

CHAPTER 4

ANALYSIS OF DATA

4.0 Introduction

This chapter presents the results of the study. Data was analyzed using descriptive statistics, nonparametric statistical tests and qualitative methods to answer the following research questions:

1. What is the effect of the Biology Web-based Constructivist Learning Environment (Bio-WebClen) on learning among students of different learning styles (auditory, visual and tactile)?
2. Do the activities in the Bio-WebClen enhance content acquisition among students of different learning styles?
3. What is the nature of the learning process in the Bio-WebClen?
4. How do students perceive the Bio-WebClen?

Apart from the above, demographic data was also analyzed to present the main characteristics of the sample.

4.1 Demographic Data

The sampel in this study comprised of 18 Form 4 students from S.M.K. Kampung Nangka, Sibul, Sarawak. Of these, there were eight boys and ten girls. As shown in Table 4.1, all the students have some experience in using computers and the Internet. However, only 28% (5) of the students have personal computers at home and 17% (3) have computers connected to the Internet. Nonetheless, 89% (16) of the students have used the

Internet before. An encouraging point is that some students have experience with a few of the Internet applications. 67% (12) of the students have used e-mail, 78% (14) have surfed the WWW, 22% (4) have used discussion board and 50% (9) have experience with chatting (IRC).

Table 4.1.

Learner demographics on computer and Internet use

Characteristics	Frequency (n)	Percentage (%)
1. Have computer experience	18	100.0
2. Possess personal computer at home	5	27.8
3. Have Internet access at home	3	16.7
4. Experience in Internet access	16	88.9
5. Have used e-mail	12	66.7
6. Have experience surfing in the WWW	14	77.8
7. Discuss over discussion board	4	22.2
8. Have experience in chatting (Internet Relay Chat)	9	50.0
9. Have access to Internet at Cybercafe	12	66.7
10. Have access to Internet at friends' home	4	22.2
11. Experience in web-based learning	0	0.0

Note. n = 18

With regard to the venues of Internet access, 67% (12) of the students mentioned that they accessed the Internet at cybercafes whereas 22% (4) indicated that they accessed the Internet at their friends' home. Nonetheless, all the students indicated they have never experienced learning using the Web. Hence, their participation in this Biology Web-

based Constructivist Learning Environment (Bio-WebClen) is a fresh and new experience.

4.2 Analyses of Data From Online Activities in the Bio-WebClen

4.2.1 *MsWord* Documents

Table 4.2

Summary of scores for food sources of vitamins

	Learning styles								
	Auditory			Visual			Tactile		
Group	3	6	7	1	8	9	2	5	4
Scores	6	6	6	6	6	6	6	6	6
Group mean scores	6.0			6.0			6.0		

Note. Maximum score = 6

There were two activities in the Bio-WebClen that required learners to produce their learning output on *MsWord*. The first activity was to identify the major food sources that contained each of the six major types of vitamins, namely vitamin A, vitamin B, vitamin C, vitamin D, vitamin E and vitamin K. The maximum score for this activity was 6 points. No points were given for wrong identification of food sources. As shown in Table 4.2, the auditory learners, visual learners and tactile learners each obtained a group mean score of 6.0.

Table 4.3

Summary of scores for applications of vitamins

	Learning styles								
	Auditory			Visual			Tactile		
Group	3	6	7	1	8	9	2	5	4
Scores	8	7	8	9	10	10	6	5	6
Group mean scores	7.7			9.7			5.7		

Note. Maximum score = 12

The second activity required learners to describe the applications of vitamins in various fields and submit their report in a *Word* document. The scores for this activity ranged from 12 to 0 points based on the comprehensiveness of the report. As shown in Table 4.3, the auditory learners achieved a group mean score of 7.7, the visual learners a group mean score of 9.7, while the tactile learners a group mean score of 5.7.

4.2.2 Online Reporting

Table 4.4

Summary of scores for online report on analysis of vitamin content in food

	Learning styles								
	Auditory			Visual			Tactile		
Group	3	6	7	1	8	9	2	5	4
Scores	8	4	4	6	6	8	6	4	4
Group mean scores	5.3			6.7			4.7		

Note. Maximum score = 8

There were three activities in the Bio-WebClen that required the students to report online in the web-template by submitting their reports to the report section of the web-template. The first report concerned the analysis of vitamin content in food. The students were required to analyze and compare the percentage of vitamins in two types of food and make a report regarding their choice of a more nutritious food in the report section of the web-template. This online report was assessed based on correct identification of the more nutritious food and the ability to substantiate the choice. The report with correct identification and concise substantiation was given 8 points, those with correct identification but with partial elaboration was given 6 points while those with correct identification but with no elaboration of the choice was given 4 points. No points were given for wrong identification of the food. For this report, the auditory learners have a group mean score of 5.3, the visual learners a group mean score of 6.7 and the tactile learners a group mean score of 4.7. (see Table 4.4).

Table 4.5

Summary of scores for online report on "Vitamins and Health"

	Learning styles								
	Auditory			Visual			Tactile		
Group	3	6	7	1	8	9	2	5	4
Scores	6	^a NA	6	4	6	6	4	6	6
Group mean scores	4.0			5.3			5.3		

Note. Maximum score = 8.

^aNA = non submission. Group 6 completed writing out the report but was unsuccessful in attaching their file to the web-template.

The second online report required the students to write on the six major types of vitamins, their functions, effects of deficiency or excess, and the major food sources. The report was to be presented in the context of a speech entitled "Vitamins and Health". The learners had to prepare the content of the report in *Word* document and make it available online by attaching the file to the report section of the web-template. For the learners to accomplish the task, they were provided with the opportunity to search for information related to vitamins from the websites listed in the "Link", especially the major link which had relevant information (see Appendix K). In addition, they were encouraged to use a search engine, namely "metacrawler" to look for the necessary information for their report. A numerical scale was developed to assess the content of the report, giving a greater point value to an answer which utilized scientific thought processes, vocabulary and relevant images; and fewer points for answers which stayed on the subject but had fewer vocabulary and images. No points were given when no attempt at all was made to

write the report. Based on the above criteria, the scores ranged from a maximum of 8 to a minimum of 0. The summary of scores for the content of this report is shown in Table 4.5. A total of six groups scored 6 points each for their reports. Two groups each scored 4 points whereas one group was considered a non-submission due to their unsuccessful attempt to attach their *Word* file to the web-template. As shown in Table 4.5, the auditory learners obtained a mean score of 4.0, the visual learners a mean score of 5.3 and the tactile learners a mean score of 5.3.

Table 4.6

Summary of scores for online report on issues related to vitamin intake

	Learning styles								
	Auditory			Visual			Tactile		
Group	3	6	7	1	8	9	2	5	4
Scores	5	7	3	4	6	4	7	6	4
Group mean scores	5.0			4.7			5.7		

Note. Maximum score = 8

The third online report required the students to write on issues relating to vitamin intake and recent research on its potential role in disease prevention. Similar to the other two reports, the students were to search for the relevant information and discuss with their peers before writing their report in the report section of the web-template. The reports were assessed based on critical viewpoints and evidence of the potential role of vitamins. The maximum score is 8 and the minimum is 0. With reference to Table 4.6,

the auditory learners achieved a mean score of 5.0, the visual learners a mean score of 4.7 and the tactile learners a mean score of 5.7.

Table 4.7

Summary of scores for all the three online reports

	Learning styles								
	Auditory			Visual			Tactile		
Group	3	6	7	1	8	9	2	5	4
Report 1	8	4	4	6	6	8	6	4	4
Report 2	6	^a NA	6	4	6	6	4	6	6
Report 3	5	7	3	4	6	4	7	6	4
Group mean scores	4.8			5.6			5.2		

^aNA = non submission. Group 6 completed writing out the report, "Vitamins and Health" but was unsuccessful in attaching their file to the web-template.

On the whole, the performance of the auditory, visual and tactile learners in the three online reports are as shown in Table 4.7. The auditory learners achieved a group mean score of 4.8, the visual learners a group mean score of 5.6 and the tactile learners a group mean score of 5.2.

4.2.3 Interpretation of Images

Table 4.8

Sample description and scoring procedure for the image pellagra disease

Score	Criteria	Sample Description
1	Include description of related information and all relevant observable features.	The pellagra patient looks skinny and had a flushed red face. There are two regions at the back of the neck that is septic red.
2	Include description of related information with some relevant observable features omitted.	The pellagra patient looks skinny and had a flushed red face.
3	Include description of related information with some irrelevant observable features.	The face looked red, and there is a cut at the neck.
4	Description containing unrelated information and irrelevant observable features.	The skin on the face peeled off and there are two cuts at the neck.

This activity was aimed at promoting observation skills among learners and at the same time allowing them to construct their own meaning on the observed phenomena. The learners were required to observe and describe four still images and one animated image and to give a description of each of the images they had observed. As in online reporting, a numerical scale was developed to evaluate learners' description and comments on the images. A maximum score of 4 was given for descriptions that included all relevant observable features and related information, a score of 3 for descriptions that have some relevant observable features omitted but contained related information, a score of 2 for descriptions containing irrelevant observable features but with some related

information, and a minimum score of 1 for descriptions containing irrelevant observable features and unrelated information. A sample of the description and scoring procedure is shown in Table 4.8.

Table 4.9

Mean scores for the interpretation of images in the "Media"

Learners' Learning Style	Mean Scores
Auditory	3.0
Visual	2.9
Tactile	3.0

Note: Maximum score = 4

Table 4.9 presents a summary of the scores obtained by auditory, visual and tactile learners. There is little variation in the mean scores of the three categories of learners. However, the auditory and tactile learners outscored the visual learners. This indicated that the auditory and tactile learners have adapted well to using other modalities, for instance, the visual mode in perceiving and processing information.

4.2.4 The FAQ Activity

The FAQ activity required learners to generate questions and answers for the questions. Data was collected on the cognitive level of the questions and peer assessment of FAQs and answers. This was to ascertain the higher level of thinking exercised by learners in such an environment.

(i) *Cognitive level of Learner Generated Questions*

The questions generated by learners were analyzed according to Bloom's Taxonomy (1956) and Goodwin et al. (2001). There are six levels in the Bloom's taxonomy: knowledge, comprehension, application, analysis, synthesis and evaluation. These six levels were further classified as lower or higher levels (Goodwin et al., 2001). Lower level questions are those at the knowledge, comprehension, and simple application levels of the taxonomy. Higher level questions are those requiring complex application (e.g. analysis, synthesis and evaluation skills). Each of the two categories of questions was further classified as "close" or "open". A close question is one that required a limited number of acceptable answers anticipated by the teacher while an open question is one that involves many acceptable answers which were not anticipated by the teacher. A total of 13 questions were generated by the learners. Of these, 77% (10) of the questions were lower-order questions while 23% (3) of the questions were higher-order questions. All the lower-order questions and higher-order questions were close questions.

The auditory learners generated 31% (4) of the questions and answers of which all were lower-order close questions. The visual learners generated 23% (3) of the questions and answers, of which 67% (2) were higher-order close questions whereas the tactile learners generated 46% (6) of the questions and answers but only 17% (1) were higher-order close question. It was found that one set of learners from the auditory group did not participate in the FAQ activity.

(ii) *Peer Assessment of FAQs and Answers*

Peer assessment is considered as one important element in a constructivist learning environment. The aim of this activity was twofold. First, the learners have the opportunity to compare and consider the ideas of their peers, and second, they learn to master the skill of critical judgement. This is in accordance to the constructivist ideas of multiple representations and critical evaluation.

Analysis of peer evaluation indicated that the learners made a total of 15 evaluations. The auditory learners did not evaluate any questions and answers, while the visual learners evaluated 60% (9) of the FAQs and answers and the tactile learners evaluated 40% (6) of the FAQs and answers. For example, a group of tactile learners gave an "A" grade for peer evaluation and commented: "The answer is complete and easy to understand". Another group gave a "B" grade and remarked: "Please explain your answer". One group of the visual learners gave a "B" grade and commented: "The content is quite interesting".

4.2.5 Expert-learner Online Conversation

This activity served as a form of asynchronous communication between the learners and an expert. The learners were able to get access to the questions posed by their peers and the answers suggested by the expert. It is also a form of collaboration as the learners can view all the questions and answers forwarded by their peers. A total of 14 questions were posted by the learners during the learning sessions. Of these, 57% (8) of the questions were lower-order questions while 43% (6) were higher-order questions.

Of the lower-order questions, 75% (6) were close questions and 25% (2) were open questions. All of the higher-order questions were close questions.

The auditory learners posed 43% (6) of the questions of which 33% (2) of the questions were higher-order close questions while the visual learners posed 29% (4) of the questions of which 25% (1) of the questions were higher-order close question. The number and the level of questions posted by the tactile learners were the same as the visual learners. Examples of lower-order close questions posted were: (a) "Do animals need vitamin C?" and (b) "Who was the first person to discover vitamins?" An example of a lower-order open question was (a) "What will happen if vitamin C is consumed in large quantities?" An example of higher-order close question included (a) "How can vitamin E deficiency diseases be treated?"

4.2.6 Online Quiz

The purpose of online quiz was to provide an opportunity for the learners to assess their understanding of the content they have learned. A total of 10 multiple-choice questions were presented. Six groups attempted the quiz whilst three groups did not. These three groups comprised of one group of auditory learners, one group of visual learners and one group of tactile learners. For the groups that answered the quiz questions, there was not much variation in their mean scores. In this online quiz, the auditory learners achieved a mean score of 90, the visual learners achieved a mean score of 95, and the tactile learners had a mean score of 95.

visual group a group mean score of 3.0 points and the tactile group a group mean score of 4.0. (see Table 4.10).

4.3.2 Performance on the Content Test

The pretest scores and posttest scores of the students were compared using the nonparametric Wilcoxon signed-rank test to determine if the students scored better in the posttest as compared to pretest. (see Table 4.11).

Table 4.11

Wilcoxon signed-rank test comparison of pretest scores and posttest scores

Variable	Ranks	Mean ranks	Wilcoxon Test	
			Z	p
Pretest - Posttest	Negative ranks ^a	9.50	-3.74	sig.
	Positive ranks ^b	0.00		

Note: a = Pretest < Posttest; b = Pretest > Posttest

The nonparametric Wilcoxon signed-rank test indicates that the mean rank for the cases in which the posttest is greater than the pretest is 9.50, while for cases for which pretest is greater, the mean rank is 0.00. The Z value is -3.74. This is significant at $p < 0.05$. This indicates that the students achieved significantly higher scores in the posttest as compared to the pretest.

Table 4.12

Comparison of pretest and posttest content scores of auditory, visual and tactile learners

Learners' Learning Styles	Group	^a Pretest Scores	Posttest Scores	Difference	Percent Increment	Mean Percent Increment
Auditory	3	40	48	+8	20%	51%
	6	35	60	+25	71%	
	7	28	45	+17	61%	
Visual	1	33	53	+20	61%	50%
	8	40	55	+15	38%	
	9	35	53	+18	52%	
Tactile	2	30	55	+25	83%	63%
	4	38	43	+5	13%	
	5	35	68	+33	94%	

^a Scores on content to be learned only (excluding prior knowledge)

In order to examine the performance of each of the three groups of learners: auditory, visual and tactile learners, the difference in pretest and posttest scores and the percent increment of test scores of the auditory, visual and tactile learners were computed. As a whole, all the three different categories of learners of different learning styles indicated a marked increase in scores. As shown in Table 4.12, the auditory learners have achieved a 51% increment in scores, the visual learners a 50% increment while the tactile learners a 63% increment in scores. To further determine if the scores were significantly different, the nonparametric Kruskal-Wallis test was used. (see Table 4.13 below).

Table 4.13.

Kruskal-Wallis test comparison of posttest scores of auditory, visual and tactile learners

Variable	Learners' Learning Style	Mean ranks	Kruskal-Wallis Test	
			Z	p
Posttest	Auditory	6.83	0.167	non-sig.
	Visual	9.33		
	Tactile	12.33		

Table 4.13 shows the average ranks for the posttest scores for the three learning style groups: auditory, visual and tactile. The mean rank for the auditory learners is 6.83, the visual learners 9.33 and the tactile learners 12.33. The observed significance level is 0.17 which is not significant at $p < 0.05$. This indicates that there is no significance difference in the mean ranks for posttest scores for the three groups of students. Therefore, it seems that the three groups of students achieved equally well in the posttest.

4.4 Analyses of Data from Classroom Observation

Classroom observation was carried out to answer the following research question:

- (i) What is the nature of the learning process in the Bio-WebClen? The nature of the learning process in this study encompassed the pattern of interaction and learners' time on task.

4.4.1 Pattern of Interaction

A major process that occurred in the Bio-WebClen was interaction. As in any collaborative learning environment, three types of interactions were observed to occur, namely, learner-to-content interaction, learner-to-learner interaction and learner-to-teacher interaction. The three types of interactions were perceived to occur in the ratio of 3:3:4. Learner-to-content interaction occurred when learners search for information in the Web to enable them to process and hand in their product. During this time, the learners would seek help from their peers or teacher if they encountered technical obstruction or difficulties in achieving the learning goals. Thus learner-to-content interaction, learner-to-learner interaction and learner-to-teacher interactions were observed to occur concurrently.

Learner-to-learner interactions were most prominent during discussion. Informal within-group discussions dominated the discussion process. The group members were seen to mentor each other and offer suggestions regarding the problem solution. They also asked each other questions and supported each other. Learner-to-teacher interaction occurred when the students asked for support in technical skills such as importing and resizing images, minimising and maximising a program, and attaching file to the web-template. In addition, learner-to-teacher interaction also occurred when the students sought clarification regarding the information in the English websites.

4.4.2 Learners' Time On Task

Table 4.14

Learners' time on task.

Learners' Learning Styles	Group	Percent Time On Task (%)	Mean Percent Time On Task (%)
Auditory	3	79	80.0
	6	79	
	7	81	
Visual	1	81	84.0
	8	86	
	9	86	
Tactile	2	84	82.0
	4	84	
	5	77	

Learners' time on task was determined using the momentary time sampling method (Carey & Sale, 1997) where an observer coded a student's behavior as "attentive" or "inattentive". The "attentive" behaviors were those in which students appeared to be appropriately engaged according to the intent of the activities designed by the teacher. A student is classified as "attentive" if he is doing what the majority of his friends are doing. A student is considered as "inattentive" when he is doing activities not specified in the activities designed by the teacher.

Table 4.14 displays the data on learners' time on tasks. The data shows that the time on task of the auditory learners was 80%, that of the visual learners was 84% while that of the tactile learners was 82%.

4.5 Analyses of Data from Perception Questionnaire

To analyze how the students perceived the Biology web-based constructivist learning environment, a set of perception questionnaire was administered at the end of the online learning sessions. The questionnaire comprised of four sections. The first and second sections sought to obtain information regarding learners' background and experience in computer and Internet literacy. The third section consisted of 34 items of Likert-scale type which required learners to respond as follows: "strongly agree", "agree", "strongly disagree", and "disagree". The scale "strongly agree" was collapsed into "agree" while "strongly disagree" was collapsed into "disagree" during analysis. These 34 items sought to obtain learners' opinion on the following: (a) web-based constructivist learning environment, (b) learning activities of the Bio-WebClen, (c) online support, (d) collaborative learning, and (e) computer technology embedded in the Bio-WebClen. The fourth section consisted of four open-ended questions seeking learners' opinion on the following: (a) activities suitable for learning, (b) activities that are enjoyable, (c) activities the learners dislike, and (d) suggestions on additional activities to be incorporated into the Bio-WebClen.

4.5.1 Learners' Perceptions of Learning in the Web-based Constructivist Learning Environment

Table 4.15

Learners' perceptions of learning in a web-based constructivist learning environment

Item	Agree	Disagree
	% (n)	% (n)
1. I like to use the Web for learning.	94.4 (17)	5.6 (1)
2. I hope other topics in Biology can be learned using the Bio-WebClen approach.	94.4 (17)	5.6 (1)
3. Learning about vitamins by using Bio-WebClen is better than learning it by listening to teachers' explanation in the class.	77.8 (14)	22.2 (4)
4. I prefer to learn about vitamins from notes in textbooks or reference books rather than to learn it by carrying out the activities in the Bio-WebClen.	22.2 (4)	77.8 (14)

Note. n = 18

As shown in Table 4.15, 94% of the learners indicated that they like to use the Web for learning. Similarly, 94% of the learners indicated their interest to learn other topics in Biology using the Bio-WebClen. Further, 78% of the learners indicated that learning the sub-topic "Vitamins" using the Bio-WebClen is better than listening to the teacher's explanation in the class. However, 22% of the learners indicated that they prefer to learn about vitamins from notes in the textbooks or references rather than to learn it from the Bio-WebClen website.

4.5.2 Learners' Perceptions of Learning Activities in the Bio-WebClen

Table 4.16

Learners' perceptions of learning activities in the Bio-WebClen

Item	Agree	Disagree
	% (n)	% (n)
1. I concentrate my learning on issues that interest me.	100.0 (18)	0.0 (0)
2. Learning activities in the Bio-WebClen are of interest to me.	100.0 (18)	0.0 (0)
3. Learning vitamins from the Bio-WebClen make me understand the applications of vitamins in various fields, such as in biological systems, chemical industry and food industry.	100.0 (18)	0.0 (0)
4. I learn interesting things about vitamins from the Bio-WebClen.	94.4 (17)	5.6 (1)
5. What I have learned connected well with daily activities.	94.4 (17)	5.6 (1)
6. Images in the "Media" of the Bio-WebClen interest me.	94.4 (17)	5.6 (1)
7. I like to observe images in the "Media" and to give a description of them.	94.4 (17)	5.6 (1)
8. I like the activity that requires my group to describe our learning experience.	94.4 (17)	5.6 (1)
9. I like the activity that requires me to describe my own experience in learning.	72.2 (13)	27.8 (5)
10. I like to post questions to the specialist.	88.9 (16)	11.1 (2)
11. I am eager to obtain answers from the specialists.	94.4 (17)	5.6 (1)
Note. n = 18		(table continues)

Table 4.16 (continued)

Learners' perceptions of learning activities in the Bio-WebClen

Item	Agree	Disagree
	% (n)	% (n)
12. I like the task that requires me to generate FAQs and to give the answers.	83.3 (15)	16.7 (3)
13. I like the activity that allows me to prepare a report on issues relating to vitamin intake.	83.3 (15)	16.7 (3)
14. Learning task on analyzing information is too difficult.	22.2 (4)	77.8 (14)
15. I like the activity that requires me to write up a report on "Vitamins and Health".	55.6 (10)	44.4 (8)
16. I am critical about my own ideas.	83.3 (15)	16.7 (3)
17. I am critical of other students' ideas.	83.3 (15)	16.7 (3)
18. I think critically about ideas in the reading materials.	72.2 (13)	27.8 (5)

Note. n = 18

As shown in Table 4.16, all the learners indicated that they focused their learning on issues that interest them and all of them agreed that the learning activities in the Bio-WebClen were of interest to them. All the learners also indicated that the Bio-WebClen provided them with opportunities to learn about the applications of vitamins in various fields - biological systems, chemical industry and food industry. More than 94% of the learners indicated that they had learned interesting things about vitamins from the Bio-

WebClen. Likewise, more than 94% of learners indicated that what they had learned connected well with their daily activities.

Regarding the different types of activities in the Bio-WebClen, 94% of the learners indicated that the images in the "Media" were of interest to them and that they liked to observe and to give descriptions of them.

In writing reflective essays, 94% of the learners indicated that they liked to do it collaboratively. However, only 72% of the learners indicated that they liked to describe what they had experienced individually.

As for the conversation between expert and learners, 89% of the learners indicated that they liked to post questions to the expert and 94% of the learners indicated that they were eager to obtain answers from the expert. An interesting point to note was that a visual learner did not like to pose questions but was interested in getting answers from the expert.

With regard to generating FAQs and answers, 83% of the learners indicated that they liked the activity. Similarly, 83% of the learners indicated that they were interested in writing the report on issues related to vitamin intake.

A total of 78% of the learners indicated that the task of analyzing information was not too difficult. On the other hand, only 56% of the learners liked the task of writing online report on "Vitamins and Health".

In terms of reflective thinking, 83% of the learners indicated that they were critical about their own thinking. Likewise, 83% of the learners indicated that they were critical of other students' ideas. However, only 72% of the learners indicated that they thought critically about ideas in the reading materials.

4.5.3 Learners' Perceptions of Collaboration

Table 4.17

Learners' perceptions of collaboration

Item	Agree	Disagree
	% (n)	% (n)
1. I like the interactions that exist between teachers and students. Help is always available from the teacher or other students.	100.0 (18)	0.0 (0)
2. I have opportunities to ask other students to explain their ideas.	100.0 (18)	0.0 (0)
3. I have opportunities to explain my ideas to other students.	94.4 (17)	5.6 (1)
4. Interactions in the Bio-WebClen enable me to learn more as compared to learning the topic "Vitamins" on my own.	94.4 (17)	5.6 (1)
5. Other students ask me to explain my ideas.	88.9 (16)	11.1 (2)

Note. n = 18

As shown in Figure 4.17, all the learners of different learning styles agreed that they liked the interaction that existed between the teacher and the learners or between learners and learners. All of them agreed that they did ask their friends to explain their (friends') ideas. More than 94% of the learners agreed that they had opportunities to explain their own ideas to their friends and that the social interaction incorporated in the Bio-WebClen enabled them to learn about vitamins better. However, only 89% of the learners agreed that their friends did seek explanation from them.

4.5.4 Learners' Perceptions of Online Support

Table 4.18

Learners' perceptions of online support

Item	Agree	Disagree
	% (n)	% (n)
1. Instructions in the Bio-WebClen are clear.	100.0 (18)	0.0 (0)
2. I can't follow the instructions given in the Bio-WebClen.	100.0 (18)	0.0 (0)
3. I prefer "Link" in Bahasa Malaysia as compared to "Link" in English.	100.0 (18)	0.0 (0)
4. I can't understand most of the information from the websites listed in the "Link".	22.2 (4)	77.8 (14)

Note. n = 18

As shown in Table 4.18, all the learners indicated that the instructions in the Bio-WebClen were clear. Likewise, all of them indicated that they were able to follow instructions given in the Bio-WebClen. All of them also indicated that they preferred websites in the "Link" to be in Bahasa Malaysia. Some (22%) of the learners indicated that they could not understand most of the information from the websites listed in the "Link".

4.5.5 Learners' Perceptions of using Computer Technology

Table 4.19

Learners' perceptions of using computer technology

Item	Agree	Disagree
	% (n)	% (n)
1. I like activities that require me to type the answers or report into the computer.	94.4 (17)	5.6 (1)
2. Retyping answers or reports into the computer is a waste of time.	11.1 (2)	89.9 (16)
3. I prefer to write the answers/ report in the worksheets provided as compared to typing into the computer.	11.1 (2)	89.9 (16)

Note. n = 18

As shown in Table 4.19, 94% of the learners liked activities that required them to type their answers into the computer. A total of 11% of the learners indicated that retyping into the computer was a waste of time although they indicated they liked the activity. As such these learners prefer to write the answers or report in the worksheets as compared to typing into the computer.

4.5.6 Learners' Responses to Activities Suitable for Learning

Table 4.20

Learners' responses to activities suitable for learning

Learners' Responses	Frequency			
	Auditory	Visual	Tactile	Total
1. Interpreting visual images	1	3	3	7
2. Analyzing information	3	2	1	6
3. Writing online report on "Vitamins and Health"	1	2	2	5
4. Generating FAQs	2	1	2	5
5. Writing online report on issues related to vitamins	2	0	2	4
6. Posting questions to the expert	0	1	1	2
7. Writing online report on applications of vitamins	1	0	1	2
8. Doing experiment	1	1	0	2
9. Answering quiz questions	0	1	0	1

As shown in Table 4.20, the activity that was most suitable for learning was the interpretation of visual images (7 students). Of this the visual and tactile learners were the most. Other suitable activities for learning included analyzing information (6 students), writing online report on "Vitamins and Health" (5 students), generating FAQs (5 students) and writing online report on issues related to vitamins (4 students). Less suitable activities included posting questions to the expert, writing online report on applications of vitamins, doing experiment and answering quiz questions.

4.5.7 Learners' Responses to Enjoyable Learning Activities

Table 4.21

Learners' responses to enjoyable learning activities

Learners' Responses	Frequency			
	Auditory	Visual	Tactile	Total
1. Interpreting visual images	3	1	2	6
2. Doing experiment	2	1	3	6
3. Generating FAQs	2	1	1	4
4. Answering quiz questions	0	2	2	4
5. Writing online report on issues related to vitamin intake	1	1	2	4
6. Writing online report on "Vitamins and Health"	1	0	1	2
7. Posting questions to the expert	0	1	1	2

As shown in Table 4.21, two activities were indicated as the most enjoyable by learners: interpretation of visual images and doing experiment. Other activities that were indicated as enjoyable included generating FAQs, answering quiz questions and writing online report on issues related to vitamin intake. Less enjoyable activities included writing online report on "Vitamins and Health" and posting questions to the expert.

4.5.8 Learners' Responses to Activities They Dislike

Table 4.22

Learners' responses to activities they dislike

Learners' Responses	Frequency			
	Auditory	Visual	Tactile	Total
1. Writing online report on "Vitamins and Health"	1	5	3	9
2. Writing report on food sources containing vitamins	1	1	5	7
3. Generating FAQs	1	2	1	4

When asked on the activities disliked most, 9 out of 18 learners indicated writing online report on "Vitamins and Health", 7 out of 18 learners indicated writing a report on food sources containing vitamins and 4 out of 18 learners indicated generating FAQs.

4.5.9 Learners' Suggestions on Learning Activities To Be Added to the Bio-WebClen

Visual and tactile learners suggested that learning activities such as games (for example, crossword puzzles) could have been included in the Bio-WebClen. Other suggestions forwarded by these two categories of learners were provision of additional images and provision of more links in Bahasa Malaysia. The auditory learners, on the other hand, have a different opinion. They suggested the incorporation of synchronous communication and the extension of time for learning using the Bio-WebClen.