group members took pains to clarify and explain to those whose opinions differed from theirs. The discussion would continue until a common understanding was reached. It was the conflict that stimulated and drove the discussion further. The development of shared knowledge was created through a process of convergent understanding. Following this shared understanding, the disconcerted party could apply the newly-constructed meaning. This process supported Piaget's theory that learners are actively involved in constructing their own personal meaning based on their prior experiences. It is clear that the process whereby incoming information was modified in the students' minds so that they could fit it in with what they already knew was present during OC. The process showed that the students were seeking equilibrium, i.e. a balance between what is known and what is currently experienced. All four phases of interaction play an important role for learning to take place.

Thirdly, the findings show that ESL students on the whole employed relatively similar number of operations for different reading tasks during OC. Likewise, there was no significant difference in the frequency of operations used by interactive phase. The

pattern of operations used was different for all four interactive phases suggesting that different reading tasks influenced ESL students' use of operations.

Moreover, no significant correlations were found between the patterns of operations used and the different reading tasks except for one similarity and one difference in the operations used for the tasks of Previewing and Predicting and Identifying Sentence Patterns in Phases I and Phase II respectively. This seems to indicate that generally, different reading tasks had an effect on the operations used. This also means that ESL students were flexible in the use of operations.

Lastly, the overall reading performance of ESL students was not related to the frequency of operations used for different reading tasks. However, for the task of Previewing and Predicting, there were significant correlations between the operations "Corroborating examples provided by one or more participants" in Phase I, "Negotiating or clarifying the meaning of terms" in Phase III, and "Summarizing of agreement" and the reading scores in Phase IV. For the task of Identifying Sentence Patterns, significant correlation was found between the scores and the operation "Identifying and stating areas of disagreement" in Phase II. For Paraphrasing, significant correlations were found between the operations "Expressing a statement of agreement from one or more other participants", "Corroborating examples provided by one or more participants", and "Asking and answering questions to clarify details of statements" and the reading scores in Phase I. There were significant correlations between the operations "Identifying and stating areas of disagreement" and reading scores in Phase II and between the operations "Identifying areas of agreement or overlap among conflicting concepts" and "Proposing and negotiating new statements

embodying compromise, co-construction" and the reading scores in Phase III. Hence, the different operations used which relate significantly to the reading scores seem to indicate that during OC, ESL students were flexible in their use of operations. This suggests that they could vary the use of operations according to the online tasks.

The implications of the findings are discussed in the following chapter. The discussion would focus on the significance of the findings in relation to past research on OC and the current theoretical views on online learning.