CHAPTER 5

ANALYSIS OF DATA

This chapter presents an analysis of the data collected based on the 4 research questions.

The research questions that guided the analysis of the data are as follows:

1) To what extent did the various activities of the Web-based constructivist learning environment (WebClen) encourage higher order thinking and enhance content acquisition among primary sBelinl learners?
2) What are the characteristics of cooperative and collaborative learning in the WebClen?
3) What is the role of the teacher in the WebClen?
4) What are learner perceptions of the WebClen?

The analysis pertaining to each of these questions is presented as follows:

Research Question 1: To what extent did the various activities of the Web-based constructivist learning environment (WebClen) encourage higher order thinking and enhance content acquisition among primary sBelinl learners?

(A) Encouraging Higher Order Thinking Skills

The various activities of the WebClen were designed to encourage the development of higher order thinking skills which required learners to go beyond the recognition and recall of information. Various data sources were analyzed to determine whether the WebClen encouraged the development of higher order thinking. These included:

(a) Online written reports,

(b) The Frequently Asked Questions (FAQ) activity,

(c) Keeping a journal of a time-based authentic online activity,

(d) Interpretation of visual information,

(e) Expert-learner online conversations, and

(f) Performance on the Thinking Skills Test and the Information Skills Test.

(a) Online Written Reports

Each of the twelve groups of students were required to write five online reports (Appendix Q) on the four Geoscience topics. Each report was analyzed to determine if they could critically evaluate information. Table 5.1 is a summary of the scores assigned for critical evaluation according to the different ability groupings. Out of a maximum score of 4, group average ranged from between 0.2 and 2.8. Interestingly, low ability groups scored the highest with a mean score of 1.8 followed by high ability groups with a mean score of 1.6 while the mixed ability groups had a mean score of 1.0. Notable is Group 7, a high ability group that obtained an average score of only 0.2 compared to a low ability group (group 8) which had the highest average score of 2.8. Data were also analyzed according to performance on the individual reports. Mean scores for the five reports ranged from 0.9 to 2.8 points with the lowest being for Report 4 (Rotation and Revolution of the Earth and Moon) and the highest being for Report 1 (The Earth, Moon and Sun). Further analysis revealed that 4 groups did not submit Report 5 and a further 4 groups scored 0 points for Report 5 and 6 groups scored 0 points for Report 4.

Table 5.1

Summary of Scores for Critical Evaluation of Online Written Reports

	High Ability				Mixed Ability				Low Ability				Mean Score
[a]Report	6	7	9	11	2	4	10	12	1	3	5	8	
Report 1	3	1	4	4	2	2	4	2	2	2	4	3	2.8
Report 2	4	0	1	0	0	[b]NA	1	0	0	1	3	2	1.1
Report 3	4	0	0	4	1	1	1	0	NA	1	2	4	1.6
Report 4	3	0	2	0	0	0	2	0	NA	0	1	2	0.9
Report 5	0	0	0	2	2	NA	NA	0	1	NA	NA	3	1.0
Group Mean	2.8	0.2	1.4	2.0	1.0	0.8	2.0	0.4	1.0	1.0	2.5	2.8	
Ability Group Mean		1.6				1.0				1.8			

Note. Maximum score = 4.

[a]Report 1: Earth, Moon & Sun; Report 2: Earth Layers; Report 3: Earthquakes, Volcanoes, Geysers and Hot Water Ponds; Report 4: Rotation and Revolution of the Earth and Moon; Report 5: The Solar System.

[b]NA = non submission.

(b) The Frequently Asked Questions (FAQ) Activity

The questions and answers generated in the FAQ activity (Appendix R) were analyzed according to the cognitive level of questions, learner evaluations of answers to questions generated by peers and learner responses to questions posed by the teacher.

(i) Cognitive level of learner generated questions

A total of 46 questions were generated by learners over the four weeks and they were analyzed and categorized according to four cognitive levels based on Wilen (1991) and Pearson and Johnson's (1978) taxonomy. Lower order convergent (LOC) questions required recall or recognition of information while for higher order convergent (HOC) questions, students' questions went beyond recall which required understanding of information. Lower order divergent questions (LOD) required respondents to think critically about the information, analyze it to draw conclusions, and support their opinions with reasons. Higher order divergent questions (HOD) required original and evaluative thinking such as prediction, solution of life-like problems, production of original communication and making judgements.

Each of the four categories of questions were further classified as "direct" if there were directly related to content studied, and "elaborate" if they required information that goes beyond the content studied.

Table 5.2 is a classification of the 46 questions generated according to the four cognitive levels identified. A total of 39 of the 46 questions (85%) generated were convergent questions. Of these questions, 21 were lower order convergent while 18 were higher order convergent. Only 7 of the 46 questions (15%) generated

Table 5.2

Cognitive Level of Questions Generated by Learners

	High Ability	Mixed Ability	Low Ability	Total
1. Lower Order Convergent				
– Direct	2	3	3	8
– Elaborate	2	4	7	13
2. Higher Order Convergent				
– Direct	1	3	10	14
– Elaborate	1	2	1	4
3. Lower Order Divergent				
– Direct	0	1	1	2
– Elaborate	1	0	1	2
4. Higher Order Divergent				
– Direct	0	0	0	0
– Elaborate	1	1	1	3
Total	8	14	24	46

were divergent questions of which 4 were of lower order while 3 were higher order questions.

According to ability grouping, more questions were generated by low ability learners compared to mixed and high ability learners. In fact, low ability students generated 52% or 24 of the total questions and out of this 21 questions were convergent type questions while the rest were divergent questions. Similarly, of the 8 questions generated by the high ability groups, 6 were convergent, while 12 out of 14 questions generated by the mixed ability groups were convergent. With regard

to whether the questions were direct or elaborate, slightly more than half (52%) of the total number of questions generated were directly related to content studied, while the rest (47%) of the questions were classified as 'elaborate' or those questions that required learners to go beyond the content studied. The following are examples of questions for each of the four main categories identified:

Lower Order Convergent. What is the instrument used to measure earthquakes? This question is convergent, as it requires the name of the instrument. It is also lower order as the learner merely provides the correct name from memory or recall.

Higher Order Convergent. How are volcanoes formed? This question is convergent as the answer can be anticipated whereby it requires the learner to list procedurally what will happen. It is higher order as students need to exercise their reasoning powers.

Lower order Divergent. Why does the moon take different shapes? This question is divergent as student answer may not be anticipated.

Higher Order Divergent. Is the water on the moon sufficient for 2000 people for the next 100 years? This question is divergent as student answer may not be anticipated. It is higher order, as students have to predict, produce original communication and make judgements.

(ii) Learner evaluation of answers to questions generated by peers

The purpose of learner evaluation of answers to questions generated by peers was to encourage learners to critically evaluate peer answers to FAQs (Appendix S). Learners evaluated the answers based on their own criteria. As it was possible to have two or more groups responding to one question, a total of 66 sets of answers were produced in response to the 46 FAQs. High ability students

evaluated 39 (59%) of the 66 answers. Mixed ability students evaluated a total of 20 (30%) while low ability students evaluated 7 (11%) of the 66 answers. To evaluate peer answers, students were first required to grade their peer work by giving a letter grade of between 'A' to 'E'. Analysis of grades given showed that learners gave 73% of the answers an 'A', 21% a 'B' and 6% a 'C'. Besides assigning grades, students were required to give reasons and comment on the grades assigned by providing some subjective feedback.

Analysis of the feedback revealed that learners from the high ability groups tended to provide more elaborative feedback. The following are samples of learner feedback for a grade "A": 'because it contains important information', 'searched for information carefully', 'all this group members always think when they are searching for answers' and 'because the output is satisfactory'. Answers that were perceived to be lacking (given a Grade B or C) were tagged with 'add more information', 'did not complete the work', 'because the answer does not match the question' and 'the picture does not fit the information'. Learners in the mixed ability groups evaluated the answers with terms such as 'good explanation', 'good at searching for information' and 'the sentence you wrote is good and satisfactory'. In contrast, low ability students responded with less elaborative terms such as 'good', 'not very good' and 'clever' in their evaluations of the answers given.

(iii) Learner responses to a question posed by the teacher

The purpose of this activity was for learners to apply the recently acquired geoscience knowledge to a real world phenomena or problem. Students were required to answer the following question posed by the teacher "*Will the Asteroid XF11 crash into Earth in the year 2028?*" Besides Internet resources, learners

were given newspaper cuttings on information related to the Asteroid. Responses to this question were analyzed according to students' ability to take a position and support the position taken with information; provide additional relevant information and make reference to authoritative sources of information.

To answer the question, the students worked in their respective groups answering the question. Out of the twelve groups, only 8 groups of students attempted the question. Of these, only 6 groups were able to take a position in terms of whether or not the asteroid will crash into earth. The other two groups were non-committal. For example, one group responded that they did not know if the asteroid will or will not crash into Earth in the year 2028. As illustrated in the following response, Group 7 took the position and supported the position with information stating that the asteroid will not crash into earth.

> *Asteroid 1997 XF11 will pass well beyond the Moon's distance from Earth in October 2028 with a zero probability of impacting the planet. The asteroid is predicted to pass at the rather comfortable distance of about 600,000 miles (about 960,000 kilometers) in 2028.*
>
> (Excerpt from answer of Group 7 students)

With regard to providing additional relevant information only 3 out of the eight groups were able to do so. The following is an excerpt of Group 9. The group members stated the possible consequence of the asteroid hitting the earth, which is relevant to the question.

> *The effects of a collision include: 1. Asteroid impact causes a massive blast wave similar to a nuclear explosion and destroys everything around it for several hundreds of kilometers; 2. Earthquakes will rock the world for days with huge high sea waves; and 3. Vaporised water and rocks will eject into the stratosphere.*
>
> (Excerpt from answer of Group 9 students)

Student answers were also evaluated with regard to making reference to authoritative sources. It was observed that only 4 groups had referred to authoritative sources for their information and the following is an example of such evidence.

> *But researchers say even if 1997 XF11 had been headed towards Earth, it would have been easy to deflect. The International Astronomical Union (IAU), which keeps track of such objects said that an asteroid would pass very close to the Earth in 2028 and might conceivably hit it. But NASA said its calculation showed it would miss the Planet by 960,000km.*
>
> (Excerpt from answer of Group 4 students)

(c) Keeping a journal of a time-based authentic online activity

The purpose of keeping a journal of a time-based authentic online activity (Appendix T) was to expose learners to an authentic situation where they could apply the concepts and principles learned. For this activity, students kept track of the Popocatepetl volcano using a suggested website, (http:// www.cenapred.unam.mx/~jfg/popo/reportes/ultrepi.cgi) which provided live and updated information on the volcanic activity. For a period of seven days, students were required to read the daily protocols, extract main ideas and keep a journal. The written protocols from the journals were assessed according to the students' ability to paraphrase and redefine the information they have accessed.

A total of 50 protocols were recorded by 11 of the 12 groups. The number of protocols per group ranged from one to nine with the most number of protocols done by Group 8 and 11. The high ability groups recorded the most protocols (25) followed by the mixed ability (13) and the low ability (12) (see Table 5.3). It was found that only 30% of the written protocols had been paraphrased and most of the protocols that had been paraphrased were from the high ability groups. The other protocols were verbatim accounts of the information provided about the volcano during the

Table 5.3

Number of Journal Protocols that were Paraphrased and Recorded Verbatim

Groups		Number of Protocols		Total	Grand Total
		Paraphrased	Verbatim		
	6	1	2	3	
High Ability	7	3	2	5	25
	9	1	7	8	
	11	4	5	9	
	2	0	7	7	
Mixed Ability	4	2	0	2	
	10	0	2	2	13
	12	0	2	2	
	1	0	1	1	
Low Ability	3	1	1	2	
	5	NA	NA	0	12
	8	3	6	9	
Total		15	35		50

Note. NA = non submission

seven-day period. The excerpt below is an example of a written protocol that was neither paraphrased nor redefined. Students accessed the related website and presented the information verbatim. This output was therefore assigned a score of 1 point.

> *During the last 12 hours the activity of Popocatepetl volcano has been stable, only small and medium exhalations have been recorded. The most important one occurred at 23:55 (05:55 GMT), event which lasted 7 minutes. A low magnitude tectonic*

A-type event occurred at 01:23 (17:23 GMT). Also low and high frequency tremor signals continue to be recorded. This morning a light fumarole could be seen (see image) with winds directed to the southeast. Recommendation is made to stay away from the volcano in a radius of 7km from the crater. The traffic-light alert signal remains yellow.

(Excerpt from answer of Group 2 students)

The following excerpt is an example of the earlier protocol but which has been paraphrased and whereby main and subordinate ideas have been extracted. Thus the output was assigned a score of 2 points.

The volcano had stayed stable in general with low levels of activity. A continuos gas steam and some ash fumarole can be seen which rises 1 km above the crater. Recommendations are made not to get closer than 7km to the crater.

(Excerpt from answer of Group 3 students)

It was also found that creative use of images accompanied the journals that were uploaded into the Geoscience template. For example, Groups 2, 8, 9 and 11 had on their own accord attached images of the Popocatepetl volcano to their journals. The images obtained from the given website helped the learners to explain the concepts in a clearer manner. One group even went further such as to attach captions to their journal. To illustrate, a high ability group (Group 9) had the following caption attached to their document: "*worlds greatest reporters from Planet Uranus*". Along with the text, members of Group 9 had attached an animated picture of a reporter working on a computer.

(d) Interpretation of visual information

The purpose of interpretation of visual information (Appendix U) was to have students actively construct meaning through interpretation of multimedia images. Each of the twelve groups was presented with a total of 22 images

consisting of thirteen still graphics, eight video clips and animations, and one active time-based Internet link. Hence the maximum possible interpretations from each ability grouping was 88 (4 groups × 22). Learners reviewed the images in groups and then presented their responses on to the template. To illustrate how learner responses were evaluated, sample descriptions of a still image of the earth is provided. The following are sample descriptions of the image and how each description is scored:

Score	Criteria	Sample description
1	Description not related to the image	An atmosphere consists of several layers of air that surround our planet. The layer nearest to the earth's surface is called the troposphere. It is about 10 kilometers thick at the poles and 16 kilometers thick at the Equator. About one-fifth is a gas called nitrogen, and the rest is made up of argon, carbon dioxide and small amounts of other gases. The top of the troposphere is called the tropopause. Here, the air does not have enough oxygen for living things to survive.
2	Related description, but mixed with irrelevant information	I can see a layer of atmosphere around the earth. The atmosphere also protects living things on earth and from ultra-violet rays.
3	Description related but brief	I see a layer outside the earth.
4	Related and detailed description.	I can see the earth surrounded by a transparent layer of material. The color is bluish and there are cloud like images in it.

Table 5.4 presents a summary of the scores obtained and number of images interpreted by each group. High ability learners interpreted the most number of

Table 5.4

Scores Obtained for Interpretation of Visual Information

Ability Groups	Mean	Number of interpretations
High	2.35	70
Mixed	2.94	51
Low	2.80	47

images (70) with the least being by the low ability learners (47). In terms of the ability to interpret visual information, overall, there was little variation in the mean scores according to ability grouping. Students in the mixed and low ability groups scored higher (M = 2.94) and (M = 2.80) respectively as compared to the high ability group which scored a lower score (M = 2.35). Despite having made more frequent interpretation of images, high ability groups did not exhibit a higher score for quality of interpretations.

(e) Expert-Learner Online Conversations

A total of 23 questions were posed to the geo-experts by students from 10 of the 12 groups (Appendix V). Students from Group 3 (low ability) and Group 12 (mixed ability) did not pose any questions. On the whole, there was not much variation in the number of questions sent to the geo-experts according to ability groupings. The high ability groups submitted 9 questions, the mixed ability groups submitted 6 questions while the low ability groups submitted 8 questions. In terms of cognitive levels of the questions submitted, 56% (13) were lower order and 44% (10) were higher order questions (Table 5.5).

Table 5.5

Cognitive Level of Questions Sent to the Experts

Ability Groups	Lower Order Questions	Higher Order Questions
High	17% (4)	22% (5)
Mixed	22% (5)	4% (1)
Low	17% (4)	17% (4)
	56% (13)	44% (10)

Examples of lower order questions include (a) *Who is the first woman who landed on moon?* (Group 1), (b) *What is a neutron star?* (Group 8) and (c) *What is the Ozone layer?* (Group 8). Examples of higher order questions include (a) *Why is the sky blue?*(Group 7) and (b) *How does the moon phases help identify the starting date of the Ramadhan month?* (Group 8).

(f) Performance on the Thinking Skills Test and The Information Skills Test

The Thinking Skills Test consisted of 35 multiple choice questions measuring five skills: classification, analogical reasoning, deductive reasoning, spatial thinking and mechanical comprehension. Each of these sub-tests had 7 items with five choices. The scores were analyzed for significant differences using the repeated measures model with pre and posttest as within-subject variables. Table 5.6 shows the means and standard deviations for the total test and the individual sub-tests.

The total mean for the pretest was 21.8 with a standard deviation of 3.9, while the total mean posttest score was 23.2 with a standard deviation of 3.6 and the difference was statistically significant at $p \leq 0.05$. Further analysis revealed that the difference was significant only for the classification sub-test where the pretest

Table 5.6

Mean and Standard Deviation for the Thinking Skills Test (Pretest and Posttest Scores)

Type of thinking skills	Pre-test		Post-test		
	Mean	Standard Deviation	Mean	Standard Deviation	F value
Classification	3.50	1.20	4.00	1.20	4.72*
Analogical Reasoning	5.33	1.42	5.63	1.42	1.49
Deductive Reasoning	4.40	1.40	4.80	1.30	3.79
Spatial Thinking	5.06	1.20	5.39	1.20	2.04
Mechanical Comprehension	3.60	1.40	3.60	1.60	0.01
Total	21.80	3.90	23. 20	3.60	4.29*

Note. *significant at $p \leq 0.05$

N = 36

mean was 3.5 and the posttest mean was 4.0. For analogical reasoning, deductive reasoning, spatial thinking and mechanical comprehension, posttest scores were higher than pretest means, but the gain was not significant. No differences were recorded for mechanical comprehension.

Performance on the thinking skills test was also analyzed according to ability groupings (see Table 5.7). The mean pretest score for the high ability group was 22.66 with a standard deviation of 3.33, and the mean posttest score was 24.75 with a standard deviation of 3.13. The difference between means was significant at $p \leq 0.05$. Though the posttest means for the mixed ability group (M = 22.90) and the low ability group (M = 21.81) were higher than the pretest mean scores, (M = 22.63) and (M = 20.18) respectively, the gains made were not statistically significant.

Table 5.7

Mean and Standard Deviation for the Thinking Skills Test According to Ability Groups

Ability Groups	Pre-test		Post-test		
	Mean	Standard Deviation	Mean	Standard Deviation	F value
High	22.66	3.33	24.75	3.13	4.82*
Mixed	22.63	3.88	22.90	3.98	1.10
Low	20.18	4.30	21.81	3.42	1.12

Note. *significant at $p \leq 0.05$

N = 36

Besides the Thinking Skills Test, an Information Skills Test consisting of 30 multiple choice questions was administered at the beginning and at the end of the study. The test questions measured the following skills: main idea extraction inferencing, and differentiating fact from opinion. The scores were analyzed for significant differences using the repeated measures model with pre and posttest as within-subject variables. Table 5.8 shows the means and standard deviations for the total tests and the individual sub-tests.

The total pretest mean was 13.35 which improved over the period to 14.38 in the posttest but the difference was not significant at $p \leq 0.05$. Analysis according to the individual information skills revealed that gains were recorded for inferencing skills (M = 4.81) and skills in distinguishing facts from opinions (M = 6.84). But, the improved posttest scores for the individual subskills were not significant. Surprisingly, scores for the skill of extracting main ideas declined from M = 3.06 to M = 2.84 in the posttest.

Performance on the Information Skills Test was also analyzed acording to ability grouping (see Table 5.9). The posttest means for the high ability group

Table 5.8

Mean and Standard Deviation for the Information Skills Test (Pretest and Posttest Scores).

Sub-tests	Pre-test		Post-test		
	Mean	Standard Deviation	Mean	Standard Deviation	F value
Inferencing	4.42	1.22	4.81	1.30	1.75
Facts and Opinions	6.12	1.74	6.84	1.66	3.28
Main Idea	3.06	1.37	2.84	1.41	0.43
Total	13.35	2.91	14.38	2.71	2.57

Note. *significant at $p \leq 0.05$

N = 36

Table 5.9

Mean and Standard Deviation for the Information Skills Test by Ability Grouping

Groups	Pre-test		Post-test		
	Mean	SD	Mean	SD	F value
High	14.91	3.02	16.33	2.70	0.98
Mixed	12.54	2.16	14.00	2.09	3.29
Low	12.45	2.94	12.63	1.911	0.03

N = 36

(M = 16.33), the mixed ability group (M = 12.63) and the low ability group (M = 12.63) were higher than the pretest mean scores of M = 14.91, M = 12.54 and M = 12.45 respectively. But the gains made were not statistically significant at $p \leq 0.05$.

(B) Acquisition of Content

In determining whether the WebClen led to the acquisition of content knowledge, the following data sources were analyzed:

(a) Online written reports,

(b) Online quizzes, and

(c) Geoscience Achievement Test.

(a) Online Written Reports

Each group of students was required to write five reports based on the four geoscience topics. To assess content acquisition, the reports were analyzed for accuracy, completeness and conciseness. A maximum score of 12 was given for accuracy, completeness and conciseness. Table 5.10 shows a summary of the scores obtained for the online reports submitted according to ability groups.

High ability groups scored the highest with a mean score of 10.8 followed by mixed ability groups with a mean score of 10.2 and the low ability groups had a mean score of 9.4. Closer examination of Table 5.10 shows that despite lower means, some mixed and low ability groups performed well in their reports. For example, learners in Group 8, which consisted mainly of low ability learners, and learners in Group 12, which consisted of mixed ability learners, each scored comparatively high scores with an average of 11.0 points.

Table 5.10

Summary of Scores for Content Acquisition Based on Online Written Reports

	High Ability				Mixed Ability				Low Ability				Mean Score
Reports[a]	6	7	9	11	2	4	10	12	1	3	5	8	
Report 1	10	10	10	11	8	10	11	11	7	9	11	9	9.8
Report 2	11	10	11	12	10	NA[b]	10	9	6	6	10	12	9.7
Report 3	11	12	6	12	9	12	7	12	NA	9	8	12	10.0
Report 4	11	12	11	11	12	10	10	12	8	10	11	11	10.8
Report 5	12	12	11	11	10	9	10	11	11	11	8	11	10.6
Group Mean	11	11.2	9.8	11	9.8	10.3	9.6	11	8	9	9.6	11	
Ability Group Mean	10.8				10.2				9.4				

Note. Maximum score = 12.

[a]Report 1: Earth, Moon & Sun; Report 2: Earth Layers; Report 3: Earthquakes, Volcanoes, Geysers and Hot Water Ponds; Report 4: Rotation and Revolution of the Earth and Moon; Report 5: The Solar System.
[b]NA = non submission.

(b) Online Quizzes

The purpose of online quizzes was to have students keep track of their learning as well as their ability to retain what has been learnt. A total of 70 multiple-choice questions covering the four topics were presented to the students. Table 5.11 presents the scores obtained for the quizzes. Overall, there was not much variation in mean scores for the three ability groups, with high ability groups scoring 74.5%, mixed ability groups scoring 65 % and low ability groups scoring 66.8%.

(c) Geoscience Content Test

The Geoscience Content Test consisted of 40 multiple choice questions measuring content knowledge of four topics: *Earth, Moon & Sun*; *Natural Phenomena*; *Rotation and Revolution of Earth and Moon*; and *The Solar System*. The scores were analyzed using the repeated measures model with the pre- and posttest as within-subject variables. Table 5.12 shows the means and standard deviations for the scores obtained for the total test and individual topics.

The overall pretest mean was 19.57 with a standard deviation of 4.08 and the overall posttest mean was 25.69 with a standard deviation of 4.47 with a gain of 6.12 or 31%. The difference was significant at $p \leq 0.01$.

Further analysis revealed that the difference was significant for the Natural Phenomena, Rotation and Revolution of the Earth and Moon and the Solar System topics with a pretest mean of 4.21, 3.67 and 3.24 and a posttest mean of 7.36, 5.27 and 4.33 respectively. The mean pretest score for the Earth, Moon and Sun topic was 7.84 with a mean post-test score of 8.21. But the higher scores in posttest were not statistically significant.

Table 5.11

Average Percentage Scores Obtained for Online Quiz According to Ability Grouping

	High Ability				Mixed Ability				Low Ability			
	6	7	9	11	2	4	10	12	1	3	5	8
	(%)	(%)	(%)									
Quiz One	90	80	87	97	87	73	60	73	66	87	87	73
Quiz Two	66	53	NA	87	60	NA	53	NA	60	40	40	80
Quiz Three	55	NA	55	NA	45	63	NA	55	NA	50	NA	63
Quiz Four	NA	NA	83	75	60	70	80	NA	75	65	NA	85
Mean	70	67	75	86	63	69	64	64	67	61	64	75
Group Mean	74.5				65				66.8			

Note.

NA = Quizzes not submitted

Table 5.12

Mean and Standard Deviation for the Geoscience Content Test (Pretest and Posttest Scores)

Topics	Pre-test		Post-test		
	Mean	Standard Deviation	Mean	Standard Deviation	F Value
Earth, Moon & Sun	7.84	2.02	8.21	1.49	1.40
Natural Phenomena	4.21	1.38	7.30	1.61	138.72**
Rotation and Revolution	3.67	1.45	5.27	1.84	25.7**
Solar System	3.24	1.29	4.33	1.16	20.69**
Overall	19.57	4.08	25.69	4.47	125.4**

Note. ** significant at $p \leq 0.01$

N = 36

Performance on Geoscience Content Test was also analyzed according to ability grouping (see Table 5.13). The mean pretest score for the high ability group was 21.66 with a standard deviation of 2.46, and the mean posttest score was 28.25 with a standard deviation of 2.63. The difference between means was significant at $p \leq 0.01$ with a gain of 30% or 6.59 points. Similarly the mean pretest score for the mixed ability groups was 20.18 with a standard deviation of 4.28 and the mean posttest score was 25.54 with a standard deviation of 4.987. The difference between means was significant at $p \leq 0.01$ with a gain of 27% or 5.36 points. The mean pretest score for the low ability group was 16.40 with a standard deviation of 3.83, and the mean posttest score was 22.80 with a standard deviation

Table 5.13

Mean and Standard Deviation for the Geoscience Content Test by Ability Groups

Groups	Pretest		Posttest		
	Mean	SD	Mean	SD	F
High	21.66	2.46	28.25	2.63	57.84**
Mixed	20.18	4.28	25.54	4.987	22.20**
Low	16.40	3.83	22.80	4.10	57.24**

Note. ** significant at $p \leq 0.01$

N = 36

of 4.10. The difference between means was significant at $p \leq 0.01$ with a gain of 39% or 6.4 points.

The high ability groups improved in their posttest scores with a gain of 6.59 points or 30%, the mixed ability groups made a gain of 5.36 points or 27% and the low ability group gained by 6.4 points or 39%. The low ability group made the most gains.

Research Question 2: What characteristics of cooperative and collaborative learning were evident in a Web-based Constructivist Learning Environment?

Cooperative learning is defined as learning that is equally shared by all members of the group to attain a learning goal. Collaboration, on the other hand, happens when groups of students exchange information with each other, with the teacher or an expert to get support in reaching their learning goals.

Based on the findings of research by Johnson et al., 1986; Fulton, 1992, and Belt & Leslie, 1992, two categories related to cooperative learning were identified for this study namely 'discussion' and 'shared workload'. In the following sections, analysis pertaining to cooperative learning based on two data sources is presented. The first data source was based on observations of cooperative learning activities using the two predetermined categories of discussion and shared workload as guidelines and the second data source was an analysis of responses to a questionnaire on students' opinions about cooperative learning. Data were further analyzed according to ability groupings.

Similarly, the occurrence of collaborative learning was examined based on two data sources. First, an analysis of students' evaluations of frequently asked questions (FAQs) was carried out. Second, an analysis of responses to student questions from the geo-experts was conducted.

Cooperative Learning

(a) High Ability Learners

With regards to the first category of cooperative learning, namely, *discussion*, it was observed that high ability group members frequently held discussions throughout the study. The purpose of these discussions ranged from seeking opinions and providing suggestions to clarifying tasks and sharing opinions. Table 5.14 presents excerpts from observational data showing the type of discussions that were typical of high ability students.

It was observed that members of Group 6 (Excerpt 1) were engaged in a discussion on the use of the metacrawler search engine. There is evidence for

Table 5.14

Excerpts of Cooperative Learning Processes among High Ability Learners Based on Observations

Groups and excerpts	Category
Group 6	
Excerpt 1	
Wong: "Do you think we need to get some more information. Don't need, right? We have done yesterday." Aja: "Look at the FAQ. If not go to Metacrawler. Type the name of the asteroid. Try to get some information."	Discussion-seeking opinions; providing suggestions
Excerpt 2	
Wong: "What is our question?" Aja : "This one I have done." Wong: "What are you doing now? (to the girl in the next group) astronomy not easy, you know." Aja : "What are we supposed to do?" Wong : "I want to read this one." (Pointing to the handouts.) "Very interesting."	Discussion-clarifying tasks
Excerpt 3	
Aja: "Okay, I read this, you read this, he read this." (She delegated the reading into parts to help them with the FAQs.). The boy was quiet and started reading the article when it was given to him.	Shared Workload-delegating work
Group 7	
Excerpt 1	
The three students were looking at a videoclip of volcanic eruption. Syarifah and Rurna were writing notes. Tazi was interested in the sound and plays it over and over again. Tazi then says to Rurna: "Tomorrow I'll copy what you have written."	Shared Workload-related to task
Excerpt 2	
The two girls were doing a lot of writing on the handouts. There was very little interaction. They referred often to the encyclopaedias for answers for the FAQs.	Shared Workload-checking out informational resources

(table continues)

Table 5.14 (continued)

Excerpts of Cooperative Learning Processes among High Ability Learners Based on Observations

Groups and excerpts	Category
Group 9	
Excerpt 1	
Fila was typing and Adin was reading and correcting the spelling errors of Fila's typing. Harul was sitting quietly and watching in an uninvolved manner.	Shared Workload-checking on each other's work
Excerpt 2	
The girls later were busy reading from a book about planet "Uranus". They were flipping the pages forwards and backwards and copied the information onto the computer screen.	Shared Workload-information sharing
Excerpt 3	
They continued editing their logo. Fila typed and put in the image. Adin started reading the handout. Harul just sat and watched them quietly. Adin asked Harul to copy from the monitor screen about asteroids. He refused.	Shared Workload-editing images and delegating work
Group 11	
Excerpt 1	
The three students were reading FAQs of other groups and were commenting on it. Nivek was referring a lot to the encyclopaedias to write out the comments about the moon. Later they were writing out comments on their grading. Nawaz was typing while Ainel gave the comments.	Discussion-shared opinions
Excerpt 2	
There was a lot of work coordination in this group. One person was typing and another was reading from the encyclopaedia while the third person was pointing out the typing and spelling errors.	Shared Workload-checking each other's work
Excerpt 3	
Ainel: "How shall we describe the volfogo?" Nawaz: "Let's describe the sound first" Kewin: "I think we should write something about the picture first."	Discussion-seeking opinions, providing suggestions

seeking of opinions in statements such as "Do you think..." and provision of suggestions in "Look at your FAQ...", "Type the name of the asteroid..." and "Try to get some information". Similarly, students in Group 11 (Excerpt 3) sought each other's opinions and provided suggestions on a task related to description of images. Apart from seeking opinions, students also sought clarification on the types of tasks to work on. This is evident in Excerpt 2 (Group 6) whereby students posed such questions as "What is our question?" and "What are we supposed to do?" Further, students' discussions also centered around sharing opinions on tasks related to grading FAQs (see Excerpt 1, Group 11).

However, it was observed that while Group 11 showed ideally how all three group members can work cooperatively with each other, this was not the case for the other 3 high ability groups. Only two members of Group 6 were frequently engaged in the discussions. The third member of Group 6 often appeared to be waiting for an invitation to join in discussions or the task sharing activity. This is evident in Excerpts 1, 2 and 3 whereby only Wong and Aja were actively seeking each other's opinions and sharing the tasks, but the boy was often quiet. Similarly, in Group 7 there was very little discussion of ideas among all three students as is evident in Excerpt 2. The excerpt shows that although the girls were working together, there was very little verbal communication between the two of them. The boy did not appear to participate in the activities. The two girls in Group 9 (Excerpts 1, 2 and 3) held few discussions while the boy was less involved in the discussions.

In the second category, *shared workload*, group members were observed to share their workload by delegating work, checking out informational resources, checking on each other's work, and editing images. Delegating work was quite typical of students in Group 6 (Excerpt 3) and Group 9 (Excerpt 3) and this was

mostly done by the girls. High ability students also shared workload by checking out on informational resources such as websites and printed resources as is evident in Group 7 (Excerpt 2) and Group 9 (Excerpt 2). Mostly, shared workload was evident in the form of checking on each other's work especially when they were keying in information into the computer. Typically, one student read and the other keyed in the information. However, the possibility of all three students sharing workload in this manner was only evident in Group 11 and not in the other groups.

Apart from observational data, students also provided feedback on how well they were getting along with each other in their respective groups. At the end of each topic, students answered a questionnaire to indicate whether discussion and sharing of workload was frequent and the findings are reported in Figure 5.1.

Over the four-week period, there appeared to be a marked decline in the frequency of discussion and shared workload as perceived by students. In the first week, 74% of learners felt that members in their group discussed frequently but this dropped to 36% at the end of the fourth week. There was a slight difference of opinion with regards to sharing of workload. In week 1, 83% of learners were of the opinion there was sharing of workload and this increased to 92% at the end of the second week. But by the end of the fourth week, only 58% of learners felt there was sharing of workload.

Students also provided feedback on the activities that were done well by themselves and those that could be done better. The students indicated that the following activities were done well: *looking for information together*; *sharing information*; *discussing on the activities to do*; *looking for images*; *and doing the FAQ and reports*. When asked what could have been done better, the

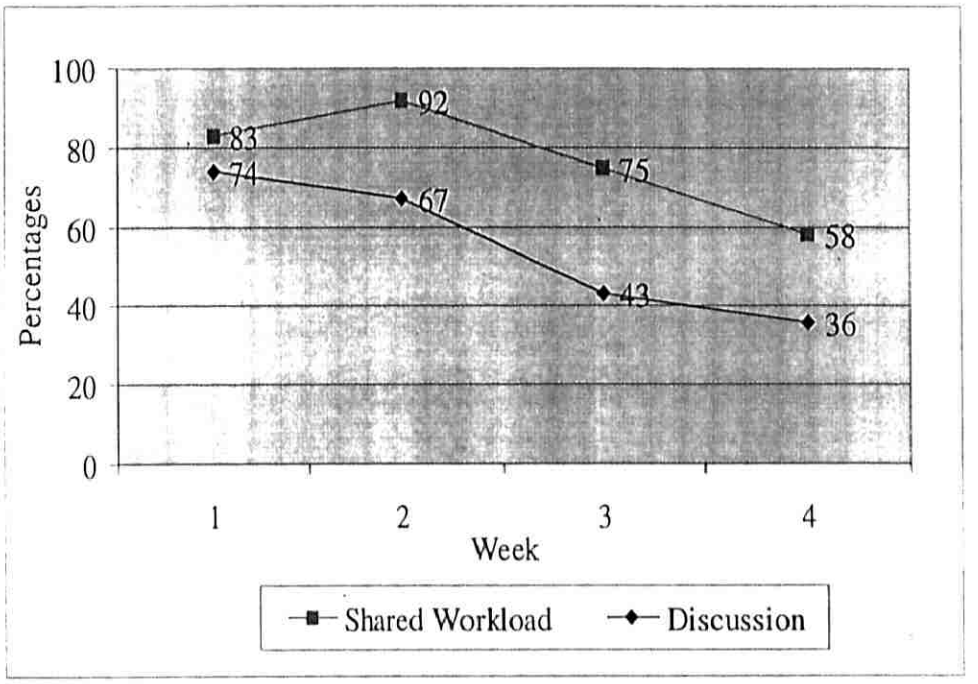

Figure 5.1. Frequency of discussion and shared workload as perceived by high ability learners

responses included *asking other groups for ideas, seeking answers and clarifying tasks with the teacher, looking for better information*, and *helping each other.*

(b) Mixed Ability Learners

Mixed ability students held discussions throughout the study, but discussions were not consistently held for all the four groups throughout the four weeks. The discussions tended to be centered more around skill related tasks such as Belinsing images for their FAQs, using a search engine and saving their images onto the hard disk and the server. Table 5.15 presents data on the nature of the discussions that were typical of mixed ability groups.

In Excerpt 2, the two students in Group 2 were seeking opinions and providing suggestions on how to capture and save an image they had found from the

Table 5.15

Excerpts of Cooperative Learning Processes among Mixed Ability Learners Based on Observations

Groups and excerpts	Category
Group 2	
Excerpt 1	
They also shift places so that they take turns to type. Occasionally Mohd Nizar talks to his friends in the Asteroid Group. After finishing their work (they could successfully transfer images to their answers) they were unsure of what to do. To keep busy Poh Ching got herself a storybook to read.	Shared workload-keyboard use
Excerpt 2	
Hafin: "How do we capture this image?" Nizar: "Right click on image, go to copy and save image as ..." "What do you want to name the image?" Hafin: "Seismograph" Nizar types the word Seismograph and asks: "Where do you want to save it?"	Discussion-Belinsing and saving images
Group 4	
Excerpt 1	
All 3 students were very quiet working individually. There wasn't much discussion, everyone was busy writing their answers on to their worksheet. However they did take turns to type on the computer.	Shared Workload-keyboard use
Excerpt 2	
Towards the later part of the lesson there was a little argument as they disagreed on what they had finished doing and what they haven't.	Discussion-overcoming disagreements
Group 10	
Excerpt 1	
April, Megat and Kushur were busy working on their report. They visited Internet sites and while one reads out the information, another writes it down into the worksheet.	Shared Workload-checking out informational resources

(table continues)

Table 5.15 (continued)

Excerpts of Cooperative Learning Processes among Mixed Ability Learners Based on Observations

Groups and excerpts	Category
Excerpt 2 The students consulted each other on how to search and capture image files from the Internet.	Discussion-capturing images
Group 12	
Excerpt 1 Malin was most active of the 3. All 3 students took turns to type their answers. Since Mawar sat in the middle the other 2 had to strain to type from both sides.	Shared Workload-keyboard use
Excerpt 3 Malin goes to GeoCreate, then clicks on Report. She started keying in some information when she was interrupted by Anand: Anand: " We've done that" Malin: " No we did not complete it" Anand: " I checked it, it's done"	Discussion-overcoming disagreements

Internet. Similarly, the three students in Group 10 (Excerpt 2) sought opinions on skills related to searching and capturing images from the internet. Although Group 2 and Group 10 held discussions related to skills, discussions in Group 4 tended to concentrate on overcoming disagreements on the tasks they had completed (Excerpt 2). Similarly students in Group 12 were more involved in discussions related to tasks that they have completed and those that were not done (Excerpt 2).

Students were also observed to be involved in sharing workload. They took turns to use the keyboard and check out informational resources. The data show that there was more cooperation in keyboard use as compared to other types of shared workload. This is evident in Excerpt 1 and 3 (Group 2), whereby the

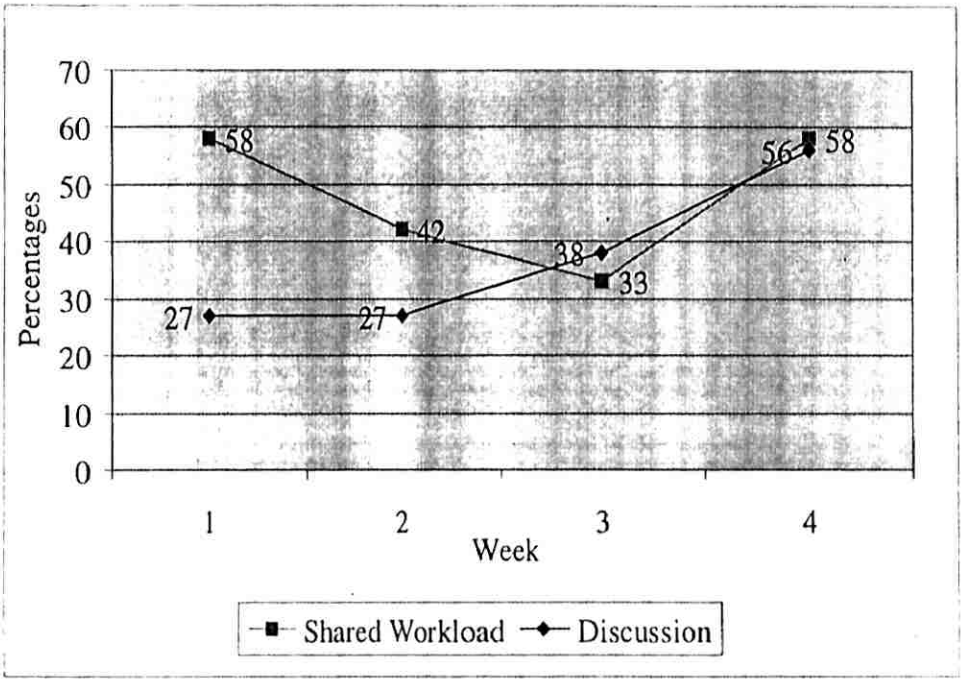

Figure 5.2. Frequency of discussion and shared workload as perceived by mixed ability learners

students took turns to key in the information. Similarly students in Group 4 (Excerpt 1) and Group 12 (Excerpt 1 and 2) shared their workload by taking turns to type in the information from worksheets. It was observed that some groups were able to share the use of the keyboard equally well among the three members (Excerpt 1, Group 2; Excerpt 1, Group 4; Excerpt 1, Group 12).

To determine how well the groups had employed cooperative strategies, students were asked to reflect on questions related to discussion and sharing of workload. At the end of each topic, students answered a questionnaire on the frequency with which discussion and sharing of workload was held and the findings are reported in Figure 5.2.

Over the four-week period, students reported engaging more frequently in shared workload than in discussion. The increase was however more consistent for discussion as there was a gradual improvement in the amount of discussion from 27% in

the first week to 56% in the fourth week. However, for shared workload, students reported that at the beginning of the program there was more sharing of workload (58%), but the ability to share their workload dropped to 42% and 33% in weeks 2 and 3 respectively. In the final week of the study, students perceived their ability to share workload improved to 58%.

Students were also asked on the group activities that were done well and what could be done better. The students indicated that the following activities were done well: *working together and helping each other*; *looking for information together*; *sharing information and discussing on the tasks to do first*; *looking for images*; *doing the FAQ*, and *writing the reports*. When asked what could have been done better, the responses included *asking other groups for ideas*, *seeking answers and clarifying tasks with the teacher*, *looking for information in more websites*, *helping each other*, and *working hard to look for information related to report writing*.

(c) Low Ability Learners

Table 5.16 shows a sample of the data on cooperative processes observed among low ability students. With regard to discussion, it was observed that low ability learners held discussions intermittently throughout the study. These discussions were mainly about types of images to insert into the FAQs, information found in websites and doing online quizzes. In Excerpt 1 (Group 1) and Excerpt 3 (Group 8), two students were observed to carry out discussions on the type of image and the manner in which to insert the image. It was observed that while the third student in Group 1 was not drawn into the discussion the third student in Group 8 refused to help the groupmates although he was quite welcomed by the other two members. Group 3 was found to be

Table 5.16

Excerpts of Cooperative Learning Processes among Low Ability Groups Based on Observations

Groups and excerpts	Category
Group 1	
Excerpt 1	
Two students monopolized the keyboard, they were discussing which image to insert into their FAQ. The third student was left out and appeared bored.	Discussion-decision on image
Excerpt 2	
Two students worked together on the computer. One would read while the other typed. The third member in the group was left out and moved to another group.	Shared Workload-keyboard use
Excerpt 3	
Towards the end of the first week, some sharing of tasks started when the three students took turns to answer the quiz questions.	Shared Workload-answering Quiz Questions
Group 3	
Excerpt 1	
The group was able to discuss their work. Aiway and Rasha were looking at the links and discussing on information found. They then read their notes on volcanoes and later completed the worksheet .	Discussion-information from the Internet
Excerpt 2	
The group had a leader who led the discussions. The students were friendly towards each other and divided their work equally. Occasionally, the students go to the book resource area to get information from other sources.	Shared Workload-looking for information

(table continues)

Table 5.16 (continued)

Groups and excerpts	Category
Excerpt 3	
While searching for information for online report, Khairudin read out the information about atmosphere from a website while Aiwei wrote the answer in a worksheet.	Shared Workload-completing tasks
Group 5	
Excerpt 1	
There was some cooperation between the girl and the boy. They consulted each other when answering the quiz questions. They tried to get a consensus before answering the question.	Discussion-quiz questions
Excerpt 2	
Only two students were active. They cooperated by helping each other type the answers on the computer. The third student frequently copied answers from the website onto a worksheet.	Shared Workload-keyboard Use
Group 8	
Excerpt 1	
The two girls worked well together. One girl was at the keyboard, and another was reading a reference about geysers. The boy waited for the girls to finish a section of the work. Later he does some work on the computer by himself.	Shared Workload-keyboard use
Excerpt 2	
The two girls were referring to a book to complete a task related to report writing. The boy looked bored. Later he takes over the keyboard and goes to GeoLink.	Shared Workload-task completion
Excerpt 3	
Hajani and Rohaz are discussing how to insert an image into their FAQ. Lamik does not want to help out although he knows what to do.	Discussion-inserting images

consistently discussing about information sourced from the Internet (Excerpt 1 & 2). Although the two girls in Group 3 were more actively involved in discussions, they did not neglect the other student as he was encouraged to contribute to the group as well. Students in Group 5 were observed to discuss mainly about answers for the online quiz activity. However, not all three members were involved (Excerpt 1).

In the second major category, *shared workload*, low ability students shared their workload on keyboard use, answering quiz questions, looking for information and completing their tasks. This is exemplified in Excerpt 2 (Group 1), Excerpt 2 (Group 5) and Excerpt 1 (Group 8). Most times one student will read while another will key in the information. The third student tended to be uninvolved. Students also shared the task of answering online quiz questions (Excerpt 3, Group 1). Students in Group 3 shared their workload by having different students look for information from different sources such as from the Internet, encyclopedia or textbooks (Excerpt 2). Apart from that, students also shared the responsibility of completing their tasks whereby one will refer to an informational source and the other will write into a worksheet (Excerpt 3, Group 3 and Excerpt 2, Group 8).

Low ability students were also asked about the opinion on the frequency of discussions and sharing of workload in their groups over the period of 4 weeks. Figure 5.3 shows the percentage of students who responded to the frequency of the two cooperative processes.

As shown in Figure 5.3, students reported engaging more frequently in shared workload than in discussion. Over the four-week period, there appeared to be a marked pattern in learners' involvement in these two categories of cooperative

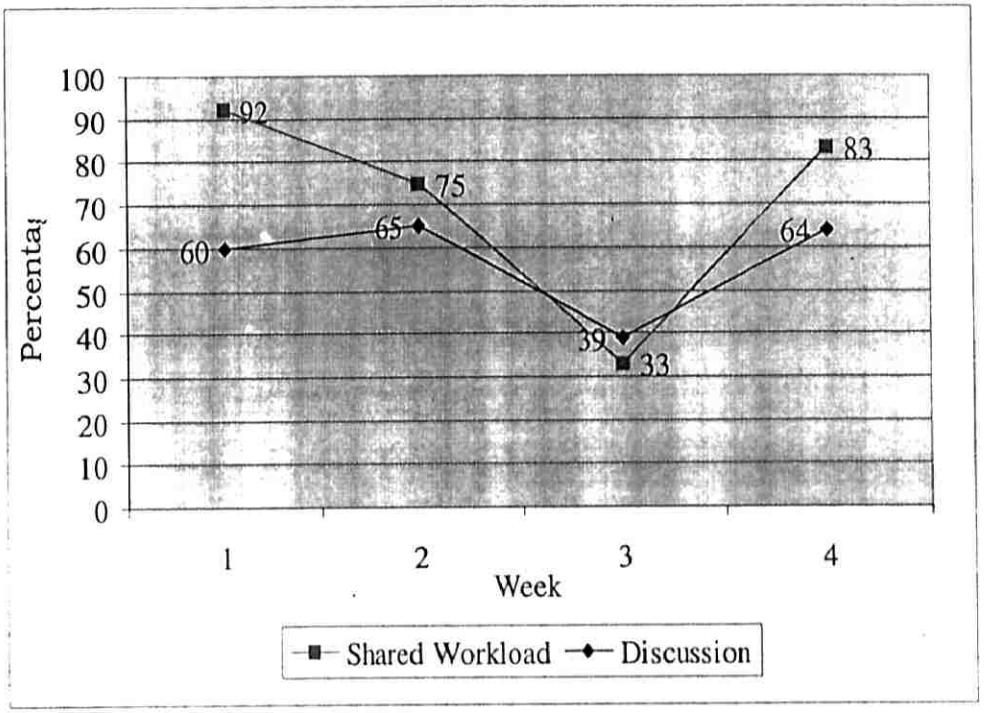

Figure 5.3. Frequency of discussion and shared workload as perceived by low ability learners

learning as perceived by studemts. Initially, students indicated that there was a high percentage (60%) of discussion among group members. This level increased at the end of the 2nd week to 65% but dropped drastically to 39% in week 3. In week 4, the level of discussion as perceived by low ability learners increased to 64%. With regards to shared workload, student feedback showed a high frequency of shared workload in week 1 (92%). Their ability to share workload dropped at the end of week 3 to 33% but improved in week 4 to 83%.

Students were also asked to reflect on the kinds of activities that they felt they had worked on cooperatively. The responses included *doing report and FAQ*, *working together*, and *helping each other*. Students' reflections also showed that they could work better on *describing images, writing the report and doing the*

FAQ, looking for information, and *contributing more ideas and sharing information to upgrade the group's performance.*

Collaborative Learning

The study also explored the extent to which collaboration was enhanced in the web-based constructivist learning environment. Two kinds of collaborative activities were measured i.e. inter-group collaboration which was based on answers to the FAQs, and collaboration with the geo-expert for which questions posed by the students to experts were analyzed.

With regard to responses to the FAQs, there was wide variation according to ability level groupings. Students in the high ability groups evaluated and graded a total of 55 responses to questions from their peers compared to 38 responses to questions evaluated and graded by mixed ability learners and 7 questions evaluated and graded by low ability learners.

Also, it was observed that students went through a number of stages during the evaluation and grading process. Initially, at the within group level, a question was evaluated for clarity and relevance to the topic itself. Having established this, an answer was then sought for the question through a process of research, consultation and consensus among group members. Only then was the response made available to other groups for evaluation. Thus from within group evaluation, the students moved to between group evaluation.

At times there was a difference of opinion among groups as to the grade to be given for a question posed. As shown in Example 1, the grade given to an answer by Group 5 lacked consensus.

Example 1

Question from Group 5	*What is haze?*
Answer from Group 5	*Haze is caused by floating particles in the* atmosphere. *When saturated, the particles absorb the sunlight causing it difficult to see the atmosphere. The particles come from different sources some are naturally caused. Haze may occur both in the urban and rural areas*
Assessment from	
Group 2	*B-Correct answer*
Group 6	*A-Enough information*
Group 11	*A- Very-very good*

It was also common to find different groups reaching cousensus about a grade for an FAQ. The question posed by Group 10 and the answer provided as shown in Example 2, showed there was consensus among the five groups who responded.

Example 2

Question from Group 10	*What's the biggest volcano in the solar system?*
Answer from Group 10	*So far, the largest volcano in our solar system is Olympus Mons on Mars. It is about 17 miles (27km) tall. That's a long hike for some future explorer. Mount Everest is about 6 miles (10km) tall.*
Assessment from	
Group 5	*A-Your answer is good and very satisfactory*
Group 2	*A-Very good*
Group 1	*A- The work was well done*
Group 11	*A-Good*
Group 8	*A- Very good*

With regards to the number of questions posed to the geo-expert, high ability students posed 9 questions compared to 7 and 8 questions posed by mixed and low ability groups respectively. Four patterns of interaction between students and geo-experts were observed. In the first instance, the geo-expert would answer the FAQ directly. The following is an example, of an answer given by the geo-expert to a question posed by students in group 4.

Example 3

Question from Group 4	*What is the difference between the Gregorian and Lunar calendar?*
Answer from Geo-expert	*The Gregorian calendar is the calendar used by us now. It was forwarded by Aloysius Lilius and adapted by Pope Gregory XIII. This calendar has 365.2425 days a year. This calendar is formulated based on calculations. The Lunar Calendar is based on the revolution of the moon. The new month starts with the appearance of the new moon.*

In the second instance, the geo-expert embedded the answer in a series of probe-questions and queries. The following is an example of a question posed and the response by the geo-expert.

Example 4

Question from Group 2	*History of the conquest of the moon by man.*
Answer Geo-expert	*Can you clarify this question? Do you need the history of moon conquerors from the beginning till now or the effects of the conquest on humans?*

In the third instance, an expert not only posed questions but also provided names of websites for the students' perusal (see example 5 and 6). Thus students arrived at the required answer to their FAQ through extended reading and use of the website.

Example 5

Question from Group 2	*History of the conquest of the moon by man.*
Answer from Geo-expert	*Your question is not clear and too broad. However, I'll provide you with one website that gives information about the history of moon quest by man.* http://lunar.arc.nasa.gov/printerready/history/timelineh.html

Example 6

Question from Group3	*Pictures about how hot is lava?*
Answer from Geo-expert	*Your question is not very clear. I hope these pictures in the following websites will enlighten you.* http://volcanophoto.com/hot/z/f.html http://pw1.netcom.com/~LStetzel/hotlava.htm

In the fourth instance, two or more geo-experts responded to the students' query. This was due to the fact that the questions were sent out to all 3 geo-experts. Thus, the students had to read and evaluate all the geo-experts' responses before making a decision about the best answer to their original question. See Examples 7 and 8.

Example 7

Question from Group 1	*What is the name of spacecraft that flew to the moon?*
Answer from Geo-expert 1	*If you mean the fist spaceship to land on the moon it is Apollo 11.*
Answer from Geo-expert 2	*The Apollo missions in the 1960s -1970s were the first missions to the moon. Apollo 11 was the mission that landed the first people on the moon.*

Example 8

Question from Group 3	*Who is Yuri Gagarin?*
Answer from Geo-expert 1	*Yuri Gagarin is a Russian cosmonaut who was born on March 9, 1934, in Moscow, Russia. Gagarin became the first person in space when he flew aboard the Vostok spacecraft in 1961. He orbited the Earth once on this historic flight. The flight lasted 1 hour and 48 minutes. Gagarin was killed in a plane accident in 1968. A crater on the far side of the moon is named after him.*
Answer from Geo-expert 2	*Yuri Gagarin, a Russian, was the first man in space on April 12th, 1961. He went around the earth in one hour and forty minutes. He was born of a peasant family in the village of Klushino, Smolensk region.*

Research Question 3: What was the role played by the teacher in the Web-based Constructivist Learning Environment?

Data on the role of the teacher in the WebClen was gathered from the following sources: (a) teacher journals; (b) observations; and (c) audio and video recordings. Analysis of these data sources revealed that the teacher played six different roles in the web-based constructivist learning environment: (1) technology expert; (2) motivator; (3) content specialist; (4) promoter of cooperative learning; (5) bilingual expert; and (6) monitor of student progress. The following sections provide the details pertaining to these roles.

(1) Teacher as Technology Expert

The teacher provided technology support in three areas, namely hardware applications, general software applications and specific software applications.

Hardware support included familiarizing students with the computers and managing limited hardware resources. Table 5.17 shows examples of support given by the teacher in relation to hardware.

From Table 5.17, it can be summarized that, the teacher supported students in starting up their computers and helping students to fix loose mouse cables or speaker cables. In managing limited resources, the teacher helped with sharing of scarce resources such as plug points, video cards and speakers.

Besides hardware applications, the teacher dealt with software applications such as explaining the meaning of terms such as *gif*, *avi*, and *http*; teaching students how to use a search engine as well as how to copy and paste information accessed from the Internet; interfacing skills such as *refresh* and *double-click*; and, managing *MS Windows* environment. Table 5.18 shows examples of support activities recorded by the teacher in relation to general software applications.

As shown in Table 5.18, the teacher led students' understanding of particular technical terms through the use of questions. These questions were designed to get students to focus on specific uses of computer terminology and to involve learners participation on specific rather than general uses of software. Similarly in providing detailed directions on the use of computer applications, learners who had limited knowledge of the use of software were taught using a 'hands-on' approach.

The role of the teacher as technology expert also included assisting students in reading and understanding the instructions on how to access, navigate and key in information into the geoscience template. See Table 5.19 for excerpts from the teacher's journal and audio recordings.

Table 5.17

Sample of Teacher Support Activities Related to Hardware Applications

Teacher Support Activity	Excerpts from teacher journal
Providing help	1. The teacher helped students when they had problems starting the computer and also fixed other computer peripherals such as mouse and speaker cables.
Managing limited resources	2. There were not enough speakers and plug points, the teacher had to ensure that students were able to share these resources.
	3. Some computers did not have the video playback card, so the teacher had to stagger the use of computers.

As shown in Table 5.19, it was important for the teacher to first teach students how to access the template by keying in the correct URL, username and passwords (Excerpt 1). It was also necessary for the teacher to have knowledge of how to navigate the different components of the template such as the main links (GeoCreate) and pages within the links that is 'next page' and 'previous page' (Excerpt 2). Apart from that students were assisted on how to use specific buttons placed within the pages such as the 'save', 'send' 'edit' and 'browse' buttons (Excerpt 3). Students were also taught how to attach graphics to their FAQs (Excerpt 4).

To quantify the role of the teacher in providing various support services, the activities were tabulated using percentages (see Figure 5.4). Overall, the teacher's role of technology expert was more prominent in the first two weeks of the study

Table 5.18

Sample of Teacher Support Activities Related to General Software Applications

Teacher Support Activity	Excerpts from journal/audio recordings
Clarification of terminology	1. "What is the meaning of *earthquake.gif*? Teacher writes the word down and asks students again. "Does anybody know what is meant by *gif*? Yes *gif* refers to the extension for a graphic file". "What about *avi*? Does anyone know what *avi* stands for?" "What is the meaning of *http*?" Teacher later provides an analogy of address on an envelope.
Using a search engine	2. "Go to *meta-crawler*, type the URL, and click search"
Copying and pasting	3. Teacher taught students how to copy and paste information from websites. "To copy, while holding down the control key, press on the 'c' key. To paste, while pressing down the control key, press the 'v' key".
Interfacing skills	4. "Later you click here, double-click okay? Do you know how to double click? Let me demonstrate." Student: "How do I right click?' Teacher: "To 'right click', place your finger on the right button of the mouse and click, like this"
Managing MS Windows-Closing or minimizing a window	5. "After you are done with the first activity, don't close by clicking on the 'x' but click on the '-' sign. What is the purpose of this (pointing to the minimize sign) symbol? Yes, to make the window smaller". Shortcut to Netscape browser was not on the desktop. Students had to be taught how to access the program from the 'start' menu.

Table 5.19

Sample of Teacher Support Activities on Specific Software Applications Related to GeoScience Template

Teacher Support Activity	Excerpts from journal/audio recordings
Accessing Template	1. Many students had problems accessing the template. The template error message was: "address not properly typed." The Neptune group (Group 7) had problems with their password. Teacher: "To get into the template, key in the URL that is in your task-sheet. Then key in your username and password"
Navigating	2. On the previous day students were worried that they couldn't find their answers. Teacher showed them how to click on the 'next page' and 'previous page' by first clicking on GeoCreate.
Button functions	3. Teacher explained the purpose of Bahasa Malaysia and Bahasa Inggeris button in the GeoExpert facility. Teacher explained to students that to edit the report, they should click on the 'edit' button. Teacher: "When you have finished typing, click on the 'save' button."
Inputting information	4. Next, teacher showed students how to attach a graphic file to their FAQ. "Point to the attachment icon, 'right click' on the mouse button. A window will appear. Select 'copy link location'. Scroll back and click the mouse at the specific location and paste."

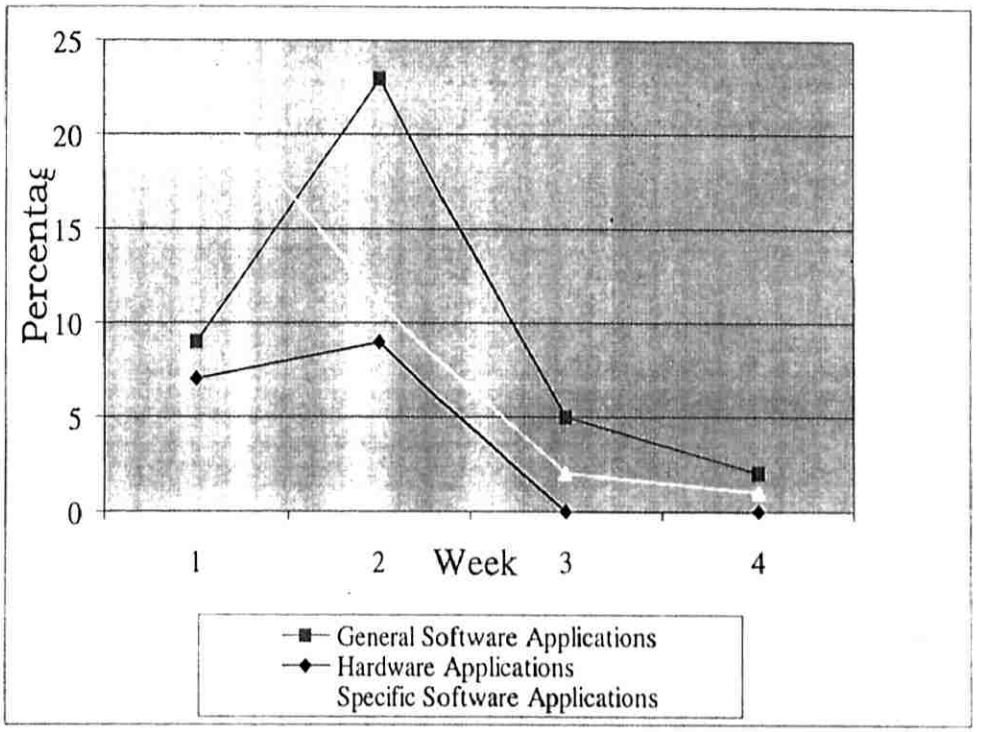

Figure 5.4. Percentage of activities performed by teacher as technology expert

which gradually became less and less. In terms of types of services, the teacher provided far more support related to software applications rather than hardware applications throughout the study.

(2) Teacher as Motivator

Besides providing technology support, the teacher was also seen as a motivator both in the online as well as offline environment. Online motivation was given when the teacher gave feedback on student work while using the computer. Offline motivation was given when the teacher conducted the lesson without use of computers or approached each group and discussed or commented on their work. Table 5.20 presents the forms of motivation provided by the teacher and excerpts to illustrate each form based on journal notes, audio and video recordings.

Table 5.20

Forms of Online and Offline Motivation Provided by the Teacher

Forms of Motivation	Excerpts from teacher journal/audio recordings/ observations
Online	
Encouragement	1. Words of encouragement such as 'good job' and 'keep up the good work' were sent online to individual groups.
Putting student information into web-template	2. Student photographs were attached in the Student Database link under CeoCenter. Teacher: "Most motivating was to see their names in the Internet..."
Offline	
Taking student work as example	3. Observer: "When student work was projected and discussed, students were very happy."
Varied audience	4. Teacher: "You have keyed in one report, right? Now, anyone in the world will be able to read about what you have written."
Individual Attention	5. Teacher: "Akesha, are you following us..."
Relate student work to real world instances	6. The Neptune group did two write-ups on Mount Popocatepetl in their journal section while the rest had still not begun. Teacher praised the students. "Looks like this group is going to be the geoscience newspaper reporters."
Encouragement	7. One group was commented on doing a FAQ on the nature of water on the moon. "Very good question, very good answer." The teacher told the students that such FAQ knowledge was not readily available in books.

The need to give students encouragement was found to be important, both online and offline. Words of encouragement such as 'good question', 'good answer' or 'good job' were often used by the teacher throughout the four weeks (Excerpt 1 and 7). One very important form of online motivation was when student photographs and names were uploaded into the web template (Excerpt 2). Offline, students were motivated in many different ways such as when their online work was projected and used in discussions, it was found that students felt very happy (Excerpt 3). Students were also motivated when they were told that the information they keyed in could be read by varied audience all over the world (Excerpt 4). It was also important for the teacher to give individuals the attention they needed as is represented in Excerpt 5 and relate student work to real world instances. (Excerpt 6).

The frequency of online and offline motivation provided by the teacher over the four weeks is represented in Figure 5.5.

Overall offline motivation was more frequently provided compared to online motivation over the four weeks. While online motivational support was intense only in the early part of the study, the intensity of offline motivational support continued throughout the study.

(3) Teacher as Content Expert

The teacher also provided support related to content. Even though the teacher did not present all the facts, concepts and principles for the four topics studied, she had to be prepared with the relevant information to serve as content expert. Table 5.21 shows how the teacher served as content expert.

As a content expert, the teacher provided support at three levels. This three tiered approach first involved support at a topical level whereby students are

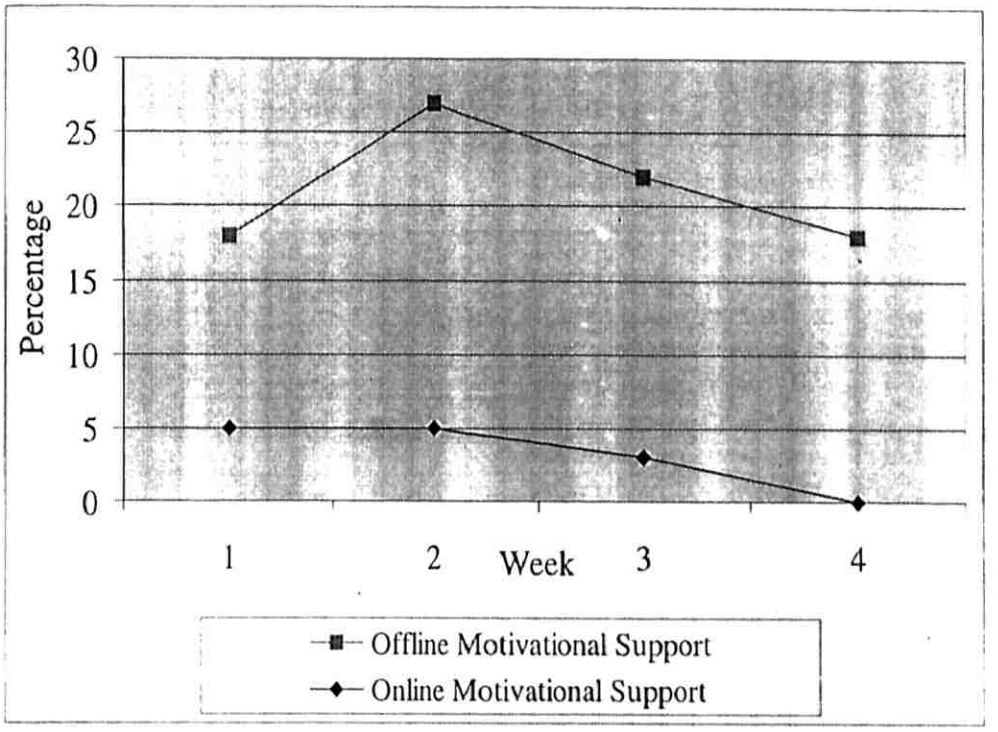

Figure 5.5. Frequency of teacher's online and offline support over the four weeks

introduced to the topic with the aid of an advance organizer (Excerpt 1). Furthermore, students' schema is activated by drawing attention to the preceeding (Excerpt 2) and following topics of study (Excerpt 10). Secondly, the teacher appears to have shifted the focus to the understanding and processing of content for the week. As shown in excerpts 3, 4, 5, 6 and 7, the teachers role as expert involves such skills as probing, clarification, exemplification, and use of visual aids. Thirdly, as a content expert, the teacher's focus shifts to the task at hand. To this end she clarified the task, by drawing on local content and by modeling the processes students needed to employ to illustrate understanding of content. Finally to ensure that students performed the task well, the teacher drew on technical knowledge and an extended reading activity. In sum, a three tiered approach appears to adequately characterize the teacher's role as content expert.

Table 5.21

Types of Content Acquisition Support Provided by the Teacher

Types of content acquisition support	Excerpt from teacher journal/audio recordings
Providing overview using a graphic organizer	1. Teacher did an overview of the four topics by using a chart. At the same time, the teacher asked students to refer to a similar chart in their folder. The whiteboard was used to explain certain features of the chart in detail.
Activating Schema	2. Explained what the topic of the week is. Told students that the previous week they had done the first topic. Focuses into today's topic about earth phenomena.
Clarification of content	3. Explained that for the first topic, students were learning about the overall aspects of earth, moon and sun. For earth phenomena, the inside of the earth is of relevance. Teacher posed a question: "How does all this happen?" Student response: "They happen because of earth movement."
Probing questions to clarify content	4. Teacher probes to find out what kind of movement. Gives hints. "Movement of what in the earth?" Teacher goes on to explain that earth layers move, therefore results in physical phenomena.
Provides local examples to enhance understanding	5. Teacher asks students "Do we have earthquakes, volcanoes, geysers and hot water ponds in Malaysia?" Since there was no response from the students, the teacher told students we have hot water ponds only, which were found in Setapak. Further, the teacher asks students to find out where else in Malaysia we have hot water ponds.

(table continues)

'able 5.21 (continued)

'ypes of Content Acquisition Support Provided by the Teacher

'ypes of content acquisition support		Excerpt from teacher journal/audio recordings
Jse of multimedia images to enhance nderstanding	6.	Teacher uses power-point slides and video-clips to explain earth layers and movements in the earth to students.
Clarifying tasks	7.	The teacher realized that students did not read instructions given in their worksheets. One such instruction was about doing Frequently Asked Questions. The teacher then explained to students the purpose of FAQ and how to do it.
Teacher modeling	8.	The teacher taught students how to describe images by using an example of an answer completed by the students. The teacher went through a process of looking at the image and student answer. The teacher then asks students if the animated picture was described properly. The teacher then goes on to explain that students must write what they see and not explain about the strength of gravity.
Assisting in information search and retrieval	9.	One group wanted to find out first women on moon. The teacher asked them to write "first woman on moon" in metacrawler, and then to click search. "Wait you must read first, then you write here (referring to worksheet) 'first woman on moon'. You got thirty-seven links. Now you read the information in the links. There is nothing here that is related to your search."
Making connections with the following topics	10.	Goes on to explain what students will be studying the following weeks, that is rotation and revolution of earth and the corresponding phenomena and also the solar system.

(4) Promoting Cooperative Learning Skills

Besides being a technology expert, motivator and content expert, the teacher in a web based constructivist learning environment also played the role of promoting cooperative learning among learners. Throughout the four weeks, the teacher constantly reminded students to work cooperatively by building group comradeship, to equally distribute workload, to get the students to handle logistical problems when using the computer, to remind students that any group arguments should be settled amicably and to encourage students to support each other. Table 5.22 shows some of the ways the teacher played this role.

With regards to shared workload, it was noted that the teacher emphasized the role that each student should play and also how they can share their work out (Excerpt 1). In encouraging discussion, students were asked to brainstorm on subtopics for their FAQ's (Excerpt 2) and the processes involved in carrying out a discussion (Excerpt 3). Apart from shared workload and encouraging discussion, the teacher also discouraged keyboard domination (Excerpt 4) gave advice on how to overcome group argument (Excerpt 5) and support each other (Excerpt 6).

(5) Teacher as Bilingual Expert

One of the observations of the study was the need for the teacher to be proficient in both the English and the Malay language. The tasks presented to students required them to write and articulate their ideas in either language of their choice. But the links to the websites were mostly in English and this posed a problem to learners who were not too proficient in English. Hence the teacher played an important role in assisting learners make the switch between the two

Table 5.22

Types Of Teacher Support in Enhancing Cooperative Skills

Area of application	Excerpt from teacher journal/audio recordings
Shared workload	1. Teacher: "When Aja is typing, one of you read and the other check the spelling." "Comet, write what you see. Describe first. Today I want to see all of you sharing your work out."
Encouraging discussion of ideas	2. "Okay, see here Lamik and Rohaz. Do both of you like this topic or not? Please read and then discuss which topic you prefer."
	3. "Megat what do you see? You'll have to write in the worksheet first and then you enter it into the FAQ template. What you see, you discuss with your group members first."
Discouraging keyboard domination	4. Teacher: "Who keyed in the information yesterday?" "Today I want someone else to sit in the center to key in the information."
Overcoming group argument	5. "Don't blame each other when something goes wrong. Try to find out the problem."
Supporting each other	6. "Rasha & Aiwei-one person write enough. You can discuss together but the faster student can write in the worksheet."

anguages. The following observations were made on the role of the teacher as a ɔilingual expert (see Table 5.23).

The teacher played a major role in helping students to translate information from the English language to the Malay language and vice-versa. This involved asking students if they understood the equivalence of certain English words in the Malay language such as 'full moon' (Excerpt 1), translate words from the Malay

Table 5.23

Teacher Role as Bilingual Expert

Type of Bilingual Support	Excerpt from teacher journal/audio recordings
Translation	1. While helping students to select information from a web-site, the teacher came across this statement "Does the full moon do strange things?" Teacher asks students what is meant by 'full moon' and 'strange things' in the Malay language.
	2. While helping students enter their search, teacher asks " What do you want to search?" Students: "Lapisan ozon". Teacher: "Type ozone layer."
	3. While helping students to write their journal entries, teacher had to teach groups of students to pick the main points such as 'low levels of activity', 'isolated small exhalations' and help them understand in the Malay language.
	4. Teacher spent some time with one low ability group to help them understand a whole answer provided by the geo-specialist which was too high a level for students.
	5. Explained the meaning and impact of the words spoken by Neil Armstrong " One small step..."
Main ideas	6. One group was reading about earthquakes. They wanted to write about problems in earthquake areas. Teacher: "No need to write everything from the website. Just pick the important facts such as "people get hurt", "buildings are destroyed", "big waves"..
Coherent writing	7. In writing conclusions, students write "Earth layers have many characteristics like thickness, temperature..." Teacher: " Restructure your sentence to include the different characteristics". "Show me your work again".
Grammar and language	8. "Sometimes your report is not properly written. Ensure your spelling is correct and there is meaning in your sentences."

language to the English language to help learners to search the Internet (Excerpt 2), understand paragraphs of information by focussing on key words which were then translated into the Malay language (Excerpt 3), explain geo-experts' answers which were in the English language (Excerpt 4) and make special effort to translate some very important phrases for example, Neil Armstrong's spoken words: "one small step ..." (Excerpt 5). In the process of helping students translate their ideas from the English language to the Malay language it became important for the teacher to ensure that students were selecting the main ideas for example, students were advised not to write everything they read in a website (Excerpt 6), writing coherently by restructuring their sentences (Excerpt 7) and checking that language and grammatical errors were minimized (Excerpt 8).

(6) Monitoring Student Progress

Monitoring student progress was defined as the teacher giving advice and assessing students. Table 5.24 shows the kind of advice and assessment that was carried out over the period of four weeks.

First, advice came in the form of reminding students to try to attempt the task on their own before contacting the geo-expert (Excerpt 1). Student progress was also checked by asking students where they were with reference to the completion of tasks given, for example, students were asked if they have typed their report (Excerpt 2). In a WebClen it was observed that keeping track of the type of information students paste into their documents was important especially with regards to intellectual property for example, students were advised not to copy and paste information verbatim (Excerpt 3). To ensure students maximized their class time, they were advised to read printed notes while waiting for the

Table 5.24

Excerpts on Monitoring of Student Progress by Teacher

Type of Monitoring Activity	Excerpt from teacher journal/audio recordings
Encouraging students to attempt tasks on their own	1. "Do not send your questions to the geo-expert until and unless you have tried your best on your own."
Completion of tasks	2. "Have you typed your report yet? I suggest you type your report first."
Intellectual property rights	3. "Can I take the information from the Internet and copy all. Teacher: "No, you cannot copy all, as it then becomes other peoples' work, not your own. You select the relevant information first, then you read and edit."
Time management	4. "Please read the printed notes while waiting for the server to upload the information you've keyed-in."
Encourage self-assessment	5. "Please check on your group progress by doing the online quiz."
Encourage peer-assessment	6. "Have you checked the grade given by your friends? What do you think of the different grades? Discuss in your group during your group reflection activities."
Teacher assessment	7. "Some are given a grade A or B, some are not given a grade as yet because you need to put in more effort. Those who got a B, may upgrade to A. Please look at my comments."

server to process the information they have keyed in (Excerpt 4). Student progress was also monitored by checking on the online assessment techniques. The teacher was able to monitor students by checking on the marks from online quiz (Excerpt 5), and grades given by peers (Excerpt 6). Apart from that, the teacher monitored student progress by grading student work that was saved in the online template (Excerpt 7).

Research Question 4: What were learner perceptions of the web-based constructivist learning environment?

At the end of the four week treatment, students responded to a questionnaire requesting their perceptions of learning in a web-based constructivist learning environment. The questionnaire consisted of two sections. Section A consisted of 27 closed-ended items which required students to respond as 'agree or 'disagree'. The items measured the following: (a) general perceptions of learning in a web-based constructivist learning environment; (b) perceptions of activities specifically relating to the geoscience template; and, (c) perceptions on group learning. Section B consisted of 2 open ended questions asking students what they liked most and liked least about learning in a web-based environment.

1. General Perceptions of Learning in a Web-based Constructivist Environment

As shown in Table 5.25, generally a majority of the students liked learning in a web-based constructivist learning environment (WebClen). Between 93% to 100% of students liked this approach of learning, felt that it made them more interested in learning geoscience, and that they could relate geoscience to what was happening around them. Furthermore, a majority of students (more than 94%)

Table 5.25

General Perceptions of Learning in a Web-Based Constructivist Learning Environment

Question	Agree	Disagree	No Response
1. I like using this approach to learning.	97.0 (34)	3.0 (1)	0 (0)
2. I like it when the teacher explains briefly and not teach for the whole session.	60.0 (21)	40.0 (14)	0 (0)
3. This approach made me more interested in learning geoscience.	97.0 (34)	3.0 (1)	0 (0)
4. I am satisfied with what I have learned.	100.0 (35)	0 (0)	0 (0)
5. Compared to the normal way I learn geoscience, I find learning geoscience this way very good.	100.0 (35)	0 (0)	0 (0)
6. After learning geoscience this way, I can relate what is learnt to what is happening around me.	100.0 (35)	0 (0)	0 (0)
7. The activities given were not difficult for me.	91.4 (32)	8.6 (3)	0 (0)
8. When doing the activities using the suggested strategies, I knew what to do.	94.2 (33)	5.8 (2)	0 (0)
9. I can do the activities at my own pace.	91.4 (32)	8.6 (3)	0 (0)
10. I can do the activities without the teachers' assistance.	54.3 (19)	45.7 (16)	0 (0)
11. My information seeking skills using the internet has improved after the program.	97.1 (34)	2.9 (1)	0 (0)
12. My understanding of geoscience improved after the program.	82.8 (29)	17.2 (6)	0 (0)

Note. n = 35

indicated that they were able to do the activities by following the strategies suggested in the tasks and that their information seeking skills using the Internet improved at the end of the four-week program. A total of 83% of the students indicated that their knowledge on geoscience improved. With regard to the difficulty level of activities and self-paced learning, 91% of students found the activities relatively easy to do, and 91% indicated that they were able to progress at their own pace.

However, students differed on a number of issues raised in the questionnaire. For example, students differed on their perceptions with regards to the role of the teacher. When they were asked if they preferred the teacher to explain briefly or teach in detail, 60% of the students wanted the teacher to explain the geoscience concepts briefly while the rest preferred the teacher to teach in detail. Similarly, when students were asked if they could do the activities without the teacher's assistance 54% indicated yes while the rest felt that they needed the teacher's support.

2. *Students' Perceptions of Activities Specifically related to the Geoscience Template*

Table 5.26, lists students perception about activities related to the template. Firstly, a majority of the students (between 80%-97%) liked the design of the template; indicated that they did not have to wait too long when getting on to the template; found the GeoLinks contained a lot of useful information; liked to describe the different types of images given in the GeoMedia; and, liked the variety of questions and feedback in GeoQuiz.

Secondly, about two-thirds of the students felt the geo-expert helped them a lot and they liked the answers from the geo-expert. However, less than half agreed

Table 5.26

General Perceptions of Specific Functions of the Web Template

Question	Agree	Disagree	No Response
1. When I open the Geoscience template, I don't have to wait long.	80.0 (28)	20.0 (7)	0 (0)
2. I like the design of the Geoscience template.	97.1 (34)	2.9 (1)	0 (0)
3. The geolinks contain a lot of useful information.	97.1 (34)	0 (0)	2.9 (1)
4. I prefer the Bahasa Malaysia links compared to the English Language links.	54.1 (19)	43.0 (15)	2.9 (1)
5. I like to describe the images in GeoMedia.	85.7 (30)	14.3 (5)	0 (0)
6. I found that the GeoSpecialist helped me a lot.	74.3 (26)	5.7 (2)	20 (7)
7. I like the answers from the GeoSpecialist.	71.4 (25)	8.6 (3)	20 (7)
8. My group sent a lot of questions to the GeoSpecialist.	28.6 (10)	60.0 (21)	11.4 (4)
9. I like to do the GeoQuiz.	85.7 (30)	11.4 (4)	2.9 (1)
10. If I am not satisfied with the GeoQuiz, I'll do it several times until I am satisfied.	71.4 (25)	28.6 (10)	0 (0)

Note. n = 35

Table 5.27

Students' Perceptions of Learning in Groups in a Web-based Constructivist Learning Environment

Question	Agree	Disagree	No Response
1. I like to do work in a group.	94.3 (33)	5.7 (2)	0 (0)
2. I discuss a lot with my group members.	77.2 (27)	22.8 (8)	0 (0)
3. My group members helped me understand what needed to be done.	80.0 (28)	20.0 (7)	0 (0)
4. If given the chance, I would change my group members.	94.3 (33)	5.7 (2)	0 (0)
5. I prefer the group to consist of 2 rather than 3 students.	57.1 (20)	42.8 (15)	0 (0)

Note. n = 35

that they sent a lot of questions of the geo-expert. With regards to the GeoQuiz, 86% of the students liked the activity. Specifically, the students said they would do the quizzes again if they were not satisfied with their results.

Thirdly, about half the students indicated that they preferred the Bahasa Malaysia links compared to the English language links.

3. Students' Perceptions on Group Learning

On the whole, students liked learning in a group. More than 77% agreed that they discussed a lot with their group members and group members helped them understand what needed to be done (see Table 5.27). However, 94.3% also

Table 5.28

Number of Student Responses as to What They Liked Most about the Geoscience Program

Student responses		%
Web-based Activities (doing online journals, FAQ...)	23	66.0
Searching information from the Internet	6	17.0
Working in groups	5	14.0
Reading books from the mini library	3	1.0
Improving knowledge about Science	3	1.0
Improved keyboarding skills	3	1.0

mentioned that if given the chance, they would change group members and 57.1% preferred the group to consist of 2 rather than 3 members.

4. Students Responses to What They Liked Most and Liked Least

Responses of students to what they like most about the WebClen was varied. Analysis of the responses were grouped into 6 categories (see Table 5.28). Some of the students mentioned more than one reason for liking the WebClen and a total of 43 responses were recorded. Twenty three responses emphasised that they enjoyed doing the web-based activities. Examples of these responses included "like doing the reports, journals and FAQs", "I like attaching pictures to journals and FAQs" and "I enjoyed listening to the sounds on volcanic eruptions". The next group of responses were searching information from the Internet (17%). Examples which students gave were: "I like to look at the pictures of planets and scan the

Table 5.29
Number of Student Responses as to What They Liked Least about the Geoscience Program

Student responses		%
Slow to upload quiz grades	3	30
Logistics and class management	3	30
Don't like group mates	2	20
Too little time on the computer	2	20

websites" and "I enjoyed searching for websites related to geoscience, getting the information and capturing the images to complete the exercises." Working in groups was the next most enjoyable activity, with 14% of responses stating that "I like my group"; "My group members helped me a lot".

The other activities students enjoyed in the WebClen were the opportunity to "read books". While doing work in a web-based environment, they also had access to the books that were placed in the classroom for reference purposes. Students also enjoyed the amount of knowledge they were exposed to as in "improved my knowledge about science", and the fact that they improved in their keyboarding skills.

Responses of students to what they like least about the WebClen was varied. Analysis of the responses was grouped into 4 categories (see Table 5.29). Some of the students mentioned more than one reason for disliking the WebClen and a total of 10 responses were recorded. Three respondents (30%) emphasised that they disliked doing the online quiz especially when it was slow to upload their quiz results. The next group of responses were logistics and classroom management

whereby 30% of the respondents found that the classroom was too noisy and that they did not like to be video-taped as in "I do not like to be video-taped or recorded". The next component they disliked (20%) was their groupmates and this was reflected in the following statements: "don't like the girls and don't like the boy". The last aspect that students disliked was the fact that they had too little time on the computer as is reflected in the following statement "groupmates let me type a little only".