

CHAPTER 5

FINDINGS OF PHASE 2: THE DESIGN AND DEVELOPMENT

In Phase 1, the analysis phase, the usage and perception of the use of technology of the group of students in the context of the study was described. From the analysis of the data, the situation of the group of students in the context of the study in the above mentioned areas were determined.

In Phase 2, a collaborative mLearning module for the topic of Nutrition in Form 2 Science was designed to take into account the usage of technology among the group of students in the context of the study. The module was designed according to Merrill's First Principles. A team of experts experienced in the field of educational technology, and the subject matter, was selected to assist in the development and formative evaluation of the design.

The research question in Phase 2 is: What information can the Subject Matter and Technology experts give to assist the development of the collaborative mLearning module for Form 2 Nutrition? The objective of this research question is to determine the design for instruction in a collaborative mLearning environment based on the opinions from the experts. The data collected consisted of the documentation of the experts' comments on the collaborative mLearning module design documents, and the interviews with the experts on the design of the collaborative mLearning module. The data was then coded, and analysed into themes, or areas of concern on the design of the collaborative mLearning module.

In the first section of this chapter, the themes or areas of concern that arose according to the experts' opinion are discussed. In the following section, the description of how the areas of concern were addressed in the development of the

collaborative mLearning module for the instruction on the topic of Nutrition in Form 2 Science was reported.

Design of the Collaborative mLearning Module: The Experts' Opinion

In this section the third research question, is addressed directly: What information can the Subject Matter and Technology experts give to assist the development of the collaborative mLearning module for Form 2 Nutrition?

The team of five experts who were identified to assist in the design and development of the collaborative mLearning module were selected based on their experience and expertise in the field of educational technology as described in Chapter 3 (See Table 3.2). The technical experts, TE1 and TE2, concentrated on the evaluation of the technical aspect and instructional design of the module, while the subject-matter experts, SME1, SME2 and SME3, concentrated on the science content of module.

The experts evaluated the design documents, which included the course syllabus, the lessons' content and assessment. The experts were required to write their comments and suggestions on the documents. An interview was later conducted with each expert to enquire further on the comments and suggestions made on the documents. Hence, the findings were reported based on the documentations, and the interview of the experts.

The documentations and interviews during the evaluation of the module revealed that the experts' concerns were on the following areas: (a) the management of the module, (b) the instruction of the subject, (c) the online collaborative group environment, and (d) instructional tools.

Management of the Module

Management issues raised by the experts were on the cost of the usage of technology, the duration for completion of the module, as well as the management and tracking of the participants' responses during the course of study using the module.

Cost of Technology

The high capital and operating costs for the use of technology in the module was mentioned. TE1 documented her concern on the cost of the technology used in the collaborative mobile learning environment in the documents for evaluation. She also expressed it during the interview.

The thing is, are the students able to afford the cost of owning handphone, SMS? Who will want to bear the cost (TE1.MANG1.71)?

And then the internet connection: must they have a PC at home? And they must have internet (TE1.MANG1.76)?

The issue about the cost of the technology is valid. Participants of the research might not be able to afford the cost of purchasing a mobile phone, and sending text messages. Furthermore, participants might not have access to a computer with an internet connection, and might not even own a computer.

Duration for Completion of Module

During the interview, both SME2 and SME3 felt that the tasks and activities for were difficult to complete within a science class period. SME2 was constantly concerned whether the questions were in the syllabus, and she made a note against each question in the documents indicating which items were in the syllabus.

No, (the questions are) not in the syllabus. Some only. How are you going to teach? If in the class, no time. You don't have time to do it. How long to finish? No time as rushing to finish syllabus (SME2.MANG2.64).

On the other hand, even though SME3 was concerned about the time frame, she was not as particular as SME2 on completing the syllabus.

It's (the course) too lengthy. Like, too wide a coverage. You seem to do so much. In a way, it is quite interesting. The activities, I mean. There is summary, there are questions. At first, I thought there were only questions, but you have summary also. Still, it covers quite a lot. Is there a time frame? I mean how long will you take to finish (SME3.MANG2.26)?

It's good if you want to do it that way. It's good in grounding the students. You have approached the question in many different ways. You give assignments, you ask questions and you have a SMS quiz. You ask the same thing in different ways. If your main objective is mastery, then it's very good (SME3.MANG 2.29)

Although SME3 was concerned about the time to complete the module, she thought that the activities were beneficial for drilling the learners to achieve mastery.

It was decided to maintain the number of questions because of the potential benefits to the learner. More questions would mean more practice in the topic.

Management and Tracking of Participants' Responses

During the interview, SME3 voiced his concern on the overwhelming amount of data he predicted would have to be collected. He noted this concern in the documents, and during the interview.

Can you imagine how many answers will come in? I'm only afraid you have problems. I wonder how you will be able to manage the responses (SME3.MANG3.47).

In the collaborative mLearning module, there might be a large amount of data and the researcher may find it difficult to track and manage participants' responses. Taking this into consideration, a system to record and track the participants' responses was planned for and used in the implementation (see section on Management and Tracking of Participants' Responses in this chapter).

The results show that the experts were concerned on the cost and usage of equipment, the duration of the implementation of the module, and the vast amount of data that had to be managed and tracked.

Instructional Issues

The second area of concern that emerged was related to instructional issues and included the use of language for giving instructions, the accuracy of the content, instructional needs, assessment, and the need to apply learning theories in instruction.

Use of Simple Language

The first aspect in instructional issues was the use of simple language for instruction. SME1 commented next to the instructions for the first online discussion

question “You may need to simplify the language. Shorter sentences better (SME1.E.OD.1).”

When interviewed, SME1 also stressed the importance of using shorter and simpler sentences to assist the learner in focusing on the meaning of the instructions.

So maybe shorter sentences lah, because in reading, we also have to identify where the subject is, where the predicate is, then only we can know the meaning. When you have so many things we also don't know what the focus of the sentence is (SME1.INST1.31).

SME1 also commented that some of the instructions were vague. In one of the tasks she had circled the word “classify” (SME1.E.OT.8). She explained the confusion in the use of the word, and attempted to rephrase the instructions in simpler form during the interview.

Classify, (is it) you meant classify according to the food classes? So, if classify the meals, you mean you want to analyse which food is given to which class, and all that. Then I think it should not be classify the meal then. Or maybe you should rephrase the question and say, study the menu given, categorize the food into their classes, instead of classify the meal. If the meal, I will say, is the meal balanced? Is the meal, you know, vegetarian? That will be how I see it as classify the meal (SME1.INST1.75).

The instructions for the tasks and activities were in English. There was concern that the level of English might be too high for Form 2 learners. This was because English was only used as the language of instruction for Science for the last two years, and learners might still find difficulties in using the language. Importance was placed on the use of simple to understand English.

To summarize, the use of simple language for instruction is considered important. Simple English should be used for presenting content, instructions and questions. Difficult or ambiguous terms, which might confuse the learner and result in misunderstanding the instructions, are to be avoided.

Accuracy of Content

The second aspect in instructional issues was providing accurate and precise content during instruction. According to the experts, scientific content does not refer to only scientific facts or concepts. The findings indicated that the other areas identified by the experts for accuracy of content are scientific symbols, shortened forms, as well as grammar and spelling.

Scientific symbols

In the documents, SME1 corrected the question which she considered as erroneous in the use of scientific symbol. During the interview, she insisted that even though there was no symbol for some scientific notations in the text messaging system, the accurate use of symbols and scientific phrases must be utilized.

37 C has no meaning to the children. Because the temperature is 37 degrees Centigrade, or Celsius. 37 degrees. In full. After all we want (to be) accurate. The use of accurate scientific language (SME1.INST2.1.21).

The accurate use of scientific symbols should be emphasized, even when in text messaging format. It was suggested that since the symbol “°” for temperature was not available in the text messaging format, the “degree” of temperature must be spelt in words.

Shortened forms

The use of shortened forms, or abbreviations, was avoided in the documents. However, as text messaging was one of the tools used, the subject-matter experts were asked during the interview if shortened forms and abbreviations such as “V I T” for vitamin could be considered for use for text messaging. SME1 rationalized as follows: “When you use short forms you defeat another purpose of your research where you want to promote the use of English (SME1.INST2.2.186).”

SME1 felt that as the emphasis was on the use of English in teaching science, proper words must be used. The use of abbreviations was not encouraged by the experts, not even when text messaging. This was because the experts felt that shortened forms and abbreviations might be misinterpreted.

Spelling and grammar

The subject-matter experts were meticulous in identifying and correcting the grammatical and spelling errors in the documents.

It was observed that SME1 not only corrected the grammar and spelling in the document evaluated but also questions which were considered leading questions. In a case where the answer could be implied from the question, she noted that the question hinted at the answer. She had circled the word “only” and wrote “Like a giveaway hint that this is not true. What do you think (SME1.E.SMS6.2)?”

Accuracy in spelling and grammar was considered important to most of the subject-matter experts.

Facts and concepts

The subject-matter experts were equally meticulous in identifying and correcting the errors in scientific content. They were also particular on checking the

questions and answers for assessment. In fact, SME2 seemed to be delighted when she spotted errors: “Ah, I spotted a mistake. Wrong answer! (SME2.INST2.4.153)”

The subject-matter experts stressed that accurate scientific content be presented during instruction to ensure that there is no misunderstanding or misconception in science.

The findings from the documentation and interview showed that ensuring the accuracy of the content was important to all the subject-matter experts. Accuracy of content included the following: accurate scientific symbols; complete phases and unabbreviated words, not shortened forms; accurate grammar and spelling; as well as accurate scientific facts and concepts.

Instructional Needs

The third aspect of instructional issues identified was related to instructional needs. From the documentation and the interviews, the following needs were identified: the need for instructional modules, the need for more examples, and the need for a detailed marking scheme.

Instructional modules

In the initial documents, no formal instructional module was designed. On the other hand, links to relevant websites were provided. During the interview, TE1 expressed the need for instructional modules for reference and guidance when attempting the activities, especially in the initial stages of the module.

Do you have an online teaching module on your website? So that (if) they [the learners] want to do it, they can have revision first. Because otherwise, you have to summarize all. (You're) asking question, question, so if they don't have time to search all these things, at least

you can... A module lah, so that they can do some revision first, as a start, then they search for others (TE1.INST3.1.114).

According to TE1's experience, learners were dependent on learning materials and were not used to finding materials without the teacher's assistance. Hence, an instructional module should be designed to provide content for the learner to access for each lesson.

Examples

In the documentation, SME1 had requested for examples to be used in questions that she considered vague. In one of the online discussion tasks, SME1 underlined the word "special feature" in the question and wrote a comment above it stating that the instruction was vague (SME1.E.OD1.1).

Examples could be used to ensure that the instructions to the tasks and questions were understood. This is to avoid errors and waste of time in contemplating on how to attempt the activity.

Detailed marking schemes and guidelines

In the documentation, the experts did not indicate that the assessment plan was not suitable. However, during the interview, TE2 suggested that the plan for assessment be explained before the learners attempted the problem-solving tasks.

Has the student assessment plan been included? Yes. But you didn't really state (example), problem solving group task online. What is expected? (Please include) more in detail. Because their skills, [they are] only Form 2. So, for them they need more. They may not be able (to attempt the tasks). If they are guided properly (on) where their marks are going to go they should be able to perform better. But over here, you have stated generally that they will be given on

participation, and {uh, participation}, individual assessment, problem-solving? Like generally only, its 30 to 10 (percent) huh? But there's no specific (details) (TE2.INST 3.3.57).

Although a general marking scheme was provided, a detailed marking scheme may be beneficial for the learner to know the expectations from the problem-solving task.

During the interview, TE2 also expressed her concern on the lack of assistance for group tasks. She felt that more guidelines were needed as Form 2 students required more scaffolding in problem-solving tasks.

For me, because {last last ...we, like} we have done in our course [Masters], so I know what to look for. You know what is expected. {Like} for these Form 2 students, they may not be able to (TE2.INST3.3.69).

From TE2's experience in using ICT in teaching Form 2, the learners required a lot of structure and guidance in attempting to solve the tasks assigned. She shared her experience in getting Form 2 learners to develop learning content in Power point presentations during the interview.

Because like, I sort of, I guided them to what I want them (to do) in the content. "Pengenalan," you must have something interesting, {what} in fact, I told them what are the areas they have to (include). If not they go hay-wire. They will put in everything. Like I put for "tokoh-tokoh tempatan," first, you write on "latarbelakang," next is the "nama, sumbangan, perjuangan," and why, why "berjuang"? And "proses perjuangan," and "sumbangan," and what is your own opinion on the "tokoh-tokoh," sort of guided. There was one year, that I didn't

really guide them, you know. It went hay-wire, they were all over, and it was not systematic at all (TE2.INST3.3.72).

Form 2 learners may require more guidance and assistance in both understanding the problem tasks as well as in using the technology. The assessment plan for the module should be included to ensure that the learners knew the expected learning outcomes. Detailed guidelines should be provided to assist learners in attempting and solving the problem tasks.

To summarize, the instructional needs of the Form 2 learners were identified from the documentation and transcript of interview with the experts. This showed that experts were of the opinion that the learners required more scaffolding in the form of instructional modules, examples, and detailed guidance and marking schemes before attempting the problem-tasks.

Assessment

The fourth aspect of instructional issues was regarding the assessment of the learners. The main area of concern was regarding the number of questions and suitability of the questions.

During the interview, SME3 voiced his concern on the larger number of assessment questions in the lessons. He said: “In a way, it is quite interesting. Still, it covers quite a lot (SME3.INST4.29).”

On the other hand, SME2 seems to prioritize preparing her learners for the exams, as she identifies the questions that were in the syllabus using approving phrases like “These are exact like exam question, will prepare them for exams (SME2.INST4.143);” and “100% in the syllabus (SME2.INST4.146);” during the interview.

Even though SME2 stated that there was too much content in the syllabus: “There is enough in the syllabus already! Ya, need to reduce! (SME2.INST4.174);” and insufficient time to prepare the materials, she could not specifically state what needed to be reduced.

Like Chemistry, they put in (topics on) “composite materials” like fibreglass. (Topic on) “Pesticides” (was) taken out. More practical. Form 2. I don’t know! (SME2.INST4.178)

From the interview with SME3, he expressed his feeling on using various forms of questions to train the learners in the science content.

It’s good in grounding the students. Especially if you want to do drill and practice. That’s right, you will be drilling the students. What do they call it? Mastery learning! Then it’s very good (SME3.INST4.34).

Hence, SME3 was of the opinion that the large number of questions provided “mastery” of the content and was beneficial to the learners, as was mentioned in the section “duration for completion of the module.”

The large number of questions may take a longer time to complete but the larger number and variety of questions was beneficial for the learners. So it was decided to maintain the quantity and variety of the assessment questions.

Other Learning Theories

The final aspect of the instructional issues is concerning learning theories. The experts brought up learning theories which could be incorporated in the materials.

During the interview and in the documents, SME1 mentioned the importance of including values in science education, and meaningful learning. SME1 considered the inclusion of values in the teaching of science as important. She wrote: “How

about including in victims of wars, conflicts – make them appreciate Malaysian peaceful society! [SME1.E.0D2.4]” She also requested that a section for students’ reflection on life, or personal action, be included [SME1.E.07.11].

SME1 was of the opinion that when only scientific facts is emphasized, science becomes “dehumanized”. Furthermore, in social learning “the human factor, how these things are related to our human inter-relationships, is emphasized whenever there is an opportunity in a very natural way (SME1.INST5.45)”.

When interviewed, SME1 also felt that in the school textbooks, values in science education were inadequately presented.

...Our textbook writers lah, they try to include values, in a purposeful way, and in the end it is not natural. But of course I think they are constrained by ...uh, requirements of the syllabus, that they must put in and it looks very artificial and unnatural. So I think sometimes it comes back to how you are suppose to present the relevant values, so that that things is absorbed and rubbed on, and not like, oh, force it down somebody’s throat (SME1.INST5.45).

When asked whether children of that age should have values incorporated in science education, SME1 felt strongly that it should as “I think that they are old enough. Children of Form 2 age, I think, there are certain things they know, if they have read widely enough, I think they can process some of these information. And come up with their own (SME1.INST5. 45).”

SME1 shared how her daughter who was also Form 2 described teachers she liked.

She says she likes this teacher because this teacher always tells them about how all these scientific things affect our lives, {so that’s how I}

so that means children, sometimes they like to relate, you know (SME1.INST5. 63).

SME1 related values in science with meaningful learning and suggested different scenarios to discuss in the questions. She felt that values in science were important but were not adequately covered in the science textbooks. She was of the opinion that teachers should relate science to everyday life and values, even at Form 2 level, for meaningful and interesting science.

SME2 insisted that the questions should cover content in the syllabus only [SME2.E.OD.4]. SME2's zeal in ensuring that the questions complied with the syllabus is shown in the following anecdote.

Three days after receiving the documents to be evaluated SME2 telephoned the researcher and excitedly informed the researcher that the questions in the document were not according to the syllabus, stating: "Your questions are not direct in syllabus (SME2.INST5.31)." When the evaluated documents were returned and analysed two weeks later, SME2 had identified several discussion questions which she considered not in the syllabus. When interviewed, SME2 cited her reasons for the cases.

For "complete food" for flood and famine victims: "... 'complete food' is never mentioned at all in the class (in Question2). In the textbook 'milk' is mentioned, but this is actually wrong also as milk has no fibre. Not complete also ...Victims of famine and flood (in Question 2) is never referred to in school (SME2.INST5.80)."

For vegetarian and other special diets: "Ha this one we don't teach so much. Just mention be careful and respect people. Don't serve certain

food. It's good (Question 1) but extended from the syllabus. Like I mentioned good for vegetarian to know, make sure their diet is balanced (SME2.INST5.88).”

For victims of natural disasters and poverty: “Question 2, we don't mention this in class (natural disasters, poor, underprivileged) (SME2.INST5.91).”

SME2 seemed adamant about not including irrelevant knowledge in the instruction. Items related to values or interesting facts were noted as not being in the syllabus.

However, some items which SME2 had identified as not in the syllabus in the documents, was later accepted and labelled “should know.” In the following example, she explained:

This one actually we never discuss Atkins' diet or vegetarian diet. But it (the question) is good. Especially so many people are vegetarian. In my school, so many vegetarians, they should know whether it is balanced or not. So can. It's in the syllabus (SME2.INST5.76).

SME2 seemed to relent in some cases which were related to everyday life and on a personal basis. Hence, after considering that SME2 was strictly “confined to the syllabus,” and yet accepted certain items that students should know, the researcher decided to include items which had potential for meaningful learning in science. In addition, these items provide an opportunity to infuse values in science.

The researcher agreed with SME1's opinion when she said:

I am not preparing students for exams. So, I, I am more idealistic in the sense that I want students to learn in a fun way, that they will enjoy learning and not doing it as a very heavy task, probably for

exam (sad, and miserable), (laugh), I think they have enough of it from the teachers. From the teachers, from their parents, they have enough of it, so if this time since you are asking them to help you with your studies, it is good to give them something interesting, at least it is like a reward to them (laugh). Make their time worth, you know (SME1.INST5.135).

In general, providing meaningful learning was important for science instruction. In addition, it complied with Merrill's First Principles of Design which was used for the instructional design of the module, where the activation of prior knowledge is one of the components. Hence, the design will emphasize meaningful learning by incorporating values in science at the same time.

Another relevant learning theory was brought up by the technical expert, TE2. She was of the opinion that there were different types of learners who had different preferences for learning. In addressing these different learners, TE2 suggested the theory of multiple intelligences be considered in developing the module for the learning environment.

...Some they (learners) prefer writing. Over here we can apply this theory, the seven intelligences? Ya, Multiple Intelligences. Some they want to talk to you (TE2.INST5.129).

Based on the theory of multiple intelligences, teaching and learning materials should not only be limited to text, but include videos, some with music, and even interactive exercises. Hence, in the design of the module, consideration was made to include the multiple intelligences theory.

In the design of the module which was based on the social constructivist theory, the aspect of meaningful learning of science and multiple intelligences were

considered. Opportunities to provide meaningful learning included incorporating values in science education, and the materials for the module took into account the multiple intelligences theory.

The area which seemed to be of importance to the experts was the area on instructional issues. Four instructional issues were identified: the use of simple language for instruction, the accuracy of content, instructional needs of the learners, the large number of assessment questions, and the inclusion of learning theories. These issues were discussed and have been incorporated in the design of the module.

Collaborative Online Environment

The third area of concern after management of the module and instructional issues was on the collaborative learning environment. This online environment was familiar to the technical experts, but not to the subject-matter experts.

The technical experts, TE1 and TE2, had experience in using web tools for learning and were familiar with online discussion forums and collaborative work spaces, or wiki. The evaluation of the technical aspect was done based on the design documents.

The findings show that the technical experts were concerned on four aspects: the language and rules for instruction in the learning environment; the freedom of choice in learning; the importance of peer and face-to-face discussion; and the evaluation of online discussions.

Language and Other Rules for Learning Environment

From the aspect of instruction, accurate grammar and spelling are important in presenting instructions and content for the tasks. On the other hand, the learners were not expected to have accurate grammar and spelling when attempting the tasks given.

When interviewed, the experts agreed that the solutions and answers to the tasks need not have accurate spelling and grammar. TE1 was of the opinion that if the learners had to have accurate grammar and punctuation when answering questions, the tasks will take longer to complete: "...when they want to {er} write something, they will (have to) think about it. If they make sentences, they think {and longer} and take (a) longer time (TE1.ENVR1.48)."

The rationale of not stressing on accurate grammar was mentioned by TE1: "The ideas flow, the idea's out (TE1.ENVR1.53)." TE1 felt that the flow of ideas would be interrupted if language was emphasized. This seemed to be the case for TE1 who even though she herself did not express herself in accurate spoken grammar, she still managed to get her ideas across. This verified the fact that accurate grammar was not important when learners expressed themselves.

Even though both the experts agreed that participants should not be penalized on the inaccurate use of language, both also strongly agreed that the rules for the learning environment had to be stated clearly.

Yes. Inform rules for the learning environment. Yes, you have already stated there. It is there. Inform the rules in learning environment. Ah, their rules, ah (pause a while). You have stated, huh. Like online, no, this one is the evaluation, but over here, somewhere here (TE2.ENVR 1. 37).

In both the documentation and during the interview, the need to inform the learners of the rules in the learning environment was an aspect that was brought up by the technical experts. This was related to the inclusion of whether accurate use of the English language was required and was considered important as it enabled the learners to know what was expected.

Freedom of Choice for Personalizing Learning

The second aspect in the collaborative environment was the freedom to personalize the learning experience. The importance of having children negotiate and make choices in learning for personalizing learning was mentioned by the technical evaluators.

However, TE1 pointed out during the interview that the areas that learners could negotiate on should be stated in the guidelines: “You didn’t mention negotiate on (what areas), but there is freedom (to) let them to discuss (TE1.ENVR.2.64).”

This was supported by TE2 who mentioned that these areas that could be negotiated were suggested in the documents: “What they can negotiate on: yes, you have mentioned, if they cannot come for the class, they can, like, contact you, or they can ... it is synchronous and asynchronous (TE2.ENVR 2.41).”

It was decided that the module should have more specific details and guidelines to ensure that the participants were clear on what items could be negotiated on.

Peer Discussion and Face-To-Face Meetings

The third aspect in the collaborative environment was the importance of face-to-face meetings. Both technical experts considered face-to-face meetings important during the course of the module.

TE1 suggested that opportunity for peer discussion should also be given during the face-to-face meetings: “Then for the meeting, face-to-face with children, right? Maybe you can suggest peer to peer discussion, not just instructor must be there. Face-to-face meeting. Yeah, what they learn, then what they want things to be (TE1.ENVR3.100).”

In her opinion, TE2 was sure that there would be problems in the initial stages. She suggested that more face-to-face discussions should be arranged in the initial stages.

(face-to-face meetings at) First and last (session). So, I felt like maybe, after err, two sessions, you may, you may have another face-to-face session to trash out certain things, the teething problems. They definitely will (have teething problems). Ya, beginning. That’s why I said you have 2 or 3 or 4 weeks, huh. What I am trying to tell is have another face-to-face session either after the second or third, but according to the requirement lah. According to the progress, uhh? Have more lah.. to overcome any teething problem. (Wrote on document). Have more to overcome, teething problem (TE2. ENVR3. 101).

During the interview, the researcher suggested that online help be provided at all times and enquired whether that was sufficient. TE2 was not satisfied:

Do you think all of them will want to voice out through online? But some they may not be so open. They'll feel like, their grammar, their language is not good. They may have language problems communicating. I'll put in, huh (TE2. ENVR3. 112)?

Online help to solve the problems was not an option. This was because according to TE2, learners might not ask for help online, and hence are not able to get attention. However, TE2 suggested having more face-to-face meetings:

And you can establish a rapport with them as well. Then can see you personally and have a kind of rapport. Sometimes, they see you as a person, the other side, behind the... some where there (laugh). So they get to know you better. Like, even our own lecturers also, if we were to be online ...maybe the rapport would be bad (TE2. ENVR3. 118)?

Face-to-face meetings enable the tutor to establish a more personal relationship with the learners, and to identify their individual needs.

Hence, in the design of the collaborative mLearning environment, more opportunities were given for face-to-face meetings, where peer discussion is conducted.

Evaluation of Online Posts

The final aspect in the collaborative environment that was brought out was the evaluation of the comments, answers and other items posted online. In the documents given to the experts, the evaluation of online discussions was based on the quality of the postings.

However, TE2 suggested that the quantity of the postings should be evaluated as well. "Has consideration been made to evaluate the quantity, or quality of posting?"

In fact, you didn't really tell the quantity. This one you didn't mention (TE2:ENVR 4.86).”

TE2 suggested that the quantity of the postings be included in the evaluation. TE2's experience showed that learners are not encouraged to post messages unless these were evaluated. Hence, both the quality and quantity of the posts were considered in the evaluation of the online discussions.

In general, the technical aspects of the collaborative mLearning environment was discussed: the language and rules for instruction in the learning environment was clearly stated; the freedom of choice that was given to personalize learning explicitly stated; the importance of peer and face-to-face discussion stressed upon; and evaluation of online discussions to include the quantity and quality of the posts. The suggestions made were incorporated into the design and will be discussed in the later section.

Instructional Tools

The final area of concern was on the technical aspect: the use of instructional tools in the learning process. Several tools were mentioned specifically by the experts in the evaluation: the web-based materials, graphic organizers, and text messaging.

Web-Based Materials

Firstly, the home page for the module was provided for the experts to view. However, only the technical evaluators had suggestions on the web-based materials. The suggestions given were on two different technical aspects: the design of the web page, and the inclusion of other web-based materials such as videos and graphics.

Design and colour of web page

TE1 noted on the design and colour of the web page on her documents. She also voiced her opinion during the interview that the webpage should be more colourful and related to food to attract young people: “For the website; the background, the background should be more pertaining to food lah, ok, to food or nutrition, more colourful (TE1.TECH1.1.107).”

TE1’s experience with young learners, as she had teaching experience in the primary school level, might have influenced her opinions. However, her opinion that there should be more graphics related to food was taken into consideration.

Use of videos and graphics

The second area on concern related to the links in the homepage was on the use of videos and graphics.

During the interview, TE2 recommended that more video and graphics be used for instruction: “Have list of software, like video, graphic all will be a mode, or medium (TE2.TECH1.2.53).”

TE2 seemed to prefer visuals and interactive materials to text. Her suggestion that the websites with videos and other activities be listed as links in the homepage was taken into consideration.

Both the suggestions related to the presentation and materials on the webpage. More graphics related to food were to be added in the webpage and on the online discussion forum. Videos, graphics and interactive software were sourced for instruction.

Graphic Organizers

In the design documents, one of the assessment tools used for organizing learning were summarizers in the form of graphic organizers.

The graphic organizers used appealed to the subject-matter experts: “I like this one, this one where you did the graphic organizers (SME1.TECH2.115).” As an activity, it was considered interesting: “In a way, it is quite interesting. The activities, I mean. There is summary, there are questions. At first, I thought there were only questions, but you have summary also. However, the element of interactivity could be put in place (SME3.TECH2.29).”

The advantages of graphic organizers in assisting learners in organising their learning, was pointed out by SME1.

Ah, ah. Some kind of organizer. So, this kind of thing {ah}, it will {like, uh} help students to organize materials, their thoughts, and in organising it, I think it will help them to process it in their minds.

Maybe I am biased because I am more towards, information processing model of learning. When I see this kind of things, I say, oh, this is very good for students too. When they classify things, they are processing the information. And they are getting an output from the raw input. So I like this kind. I think this is {uh} something that {ah} if they did it on paper {ah} they can also check it from textbook. Our textbook don't give this kind of exercises. But because you are doing in it online, and your multimedia system can give feedback; that is very helpful. This is where the classwork is {very} I would say, it is different from textbook (SME1. TECH2. 117).

The advantage of graphic organizers as summarizers to organize the learners' thoughts was documented. However, an interactive graphic organizer is considered for interactivity to engage learners as they attempt the activity.

Text Messaging

Text messaging was one of the tools used for instruction. The findings centred on two aspects: the advantage of using text messaging for alerts, and the effective design of text messages.

Text messages for alerts

In the documents, quiz questions were sent by text messages after each lesson in the module. In addition, text messaging was used for conveying instructions, and other forms of communication to the learners.

Based on the documents, TE1 was of the opinion that the one of the items in the syllabus, the need to establish office hours for learners to go online, was not relevant.

Actually with using SMS, internet, no need for office hours, right? Except depends on the instructor. The students can receive SMS. So they know that when you put up a discussion online, they will receive SMS. There's email, or something they have to read in the internet, in a discussion forum (TE1.TECH3.84).

Text messages could be used to inform learners of new developments, or when new information was posted immediately. As such, TE1 felt that there was not any need to have a date for meetings online, as information could be sent through text messages.

However, the fact that learners might not have access to mobile phones at all times was taken into consideration. Hence, it was decided to have a fixed meeting time, and post text messages on notices.

Length of text message onscreen

In the documents, there was no example of the screen display for text messages. The design of the text messages which was viewed on the mobile phone's screen was brought up by one technical expert.

SME1 noted that long text messages may not be suitable for smaller screen displays of the mobile phone.

Hm, (Nod), because you are not only asking question, you are also giving them extra tit-bits kind of information. But there's a lot of things to read. Cause they are still giving you information, interesting information. But you reduce, you also reduce content. So, I don't know where you are going to balance it (SME1.TECH3.2.155).

Even though the text messages might be long in the text message quiz, there was also interesting and meaningful information for the learners. Hence, a balance

between the length of text and interesting information given had to be found in the text messages.

The results show the concerns on the technical aspects of using some of the instructional tools were raised by the experts regarding web-based materials, and text messaging. These concerns were considered in the development of the collaborative mLearning module.

Summary of Experts' Opinion for Design

In general the experts raised concerns on the following areas: (a) the management of the module, (b) the instruction of the subject, (c) the online collaborative group environment, and (d) instructional tools, as in Figure 5.1.

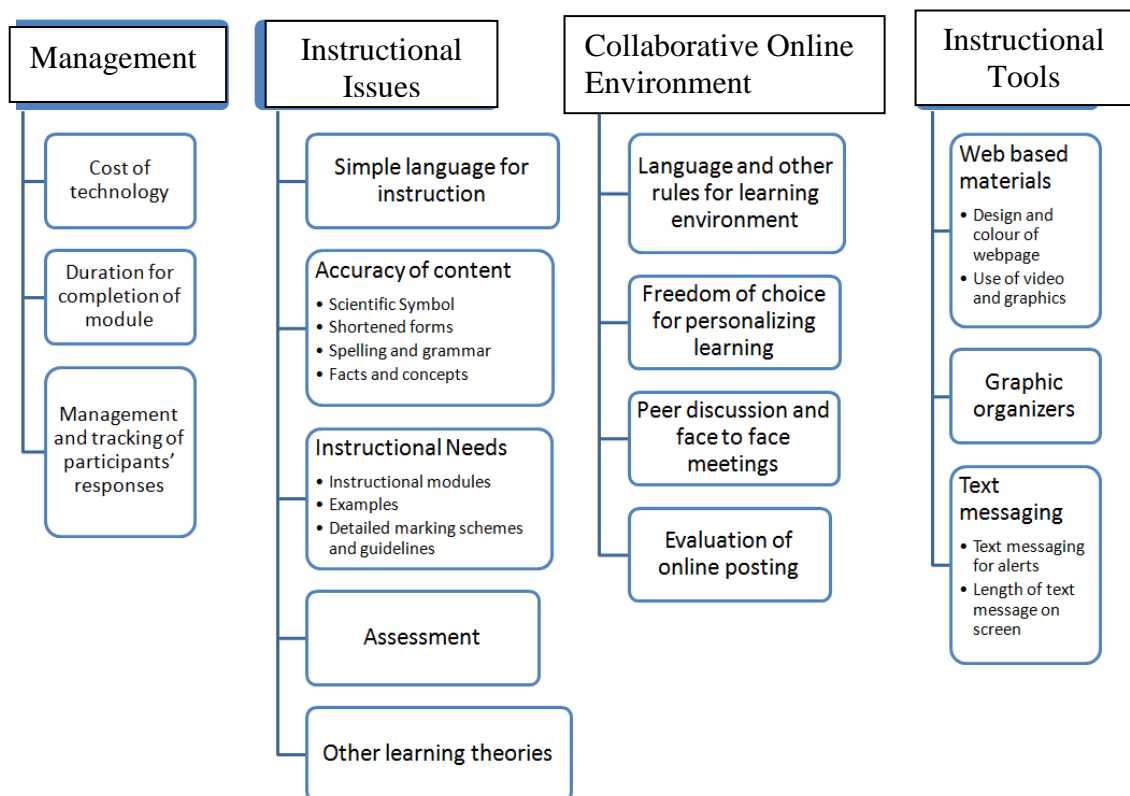


Figure 5.1. Summary of experts' opinion

Experts from the MOE seemed to have more experience in management of online courses and modules. The technical expert from the MOE had expressed concern for the cost and maintenance of the equipment, while the subject matter expert from the MOE expressed concern on the feasibility of the project and the management of large amounts of data.

The subject-matter experts' opinion dominated the area of instructional issues. While two of the subject matter experts were very particular on the accuracy of content, the other seemed to have a wider outlook and concentrated on understanding broad concepts. Some contradictions arose in the views of two subject-matter experts, both experienced teachers: SME1 emphasized meaningful learning and infusion of values in education, but SME2, was very exam-orientated, and was constantly restricted by the syllabus.

The technical experts' strength was on collaborative mLearning environment as they were familiar with the technology used. They were aware of the various technology-related learning tools and could suggest improvements and issues to consider in the use of these technology tools.

The experts' contributed to the design of the collaborative mLearning environment by expressing their opinions on four main areas as summarized in Figure 5.1. The design issues were be incorporated for the development of the collaborative mLearning module.

Development of the Collaborative mLearning Module

Based on Experts' Opinion

The development of the collaborative mLearning module, took into account the areas of concern. In this section, the actions taken to resolve the issues raised in the development of the collaborative mLearning module are discussed according to following areas: the management of the implementation of the module which includes the equipment, technologies for delivery of materials and interaction; instructional issues related to the design of the module; the collaborative mLearning environment; and the interactions during the implementation of the module (Moore & Kearsley, 2005). The summary of the action taken on the areas of concern is summarized in Table 5.1.

Management of the Module

The management issues on the cost for the usage of the technology during the implementation of the module, the delivery system for the module, and the management and tracking of the participants' responses during the course of study is addressed.

Cost of Equipment and Usage

In this study, the only costs incurred were related to the cost of purchasing and the usage of the equipment for the delivery of instruction through the internet and text messaging.

The costs related to the equipment used during the implementation of the module is on two aspects: capital costs, in purchasing mobile devices for text

messaging and computers to access the internet; and operating costs to cover the cost of text messaging, and accessing the internet.

To address the issue of capital costs in this study, the researcher invited students who had access to mobile phones and computers with internet access to participate in the study. However, participants who did not have the equipment and were interested were provided with mobile phones with text-messaging functions, and access to computers. All participants were invited to utilize the computers in the school specialist rooms. In addition, laptops with internet access were made available during the face-to-face meetings with participants.

The instructional material developed was hyperlinked to videos, interactive materials, and additional websites on the internet. The delivery of the instructional material was through freeware on the hosting website, as well as free online discussion forums and collaborative workspaces. Hence, no costs were incurred for software.

During the implementation of the module, the researcher reimbursed operating costs for participants' use of both the text messaging function and telephone calls. However, the details of the communication had to be recorded in the participants' journal for claims to be made.

Hence, during the implementation of the study the cost was minimal and related to the operating costs for the usage of equipment in delivering content.

Technologies for the Delivery of Materials and Interaction

The delivery of materials for instruction and interaction was mainly through computers with internet access, and mobile devices through text messaging and telephone calls. Print media, in the form of a User's Guide was used.

Computers with internet access were required for the delivery of content materials and for interaction between the participants and facilitator. The web-based technologies used are as follows: (a) the collaborative mLearning for Form 2 Nutrition on the *Freewebs* website for accessing instructional content, (b) the online discussion forums, *Yahoo groups* for discussions, and (c) the collaborative work space on the *Freewebs* wiki for group problem-solving tasks.

Mobile devices, or mobile phones were used for text messaging and telephone calls. The text messaging function was managed with a text messaging system, *Mobile Connect*.

The User's Guide, in print media, showed the guidelines for participation in the activities in the module, the marking schemes, and list of activities for the module.

A description of the technology tools used in the delivery of content for interaction between learners and facilitator on the computer and mobile device follows.

The collaborative mLearning website for Nutrition

The collaborative mLearning website for Nutrition was developed on *Freewebs*, a free website design and hosting tool. This website was the homepage to access the discussion, assessment and other tools for learning.

In the website, instructional modules, according to the experts' recommendation, were included in the *Lessons* page. Content was developed for each lesson and the learner was given an option to access the content if required. Figure 5.2 shows the list of lessons in the *Lessons* page.



Figure 5.2. List of lessons on collaborative mLearning module

The online discussion forums, Yahoo groups

On the collaborative mLearning website for Nutrition on *Freewebs*, a link to an online discussion group forum, *Yahoo groups*, was provided. Most of the learning activities were in the form of group discussions in the *Yahoo groups*. A link to the discussion forum was provided on *Links* on the collaborative mLearning website for Nutrition on *Freewebs*.

To access and participate in the discussions in the online discussion forum, *Yahoo groups*, the participant had to sign up as a *Yahoo* user. Only with a *Yahoo* email account, the user could apply to join the *Yahoo groups* for “Nutrition Form 2” (see Figure 5.3). The online discussion forum, “Nutrition Form 2” in *Yahoo groups* was created and moderated by the researcher. The participant’s application to join as a member of the *Yahoo groups* has to be approved by the group moderator. On approval, the user of the *Yahoo groups* could post messages and access the files in the group.

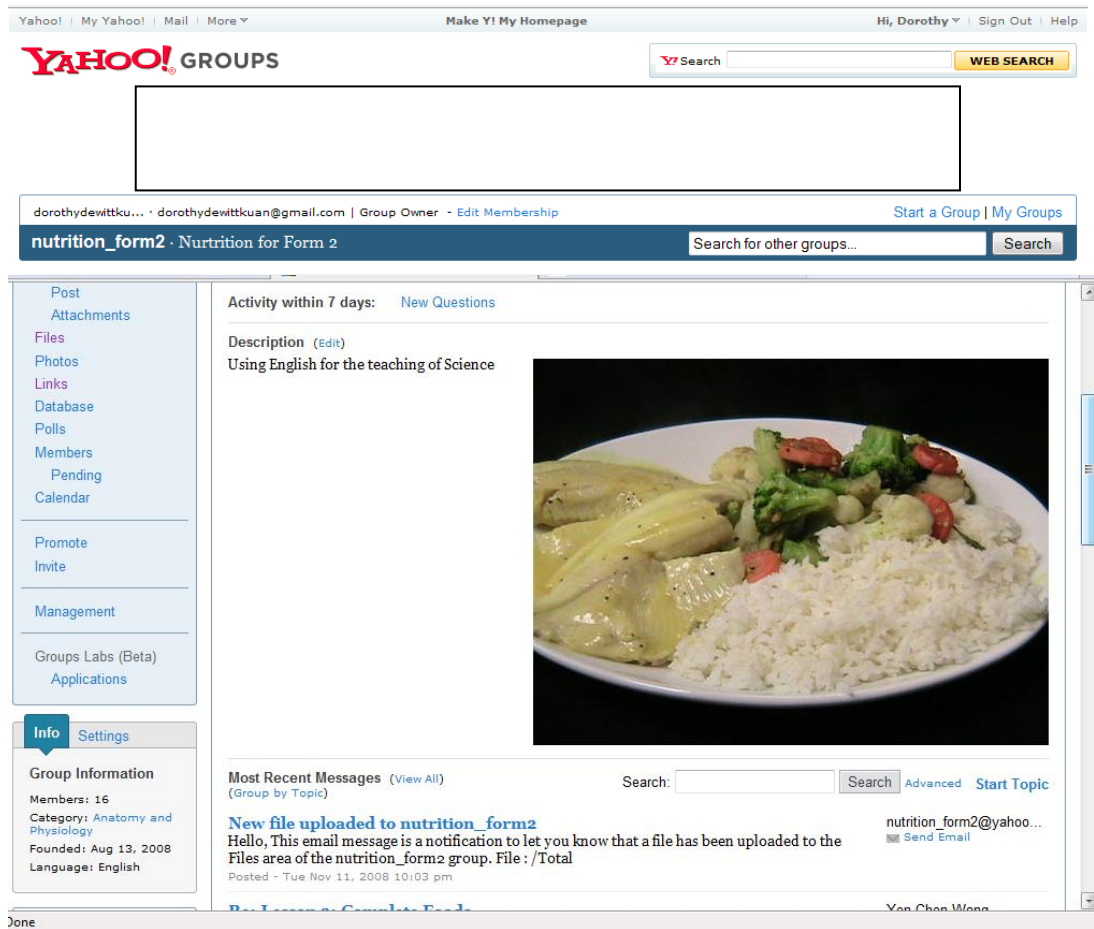


Figure 5.3. Screen capture of home page on Yahoo groups

The collaborative work space on the Freewebs wiki

On the collaborative mLearning webpage for Nutrition on *Freewebs*, a wiki page for collaborative work was developed. This was a feature of the *Freewebs* and for the purpose of the group problem tasks in this module the page was called *Group Wiki*.

In order to use the collaborative work space, or *Freewebs* wiki, the user had to request to be a member. However, no approval was required and the user could use the wiki feature immediately. The *Group Wiki* was meant for contributions from group members to the group problem-solving tasks. The wiki was easy to use and

edit and was organized under the *Wiki Navigation* on the *Group Wiki* page (see Figure 5.4).



Figure 5.4. Screen capture of *Group Wiki* page in *Freewebs*

The text messaging system, Mobile Connect.

The text messaging system, *Mobile Connect*, was provided by the service provider for the broadband internet connection used in this research. The *Mobile Connect* system is a tool to send and receive text messages.

The data from the text messages was easily captured and extracted through the *Mobile Connect* System shown in Figure 5.5. In addition, the messages were created and copied electronically: text from another electronic file was copied into the system; and the contents of the message received, copied and pasted into a separate file.

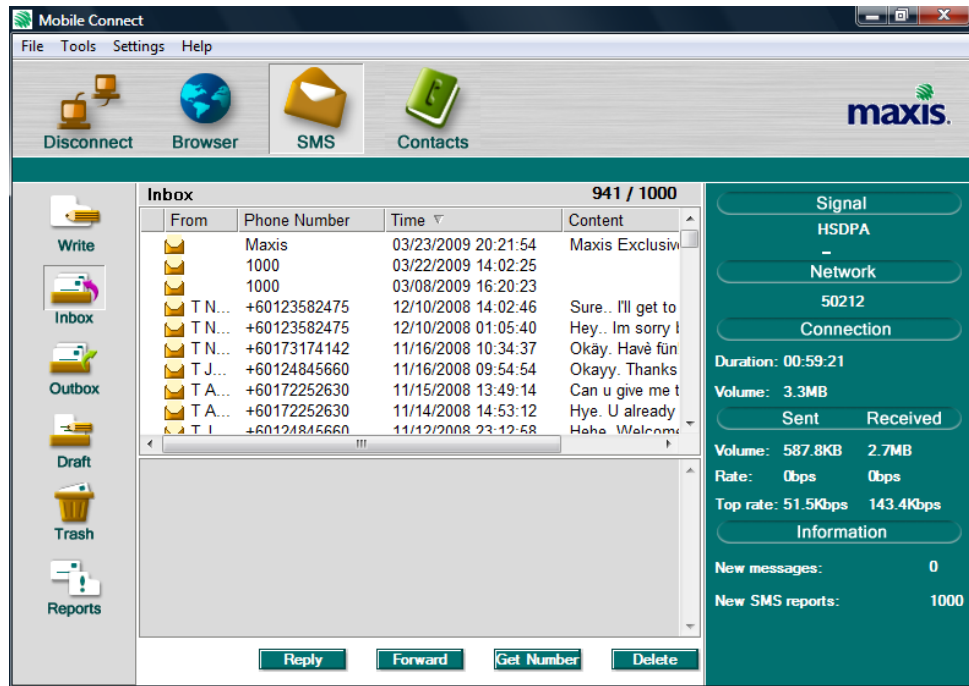


Figure 5.5. Screen capture of text messaging system, *Mobile Connect*.

To summarize, the technologies for the delivery of the instruction for the collaborative mLearning module addressed some of the issues raised by the experts related to the management of the interaction in the collaborative mLearning environment and the delivery of the instructional content.

Management and Tracking of Participants' Responses

In the implementation of the module, a large amount of data was expected from the participants' responses through the text messages and learning activities.

Firstly, data was expected to be collected from the responses to the text messages, both in the answers to the quizzes, as well as other enquiries and comments. This data was captured through *Mobile Connect* system for text messaging as the system could store as many as a thousand messages of 160-character length at any time.

Secondly, there was data from participants' responses to the online tasks, and discussion questions, during the implementation of the module. The responses to the online tasks were viewed on *Group Wiki*, while the discussion questions, on the *Yahoo* groups. This data could be stored on these pages indefinitely.

In this study, the text messages stored in the *Mobile Connect* system was backed up as soon as possible so as not to lose the data.

In addition, the online discussion questions and online tasks were evaluated. The marks the participants scored individually and in their groups were recorded in a spreadsheet.

The text messages, and the marks scored by each participant and group were recorded in an *MS Excel* spreadsheet. The description of the tracking system using the spreadsheet is described in the following section.

Tracking using MS Excel spreadsheet

A template meant for capturing data related to the study was designed on *MS Excel*. The description of the two main types of data captured in the spreadsheet is discussed.

Firstly, in order to track the data through text messaging, a matrix was designed to capture the participants' responses to the quiz questions, and other communications in a *MS Excel* spreadsheet. The answers to the SMS Quiz were recorded into designated SMS Quiz answer columns. Other communications, which included participant responses and tutor's feedback, was recorded in a separate column in the spreadsheet.

The purpose for recording the answers from the SMS Quiz into designated SMS Quiz answer columns, as in Figure 5.6, was for the purpose of totalling the marks scored. In the spreadsheet, marks for correct responses to the SMS Quiz were

computed automatically using the “count” function. Participants’ correct responses, copied in the appropriate column for “correct” responses, earned one mark, while participants’ incorrect responses, copied in the “incorrect” response column, earned no marks. The total marks scored for the SMS Quiz in each Lesson was automatically computed.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1				SMS Quiz 1			SMS Quiz 2							TOTAL MARKS
2	No.	Name of participant		Correct	Incorrect	Other responses	Correct	Incorrect	Other responses					
3	1	Participant 1												0
4	2	Participant 2												
5	3	Participant 3												
6	4	Participant 4												
7	5	Participant 5												
8	6	Participant 6												
9	7	Participant 7												
10	8	Participant 8												
11	9	Participant 9												
12	10	Participant 10												
13	11	Participant 11												
14	12	Participant 12												
15	13	Participant 13												
16	14	Participant 14												
17	15	Participant 15												
18	16	Participant 16												
19	17	Participant 17												
20	18	Participant 18												
21	19	Participant 19												
22	20	Participant 20												
23														

Figure 5.6. Template for tracking and record of SMS Quiz for Lesson 1 in MS Excel

Secondly, data in the form of marks scored by the participants’ responses to the online tasks, and discussion questions, was captured in the spreadsheet. The worksheets in the MS Excel spreadsheet was organized according to “SMS responses according to Lessons,” and “summaries of marks in Lessons”. Data in the form of marks scored for the online group tasks and online discussions were recorded in the summary of Lessons spreadsheets as in Figure 5.7. Details on the marks scored for

each skill evaluated is displayed, and the total marks, as well as average scores, was easily calculated using formulas in the spreadsheet.

1	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
2	Name of participant	SMS Quiz	Discussion Q1			Online Task 1						Total	Aspects evaluated							
3	Participant 1		I	SP	IS	I	SP	O	A	PS	IS									
4	Participant 2																			
5	Participant 3																			
6	Participant 4																			
7	Participant 5																			
8	Participant 6																			
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21	Participant 19																			
22	Participant 20																			
23																				

Figure 5.7. Template for tracking and recording activities for Lesson 1 in MS Excel

The MS Excel files prepared were templates designed for the expected data. The input of the actual data during the implementation is discussed in the findings in the next chapter.

Design of Instruction in the Module

In the design of the instruction of the module, the aspects that were discussed are: the time required to complete the module, the resources for the instructional module, and the message design for the instruction.

Duration for Completion of Module

The concern regarding the large number of questions in the module, which might take longer to complete was weighed against the benefit of the activities in mastering the content. The learning activities in the module, which included online problem-solving tasks, online discussion questions, and SMS quizzes using text messaging, were maintained. However, the participants could negotiate the number of activities to be done.

In addition, most of activities required group participation. The online problem-solving task was assigned for group work. Group members could share the work involved when attempting the problem-solving tasks. However, the discussion questions were meant for individuals to answer. As it was a forum, there was interaction with peers and group interaction. Both these online activities could be accessed anywhere and at anytime, providing the freedom of access: at home, in school, at night, or during school holidays.

The SMS Quiz had to be completed individually. However, the quiz required short answers and could be attempted at anytime and anywhere. One limitation was that mobile phones were not allowed to be brought to school as part of the school regulations. Hence, the use of mobile phones for text messaging was limited to times when the participants were not in school.

The learning activities: the online problem-solving tasks, online discussion questions, and SMS quizzes using text messaging, did not have to be completed immediately, but deadlines were given. A specific time frame for completion of each activity was stated in the schedule of activity for the module.

In addition, the researcher decided to provide choices in the number of questions answered in the SMS Quizzes. In lessons where there were a large number of questions, the participants were prompted on whether they would like to continue receiving more questions. This allowed learners who liked quizzes to proceed and receive more questions, while learners who did not wish to receive additional questions, could discontinue.

To sum up, the experts did not disagree that there were too many questions but the design of the course incorporated the personalization of learning as participants were given choices. The participant can negotiate on the number of questions he wanted to complete, request for a longer time frame to complete the activities, as well as choice on when and where the activities were done.

Resources for the Instructional Module

Resources for the instructional module refer to materials used for instruction in the collaborative mLearning module. These resources were of differing functions: tutorials, learning activities, and websites for primary sources of information (Grabe & Grabe, 2004).

The collaborative mLearning website for Nutrition on *Freewebs* had instructional modules, organized into *Lessons*, as suggested by the experts. The organization of the lessons took into account the different methods of learning.

The instructional module for each lesson seemed to be mainly text, which used visual organizers. Important science terms were highlighted and bolded. Colour was used to group similar concepts: different shades of a similar colour to show related concepts.

The content was hyperlinked to other resources: websites that supplemented or provided primary sources of content presented in a different manner; videos, which provided sound, text, graphics and animation; animation and interactive tools, as tutorials with interactivity such as “mouse-over” on the labels for the explanation. The resources catered to different needs of learners. An example is Lesson 6: The Digestive System, in Figure 5.8.

Lesson 6: The Digestive System

Digestion is the breaking down of large food particles into smaller molecules that can be absorbed by the body. You can see a short video on digestion [here](#).

The **physical digestion** of food involves tearing, mincing and grinding the food into smaller pieces. This mechanical breakdown of food through chewing is done by the teeth, and through churning by the stomach.

The **chemical digestion** of food involves enzymes which breakdown the food into small molecules. Enzymes are proteins that help to speed up chemical reactions in the body. Enzymes involved in digestion are digestive enzymes.

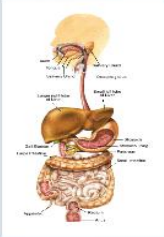
What happens when you eat a sandwich? [Click here](#) to go to an interactive site where you can go through the digestive process. The diagram may take some time to load, be patient! Then you can see the processes that occur in each part of the digestive system by clicking on the arrows.

First food enters the **mouth**. Two types of digestion happens here! Then the food is **pushed down** the throat, through the **oseophagus** in the process of **peristalsis**, into the **stomach**. After some time in the stomach where churning and chemical digestion occurs, liquid food passes into the **duodenum** for more digestive processes to occur. The food then passes through the **small intestine**, where the small molecules of food is absorbed and the balance goes through the **large intestine**, where water is reabsorped, and the rest, or feaces is removed through the **anus**.

In summary, food flows in the alimentary canal as follows:

mouth --> oseophagus --> stomach --> duodenum --> small intestine --> large intestine --> anus.

Can you identify the parts of the alimentary canal in the picture below. [Click on the picture](#) to enlarge the diagram.



[Back to Lessons](#)

Figure 5.8. Instructional Module for Lesson 6: The Digestive System

The resources for learning were also provided for the learners to access on the *Yahoo groups*, in the *Links* section.

The accuracy of content related to the instruction was given high priority as recommended by the experts. The recommendations related to use of simple language for giving instructions, and the accuracy of the content with respect to accurate use of scientific symbols, shortened forms or abbreviations, grammar and spelling, and accurate facts and concepts, were accepted. The experts' recommendations were taken and all efforts were made to check for language and accuracy in the development of the module, and in the selection of the resources used.

Message Design

In the collaborative mLearning environment, messages were used in the following: (a) delivering the instructional content on the collaborative mLearning for Form 2 Nutrition on the *Freewebs* website, (b) posting discussion questions on the online discussion forums, *Yahoo groups*, (c) posting comments and tasks on the collaborative work space on the *Freewebs* wiki, and (d) posting text messages for the SMS Quiz. Hence, message design refers to the design principles involved in the different messages in the various delivery systems.

Instructional content on the collaborative mLearning for Form 2 Nutrition on the *Freewebs* website was designed using the principles of web design (Sklar, 2006). Information was present in a clear and simple manner, ensuring the accuracy of the information. In addition, hyperlinks were used to connect to different resources on the web. The design catered to a computer monitor screen display, as participants access the website using computers or laptops, and not mobile devices.

The discussion questions posted on the online discussion forums, *Yahoo groups*, were open-ended questions, meant to encourage discussion. Palloff and Pratt (1999) suggest that the messages be fun and interesting to draw participants into the discussion. Hence the role of the facilitator in maintaining the interactions in the online discussion was important.

The tasks on the collaborative work space on the *Freewebs* wiki should also interest and encourage the participants to participate and be willing to contribute to the task.

Learning theories

The study is based on the social constructivist theory of learning. The learner is provided scaffolding through the zone of proximal development, and as the learners become more experienced, the scaffolding is gradually decreased.

In addition, the values in science education for meaningful learning was prioritized and taken into consideration during all activities and discussions, both online and offline. Meaningful learning (Ausbel, 1963) occurs the learning experiences are related to the learner's prior knowledge, and when personally relevant tasks are used (Grabe & Grabe, 2004).

Text messaging

The experts' concern on the use of text messages to convey information for learning to be effective was valid. At this moment in Malaysia, there has not been much research done in the area of message design for the mobile phone.

In this research, text messaging alerts was used to inform learners of new developments, or when new information was posted. Besides that, text messaging was be used for conveying quiz questions, instructions, and other bits of information.

In the message design, the information conveyed, and the length of the text message were important considerations for learning. The advantage of using the *Mobile Connect* system for composing text messages was that the length of text messages created was limited to 160 characters only (Figure 5.9). This translated to nine lines, or two screen displays on a standard mobile phone display. Messages which were longer than 160 characters were chunked into two messages.

This system assists in addressing the concerns by the subject matter experts on the length of the text message. In limiting the number of characters, it ensured that the messages were not too long, and yet conveyed important information. The text messaging quiz which consist of some interesting and meaningful information, and a quiz question. If the content was too much, the Quiz was divided into two messages and sent separately.

An advantage of this system is that it counts the number of characters left in the message as the message is created. The designer can then plan the display of the message, and whether two messages is required, as well as when to end the first message, or to proceed with the next sentence or idea.

Hence, in the design of the module, opportunities to provide meaningful learning, and infuse values in science education, were maintained in the problem tasks and activities. In addition, links to materials that included various media, and interactive software, in an attempt to cater for the different intelligences.

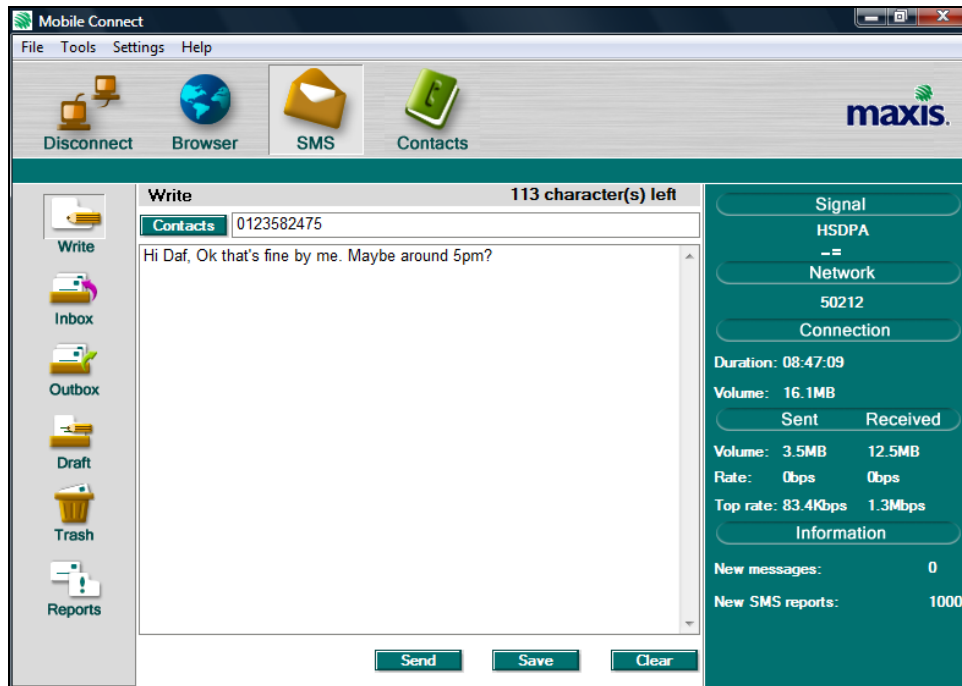


Figure 5.9. Screen capture of text messaging feature

The Collaborative mLearning Environment

The learners interact with the instructional materials, their peers and facilitator in a collaborative mLearning environment. The environment is mainly online and mobile, but face-to-face meetings are conducted for orientation and at weekly sessions.

The mobile environment consists of: (a) the collaborative mLearning for Form 2 Nutrition on the *Freewebs* website, (b) the online discussion forums, *Yahoo groups*, (c) the collaborative work space on the *Freewebs* wiki, and (d) the text messaging system and telephone calls on the mobile phone. Learning in a mobile environment meant that the learner can access the materials anywhere: not necessarily in school but at home, a friend's home, at cybercafés, or even when travelling.

However, during the implementation of this module, there were weekly face-to-face meetings in school to discuss problems that the learners might be facing in the use of the module. These meetings were held in a room conducive for discussions and group work.

Guidelines for the Learning Environment

In the collaborative mLearning environment, the needs of the learners were taken into account. More guidance and explanation was given in the initial stages.

The participants were informed of the rules in the collaborative mLearning environment during the initial orientation meeting. The rules and guidelines were available in the User's Guide provided to the participants. These rules and guidelines were clarified and explained before implementation of the module and the choices that learners could make or negotiate with the facilitator were stated.

In the instructions and tasks given, scaffolding in the form of more examples was given to ensure that instructions for the tasks and questions were understood. The marking scheme was provided in the User's Guide.

The collaborative mLearning environment was a combination of a mobile environment, with regular face-to-face meetings. In order to participate in this environment, certain rules had to be adhered to and several choices made. These rules and choices to personalize learning in the collaborative mLearning environment were explained to the participants.

Interaction in the Collaborative mLearning Environment

The nature of collaborative learning requires interaction between learners, but the mobile aspect of learning is addressed when technologies are used to assist this interaction.

The interactions in the collaborative mLearning environment include learner-task interaction: participants answering discussion questions; and learner-learner interaction: participants observing, commenting on other participants' answers, and attempting problem-solving group tasks online. Learner-tutor interaction occurred when the facilitator monitored the group, provided scaffolding by giving examples, and guided learning.

Face-to-face meetings were held weekly to assist and guide learners in their learning activities and to answer their queries on both the problem-solving tasks as well as in the use of technology. At the same time, peer discussion could also be carried out during these meetings.

The evaluation of online discussions included both the quality as well as quantity of online work.

Table 5.1

*Addressing the Areas of Concern in the Design of the Collaborative mLearning**Module*

Area of concern	Issue	Implementation
Management of the module	Cost of equipment and usage	Leverage on ICT hardware (computers and internet) available in the school. Participants used own personal mobile phones. Participants who did not own a mobile phone were provided one for use in the study.
	Technologies for the delivery of materials and interaction	Internet access through portable means: wireless broadband modem, and text messaging through mobile service provider of wireless broadband. Alternative print materials available in the form of Student's Guide. Delivery of content through online module which consists of: <ul style="list-style-type: none"> • The collaborative mLearning website • A collaborative work space, or wiki for problem solving tasks • An online discussion forums for discussion questions • A text messaging system for SMS Quiz
	Management and tracking of responses	Tracking done on MS Excel spreadsheet designed to summarize responses and total scores for summary of marks for each participant.
Design of instruction in the module	Duration for completion of module	Many questions were provided as design of the course provided for individualization of learning Choices were provided for participant to negotiate the number of questions answered, the time frame to complete the activities, as well as when and where the activities were done.
	Resources for the instructional module	An instructional module was provided online on the collaborative mLearning module's webpage. Hyperlinks to primary sources of content with interactive and graphical features.

Table 5.1 (continued).

Addressing the Areas of Concern in the Design of the Collaborative mLearning

Module

Area of concern	Issue	Implementation
Design of instruction in the module (continued)	Message Design	Principles of web design and principles of text message design were taken into account. Facilitator guidelines for interaction Based on learning theories
The collaborative mLearning environment	Environment	Anywhere: in school, at home, friend's home, at cybercafés, or when travelling. Weekly face-to-face meetings in school.
	Guidelines for the Learning Environment	Rules for participants in Student's Guide
	Interaction in the environment	Facilitator guidelines for interaction and scaffolding

Summary of the Development Phase

The collaborative mLearning module uses mobile web-based technologies for delivery of learning. The collaborative mLearning module for Form 2 Nutrition on the *Freewebs* website provided instructional content, and links to other pages. Secondly, the collaborative work space on the *Freewebs* wiki is for attempting group problem-solving tasks. Thirdly, the online discussion forums, *Yahoo groups* are important for discussion questions on the topic. Finally, text messaging on the mobile phone is used for delivering SMS Quizzes, and other interactions.

The design and development of the module took into account the issues on management; instruction; the environment; and interaction (see Table 5.1). In general, the information gathered from the experts contributed to the design of learning in a collaborative mLearning environment. The collaborative mLearning module was then implemented with a selected group of participants and discussed in the next chapter.