CHAPTER 7

DISCUSSION AND CONCLUSION

This chapter deals with the summary of the present study. The research methodology and findings that relate to the conclusion is discussed and related to theory. The next section is the implications of the study, followed by the limitations, and suggestions for further research, and finally the conclusion.

Summary of the Study

This study has provided evidence that a collaborative mobile learning module developed for teaching of 'nutrition' topic in Form 2 Science subject could be used effectively for learning science. The module was designed to address the needs based on the analysis of a group of Form 2 students in a selected school in the Klang Valley. A developmental research approach using the phases of analysis, design and development, and evaluation, was employed for the module. The research questions in the analysis phase reviewed the situation with regards the students' perceptions of technology use, while in the design and development phases, information gathered from experts during formative evaluation was used for improvement of the design of the module. Finally in the third phase, the students' perception of the activities, tools and difficulties as well as the collaborative mLearning during implementation of the module was described.

In order to answer the research questions, different methods of data collection was employed. For the first phase, data was collected from a survey of the Form 2 students in a selected school, and from the analysis of several documents. In order to answer the research question in the second phase, written records, a

checklist, and interviews were conducted with a team of five experts in the subject matter and technology. Finally in the third phase, data for the fourth, fifth, and sixth research questions was collected from various sources such as online communications records, journal records, interviews and surveys.

In the first phase, the analysis included a survey of the technology usage of 158 Form 2 students in a selected urban school in the Klang Valley. The respondents perceived themselves to be skilled in the usage of mobile phones, but averagely skilled in the usage of computers. The majority of the respondents had access to mobile phones, but fewer had access to computers. Phones were used frequently for communications via discussions and text messaging. In addition, information search tools on the internet were used frequently. Online discussion tools were also used for learning, especially for sharing information and files The respondents also believed that computers were important for learning and were motivated to learn with computers. However, the respondents were not as confident in the use of mobile phones for learning.

In the first phase, the analysis of documents was done to map the lessons to the learning outcomes, and to determine the teaching and learning approach for the module.

The findings of the first phase were used to design a collaborative mLearning module. During the second phase of design and development, the collaborative mLearning module on the topic of Nutrition was designed using Merrill's First Principles of Instruction. The learning environment employed a social constructivist approach and mobile web-based technologies were used for the

delivery of learning materials. Online discussion forums, collaborative work spaces or wiki, and text messaging, were used for learning.

A team of five experts in educational technology and in the subject matter were selected to assist in the design of the module. The team evaluated the module and brought up issues on management, instruction, the environment, and interaction, in the design of the module. These issues were resolved in the development phase.

In the third phase, the evaluation of the usability of the module was conducted. During the implementation, the researcher as the participant observer was the facilitator and tutor for the module. The users were twenty (20) Form 2 students of varied science abilities. Data was collected from the online communications, journal records, interviews, and survey, and analyzed. The participants' perception of the usability of the module was reported. Among the online communications used, the participants were most active learning with text messaging because of the accessibility of the mobile device. This was followed by the *Freewebs* online forum, and the wiki. The *Yahoo* groups forum was the least accessed as participants found it difficult to use. *Yahoo* chat was also used for communication in the collaborative mLearning environment.

The participants' engagement in using the module indicated that a collaborative mLearning module could be used for learning science.

Most participants did not have difficulties using the module. However a small number reported difficulty with the medium of instruction, some technical aspects, the subject matter, and the quantity and complexity of the tasks.

In general, the participants felt that the collaborative mLearning module was useful for learning. The participants' understanding had improved and they had collaborated during activities. However, they wanted more scaffolding by the tutor. The participants are motivated in using the module. They were interested in continuing to do more tasks in the collaborative mLearning module, and would recommend the module to their friends.

Based on the findings, it is suggested that a collaborative mLearning module, with accessible mobile tools, can be used for learning science. The collaborative mLearning module may also be used for instruction and learning in other subjects.

Discussion

The discussion is on the following areas: the developmental research process; the media, design of tasks, and the learning tools in the collaborative mLearning module; and interactions and the collaborative mLearning environment.

The Developmental Research Process

In this study, the developmental research approach (Ritchey, 1997; Wang & Hanafin, 2005) was employed to design and develop a module based on the analysis of the situation of a group of students in the context of the study. The developmental approach is similar to ADDIE's model of instructional design with the Analysis, Design, Development, Implement and Evaluation phases. In the analysis phase, the situation on the usage of technology and the content was done. The findings were used to make recommendations on the design of the module (see Table 4.7). This was in line with the needs analysis (Rossett, 1995) to obtain information on the

context and the environment of the students. The collaborative mLearning module was designed and formative evaluation was conducted by the researcher and a team of experts. The information gathered from the team of experts was addressed and used to enhance the development of the module. After development, the module was implemented with a group of students, and the summative evaluation of the module was used to answer the research questions. The research process is outlined in Figure 7.1 and the phases in the ADDIE model is highlighted to show the similarities. The final product of the evaluation is the collaborative mLearning module which is further enhanced.

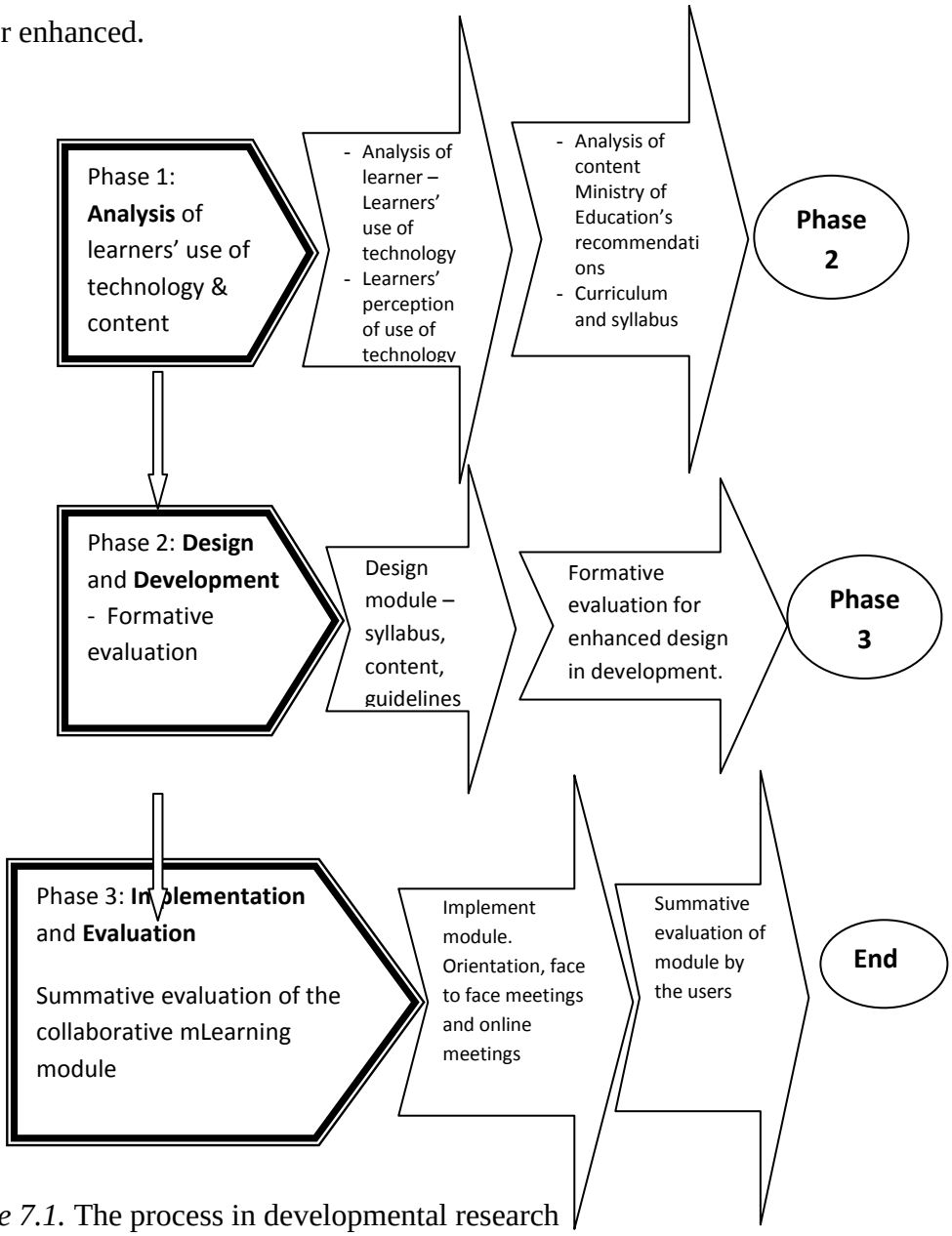


Figure 7.1. The process in developmental research

The Collaborative mLearning Module

The collaborative mLearning module is discussed according to the following aspects: the media for delivery of instruction, the design of tasks and the learning tools.

Media

The needs analysis phase showed that the internet was widely used by students for searching information. The findings were similar to previous research which indicated that in Malaysian schools the internet was most utilized by both students and teachers for teaching and learning (DeWitt & Saedah Siraj, 2007; PPPBSB, 2003; PPB, 2004). This was because the internet made knowledge accessible immediately (Rose & Nicholl, 1997).

Secondly, mobile phones were owned by most students in the context of the study and most considered themselves skilled in the use of mobile phones. This was also confirmed by much research that students find mobile phones easy to use (Colley & Stead, 2004, Saedah Siraj, 2004; Vaino & Ahonen, 2004). On the other hand, the findings indicated that students did not believe that mobile phones could be used for learning. In actuality, mobile phones have been widely used for learning in many countries (Attewell, 2005; Attewell, & Stead, 2006; Harrison, 2004; Saville-Smith, O'Nuallain & Brennan, 2005).

From the findings of the first phase, the collaborative mLearning module was developed in an online mode for delivery of content delivered through the

internet and the text messaging system. However, the print media was also used for a users' guide for reference.

The collaborative mLearning module consists of: (a) the collaborative mLearning homepage, with hyperlinks to content materials; (b) an online discussion forum for discussion questions; (c) a collaborative work space, or wiki for problem tasks; and (d) a text messaging system for the SMS Quiz. The Students' Guide was in printed form where the guidelines for the module, and support for the learning activities are described.

The components of the Collaborative mLearning Module in the different media is shown in Figure 7.2. However, the different media is not strictly delineated as the components of the module can be delivered through different media. For example, the SMS Quiz through the text messaging system is delivered through the internet broadband service, and the print media for the Students' Guide, can also be delivered through document files on the internet. The media is not the distinguishing feature of the components of the collaborative mLearning module.

Design of Tasks

The design of the collaborative mLearning is based on the first principles of instruction (Merrill, 2002). The problem task is the core and other activities support in the activation, demonstration, application and integration of knowledge. This principle is in line with the social constructivist view where meaningful tasks should be used for the learner to collaborate, solve problems and to build scientific knowledge (Brown, 2006; Cosgrove & Schaverien, 1996; Greeno, 1992; Olitsky, 2007).

The Online Task was designed for one lesson but was related. For example, Online Task 1, 3 and 4 were all related to the analysis of meals which were given to the groups. However, the lessons are on classes of food, computing the calories in a specific type of food, and on food tests for the classes of food. These tasks are all related and built on from Online Task 1.

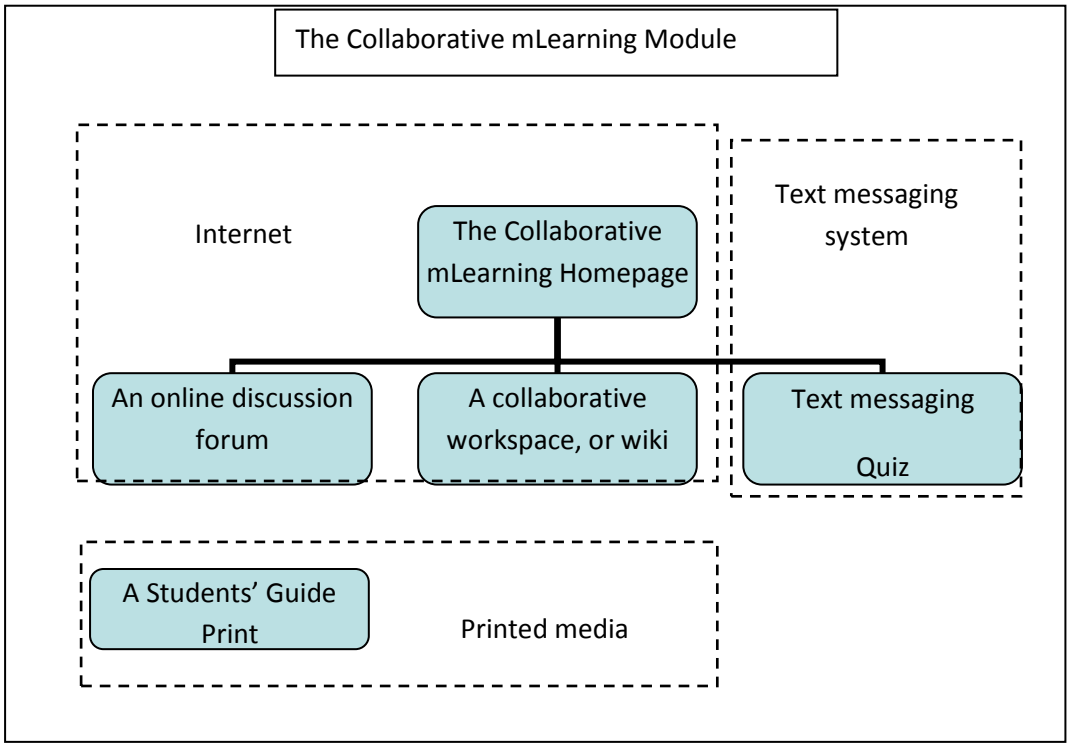


Figure 7.2. Components of the collaborative mLearning module

The activation of prior knowledge was done through Discussion Questions posted on the forum. The first discussion question was used to prompt recall of previously learnt knowledge. Demonstration of the knowledge was given through the media on the collaborative mLearning webpage. Instructional modules, with links to other web pages, documents, videos, interactive multimedia tools and animated graphics were available. In addition, the tutor provided support and gave examples, and appropriate guidance.

The Learning Tools

The opportunity to apply and integrate the knowledge was given thorough the Discussion Questions, the Online Problem Task and the SMS Quiz. The new knowledge could be practiced and applied as the learner completes the activities.

The Online Problem Task, Discussion Questions, and the SMS Quiz in the collaborative mLearning module were supported with online tools that enabled discussion and collaboration. These tools were selected based on the affordances of the tools as well as the readiness of the learner to use these tools (see Chapter 4).

The wiki was selected for collaborative group work as each member could edit the tasks synchronously. A discussion forum was used for sharing of information. The tutor provided support for technical issues, and guidance for completing the tasks. However, in both these tools, the group of learners and the public could view the tasks that were done. Personal communication through text messages was used when learners needed clarification but did not want the others to know. The chat function provided personal and synchronous communication and was used to clarify issues and problems faced. The collaborative mLearning web page provided the support as the instructional materials, links and references were on the webpage. The stages in the use of the tools in the module, is shown in Figure 7.3.

The findings of this study indicated that students could use online forums for learning. This supports the literature that showed that online discussion forums have been used effectively for learning in Malaysia (Irfan Naufal Umar, Noor Hazita Ahmad, Nur Hidayah Ah. Kamal & Nurulizam Jamiat, 2009; Norhashimi Saad & Sathiyvani, 2007; Siti Nazuar Sailin & Abdul Malek Abdul Karim. 2007; Firuz Husin, Hanim M. Salleh, & Lim, 2007).

Wikis have also been used in Malaysia but mainly for language learning (Lee, 1999). The findings of this study indicate that wikis could also be used for problem solving tasks in science learning. Text messaging has been used for learning in many countries (Driscoll, 2007; Kaye, 1992; Ragus, 2006). However, in Malaysia, text messaging is not widely used for learning yet. There has been some research when quiz questions to encourage interaction were delivered using text messaging (Sim, 2004). This study is important as it contributes to the existing body of knowledge in the use of technology, especially for text messaging and wiki in science education.

A combination of tools for web-based collaborative mLearning has also been used for teaching science (Guzdial & Turns, 2000; Slotta & Linn, 2000). However, in Malaysia there still seemed to be a lack of research in using a combination of tools. Rau, et al.'s (2005) used a combination of text messaging, online groups, and emails to investigate learning and motivation. He found that a combination of technology tools improved learning and motivation.

This study used tools such as the wiki, discussion forum and text messaging. The findings indicated the learners did learn from the use of the tools and were motivated to use these tools for learning. This was similar to the findings by Rau, et al.'s (2005).

The design of the collaborative mLearning module was based on the first principles of instruction and the social constructivist theory of learning. Hence, learning was meaningful, and the interactions in the learning environment were used to study the learning.

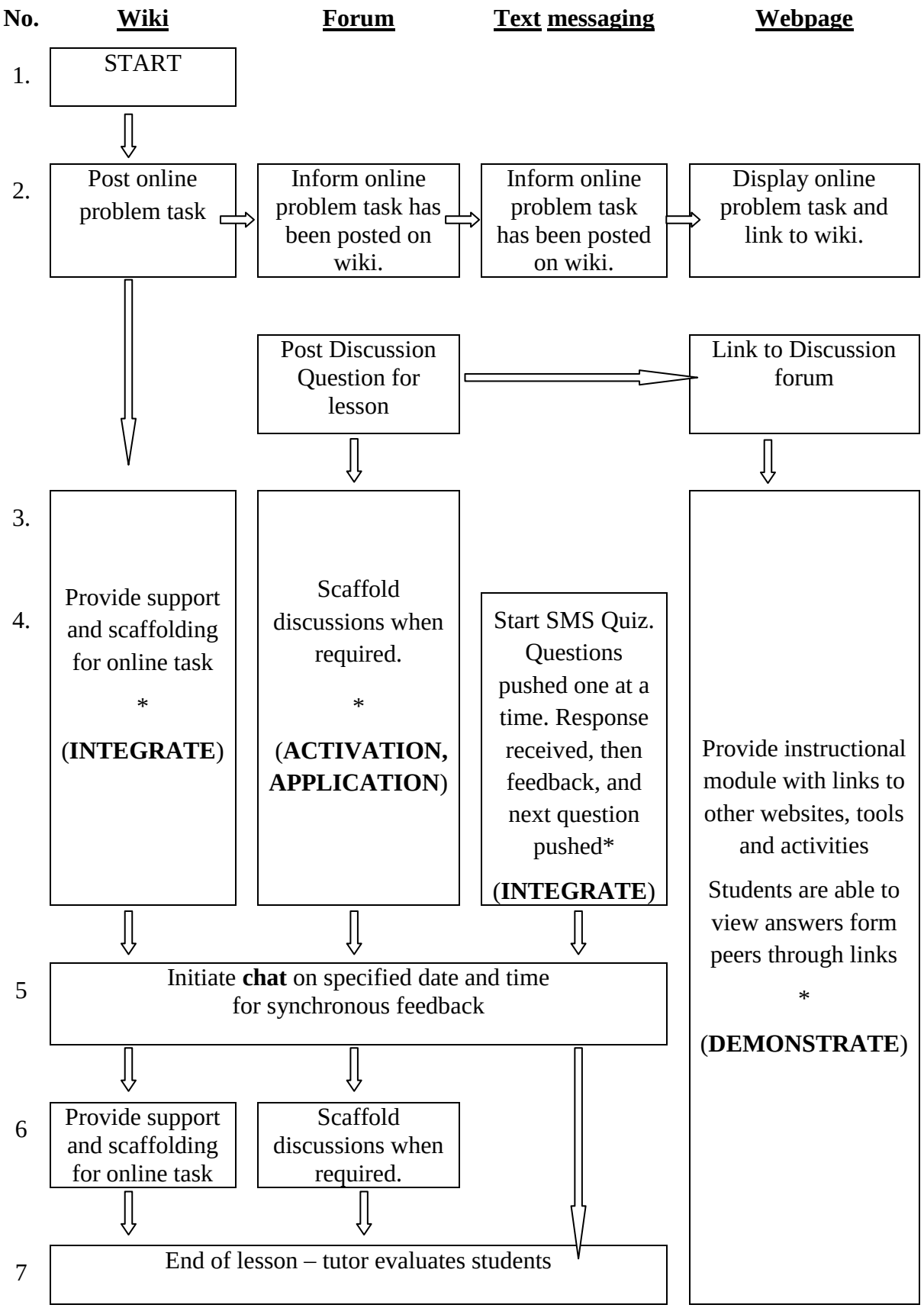


Figure 7.3. Stages in a lesson using the collaborative mLearning module

* Phase in Merrill's first principles of instruction

The Collaborative mLearning Environment

In the collaborative mLearning environment, there were many forms of interaction which contributed to learning. In this section, the interactions using the learning tools, and the collaborative mLearning are discussed.

Interactions in the learning tools

In designing the module, the different types of interaction were included. The choice of online tools made had to support discussion and collaboration. The collaborative workspace or wiki was useful for problem solving tasks in groups, while the discussion forums for individual working within the community of learners.

With the wiki, there was interaction between the learner and the tasks as the learners attempted to understand and integrate the problem with their prior knowledge. The instructional materials in the module provided instructional scaffolding for the modeling of the tasks. A number of researchers (Hoyle & Stone, 2000; Karpov & Haywood, 1998; Wolfinger, 2000) also indicated the importance of scaffolding and modeling in science learning. This was supported by the findings of the study as the learner requested for more tutor support.

In the process of solving the problem tasks, the learner searched for knowledge from other sources and materials. This included viewing the solutions posted on other groups' wiki. These provided the patterns which could be followed by the group.

The search for knowledge also included obtaining information from other learners in the group, and from the tutor. Interaction among learners within the group, and between the learner and the tutor allowed for the sharing of knowledge. These discussions on attempting to solve the problem task allowed the learner to integrate the definitions with their own understanding and as they attempt the tasks. The sharing of the learners and tutors' personal experiences in an activity allow for knowledge to be internalized. This allowed the learners to work towards a shared goal in learning, which was to complete the problem task.

The tutor's role was to provide instructional scaffolding and motivation for the learner to succeed. As the learners as a group attempts the tasks, the tutor provides guidance by writing hints on the wiki. This scaffolding was given to enable the learner to narrow the zone of proximal development and become experts. This was to provide the expert and novice interaction for the learner (Karpov & Haywood, 1998).

On the discussion forum, questions were posted to initiate the sharing of knowledge. The learners had to interact with the tasks, which is the discussion question. In understanding the task and referring to other sources of knowledge for instructional scaffolding, the learners build their knowledge. When an answer or discussion is posted, the learner has attempted to integrate the new knowledge with his existing knowledge. Answering the discussion question provides the opportunity to model other sources of knowledge and develop scientific verbal knowledge.

In the forum, the answers given by each individual could be viewed by other learners. Other learners could pattern and model the answers given and use the scientific verbal language to develop science concepts. The tutor provides

scaffolding and sometimes post questions to the answers on the discussion forum to promote thinking. This is to encourage learners to develop their thinking skills and to achieve expert level of knowledge. There is also collaborative mLearning occurring as there is a shared purpose, which is to complete the task, in the form of answering the discussion questions correctly.

The text messaging was used to provide personal interaction with the tutor. Firstly, the SMS Quiz questions were pushed to the learner. As the learner interacts with the question and tries to understand, the learner obtained instructional scaffolding through other materials such as textbooks and reference books. Sometimes the learner asked the tutor for assistance in the question, in which case the tutor provided hints to the solution. It was also noted that some learners also asked other learners for the answers to the questions.

There was always feedback from the tutor on the learners' answer. This feedback was chosen from a few alternative answer formats but was personalized to the learner. This was a form of instructional scaffolding and provided motivation as the learner felt that his answers were valued.

The summary of the three types of interactions in the online learning tools is shown in Figure 7.4. Collaborative mLearning allows for the three types of interaction identified in distance learning: learner-task, learner-tutor, and learner-learner.

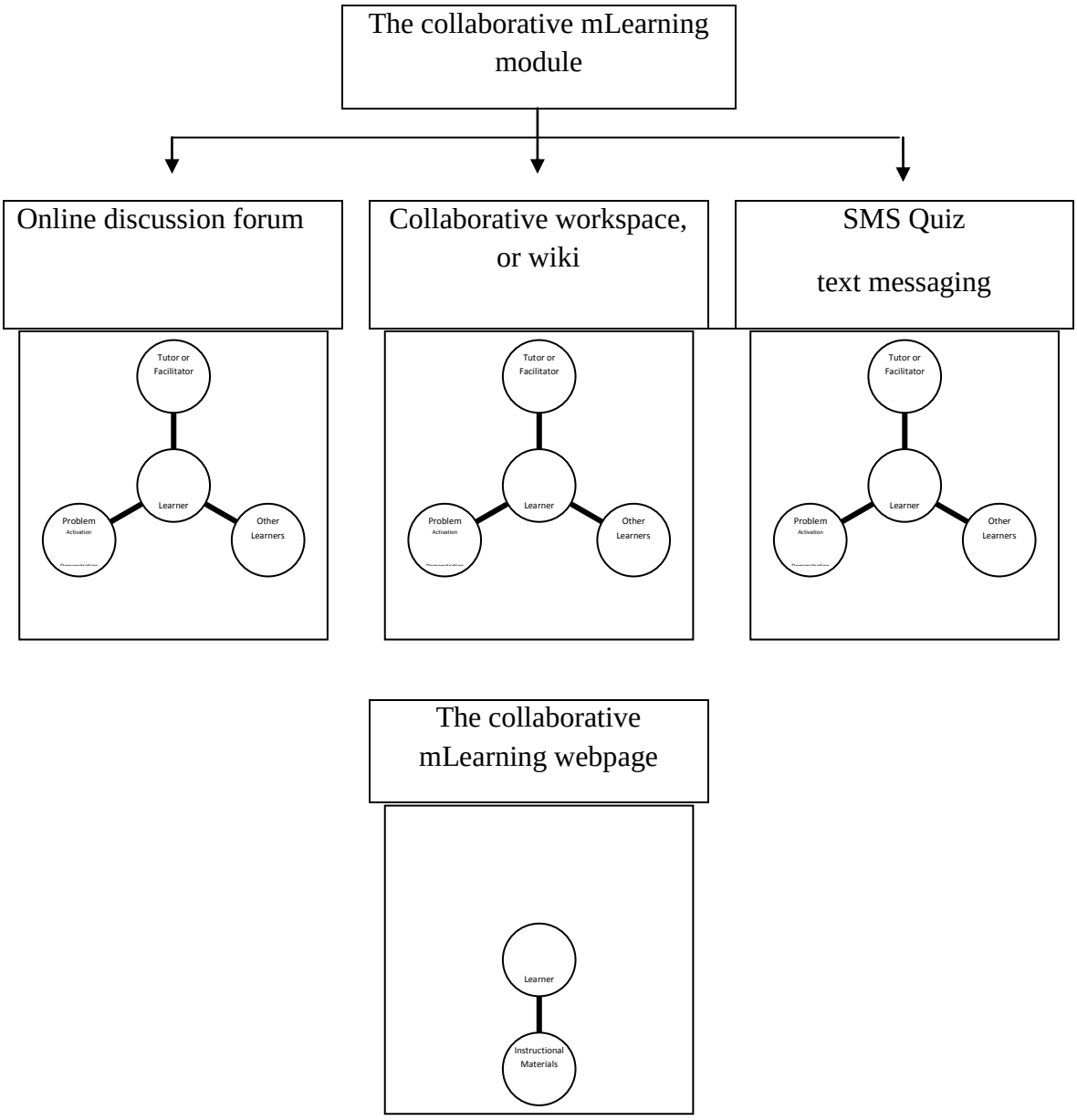


Figure 7.4. The interactions in the collaborative mLearning module

This study supported other studies which have indicated that social interactions can motivate learners to carry out activities successfully and to build their science knowledge meaningfully (Brown, 2006; Cosgrove & Schaverien, 1996; Greeno, 1992; Olitsky, 2007).

The Collaborative mLearning

The collaborative mLearning comprised of the collaborative activities the participants engaged in, the role of the tutor, effectiveness of learning, and motivation.

In this study, the students in the context of the study wanted more assistance from the tutor, and preferred that more direct answers to the questions were given. Some of the students were not confident in learning with collaborative mLearning and needed more support. The social norm in the classroom was face-to-face learning with the teacher transmitting information. Hence, for some students the expectancy of success in examinations in the face-to-face teaching environment was higher than for the collaborative mLearning environment. More support was given to these learners to build their confidence. The scaffolding has provided positive attributional feedback and increase the learners' self-efficacy and motivation.

On the other hand there were some students who wanted control over their own learning, and felt proud that they succeeded in the tasks. This positive affective reaction motivates the learner and encourages even more control by the learner. The learner is then encouraged to perform even better. Driscoll (2007) also noted that learner is motivated when he is empowered and is able to be more creative in his work.

Most students in the context of the study preferred to collaborate on the activities. This was also indicated by Kaye (1992) as he noted that learners

preferred to interact with other learners in informal situations online. On the other hand, there were some groups which did not seem to collaborate on the tasks. In these groups, the interaction was lacking because the members did not seem to have a shared purpose (Berk 2006) and may have lacked motivation (Weiner, 1996). The effort involved and their perception of the difficulty of the task discouraged some students. Others did not share the purpose, or the expectancy for success in completing the task (Schunk, 2000). Factors like mood or illness, lack of control, too much effort required, and lack of importance in the task affects students' motivation. On the other hand, groups which members had similar interests and background seemed to collaborate better towards a shared goal.

There were also 'silent observers' among the participants. These silent observers did not contribute to the tasks but observed the social interactions that took place. They were unaware that they were involved in the learning process when they observed other learners' interactions. This is because they are actually forming patterns for modeling and use of scientific verbal language.

The participants using the collaborative mLearning module in this study form a community of learners which has their own culture. The discussion forum allows the group to view all the interactions, and the wiki allowed for small groups to collaborate, and also view other groups' tasks. Only text messaging was for personal dialogue and interaction between the learner and the tutor. In this setting, learners learn from the interactions within the community.

Learning depends on the learners' perception and values. The ideas about learning, the means of communication, and ways of viewing the world influence the success of the learner. The problem-centered approach was used in the collaborative

mLearning module. In building the learning culture of the community, learners have to be motivated to learn.

The findings showed that most of the participants were motivated in using the collaborative mLearning. These participants wanted to use the module in future, and recommended others to use it. This positive attribution was due to several factors: the participants' belief that learning had occurred, the participants' positive emotional experience during learning, and the encouraging behaviors among the participants during the implementation of the module. This was in line with research that showed that learners were motivated and more active in learning on a collaborative online environment (Driscoll, 2007; Kaye, 1992; Ragus, 2006).

Learning was effective as mean test scores for the pretest and posttest had increased. The participants recalled the learning situations better during tests and enjoyed the learning experience in using new technology tools while working in groups. These attributed to the positive learning experience, and motivated the participants.

Cooperation among the participants is important in building an effective learning community. A tutor can assist in the community-building process by including introductory activities, and providing opportunities for collaborating in interesting situations and tasks. In this study the topic, nutrition was used. This topic enabled meaningful learning as real-life situations was used. This allowed the use of scientific verbal knowledge to construct their knowledge of science. The process of collaboration using the collaborative mLearning module enables scientific thought to be developed.

In conclusion, the collaborative mLearning module used authentic tasks to encourage learning which increased learner motivation. The tutor played an important role in supporting the learning process and providing personal feedback. However, learning is a personal experience and the learners' perceptions and values influenced his involvement in the learning process.

Implications of the Research

The implications of the research on the practice of instructional design and module development, and on development of collaborative mLearning is discussed.

Implications for Instructional Design

The development of the collaborative mLearning module takes on a developmental research approach with several phases, and is based on the social constructivist theory and principles of collaborative learning. This is to ensure that the module developed is theoretically sound. The formative and summative evaluation during the development and evaluation phases ensured that the module was developed based on the requirements of the user. The developmental approach combined with sound principles of design and learning can be used for development of materials.

The syllabus for the collaborative mLearning module was designed for the topic of Nutrition in Form 2 Science. The module was mobile and delivered online with the use of online learning tools such as wiki, discussion forum, and text messaging. There was a face-to face session for orientation. In addition, guidelines for participation and other rules were set during the initial orientation meeting. The process in developing the collaborative mLearning module is outlined in Figure 7.1. The developmental process in each phase in detail with the types of experts required

is in Figure 7.5. In the design of a collaborative mLearning module, instructional designers have to take into account the analysis of the content to be taught; the technology skills of the learner, and availability of the tool; the design the module based on learning principles; and the evaluation, both formative and summative, to test the usability of the module.

This process of development can be applied to other subjects other than science. The same process can be used to design the learning module as only the content was different.

Expert	Area	Details	Developmental Phase
Subject matter	Analysis content	• Curriculum specifications • Approaches for teaching and learning	ANALYSIS
Subject matter Instructional designer	Analysis learners	Survey • Use of technology tools • Skills in technology • Perception of technology tools	
Subject matter Instructional designer Technical expert	Design of module Formative Evaluation	• Task analysis • Syllabus • Guidelines • Activities • Learning Tools • Media • Collaborative learning principles • First principles of instruction • Social constructivist theory	DESIGN
Subject matter (teacher) Technical expert (teacher/ instructional designer)	Formative Evaluation	• Management of module • Instructional issues • Collaborative mLearning environment • Instructional Tools	DEVELOPMENT
Online tutor (subject matter expert and instructional designer)	Implementation User evaluation	• Orientation to tools and environment (Face-to-face meeting) • Tasks on wiki, forum and text messaging • Online meetings	IMPLEMEN-TATION
User - learners	Summative evaluation	• Survey on perception, difficulties, learning	EVALUATION

Figure 7.5. The process in development of a collaborative mLearning module

Implications for Teaching and Learning

In the design of the collaborative mLearning module, several principles of learning are used: principles of collaborative learning for a shared goal and purpose; the use of advance organizers and chunking of information for organizing learning and displaying information; and Merrill's First Principles of Instruction to encourage meaningful learning. These principles and the use of selected online tools enabled collaborative mLearning. As learners collaborated in attempting the tasks, they built their understandings of science.

The findings from the three phases of research identified areas crucial for the success of Collaborative mLearning. The analysis of the learners' skill and use of technology determined the amount of time spent in orientation to the technology, and the devices used. The collaborative mLearning module was designed to include a syllabus and set of course guidelines; the tasks; and the use of the learning tools. The module was designed based on the first principles of instruction (Merrill, 2002) and message designed in the activities were based on design principles. The Guidelines for the implementation of Collaborative mLearning was developed from these findings (see Table 7.1). These guidelines took into account several considerations from existing theories and research: learners' psychological comfort and satisfaction (Koole, 2009), forms of mobile learning (Naismith et al.,2004), principles of mobile learning (Palloff & Pratt, 1999), group size (Howe & Jones, 1993), and activities suitable for collaboration (Jonassen, 2000; Palloff & Pratt, 1999)

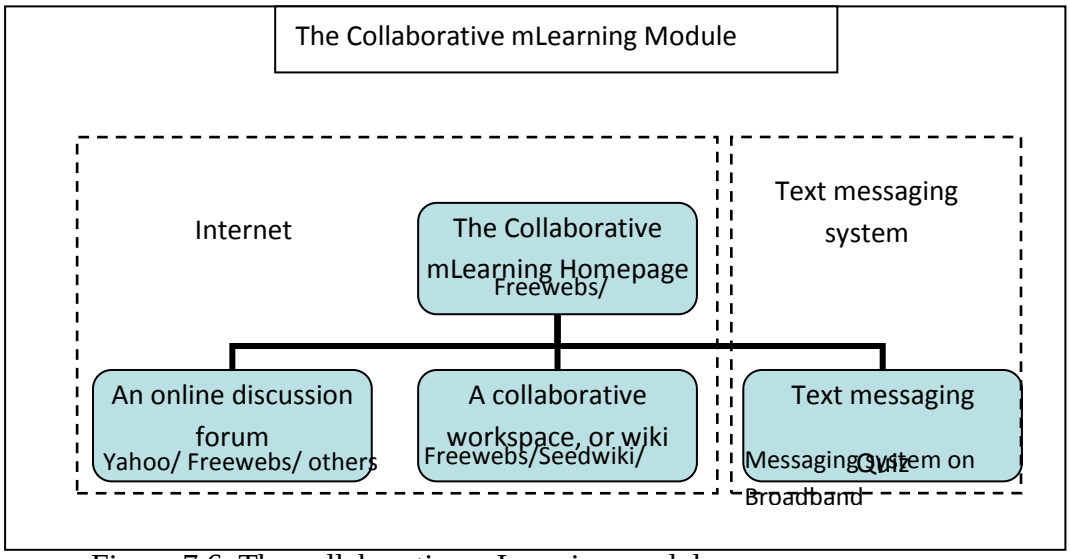
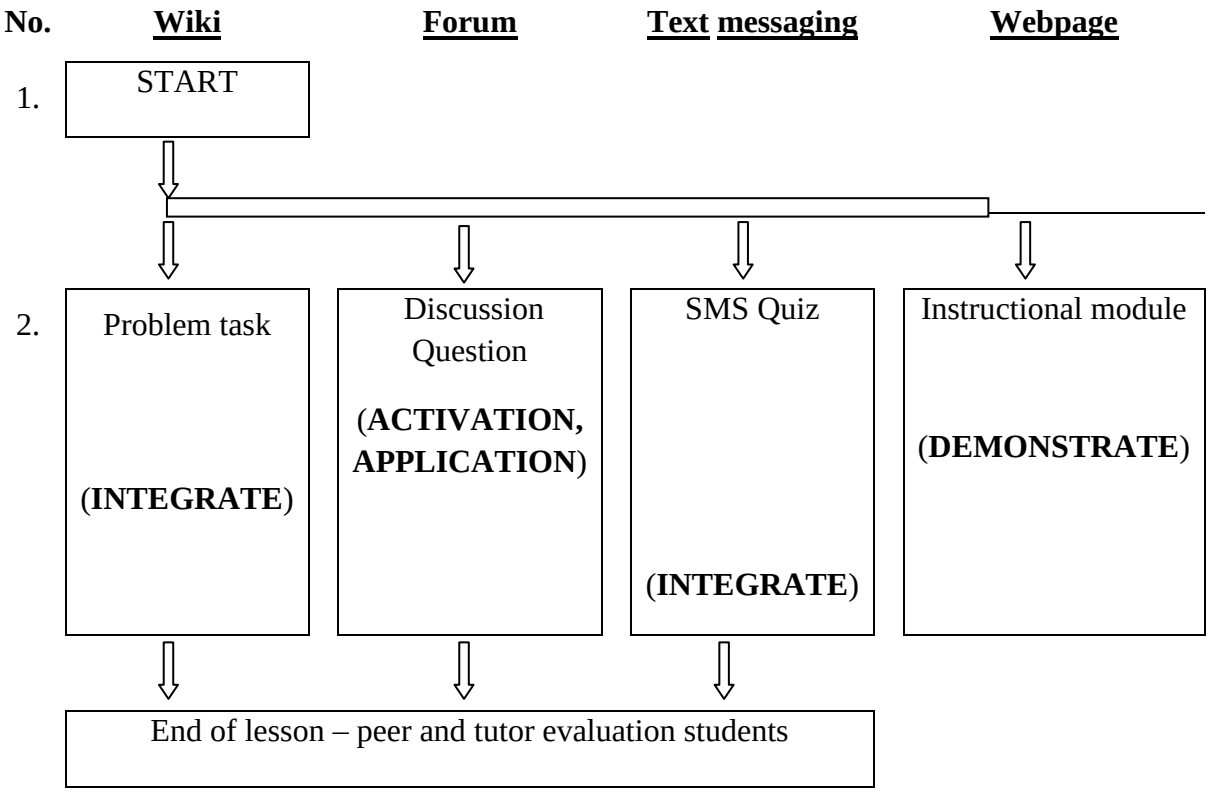


Figure 7.6. The collaborative mLearning module



* Phase in Merrill's first principles of instruction

Figure 7.7. Implementing the collaborative mLearning module

Table 7.1

Guidelines for Development of a Collaborative mLearning Module

No.	Areas	Description
1.	• Analyze the background of the learner. • Use the information to determine aspect of training required for learner	Determine skill set of the learner in the following: • Skills in the use of computer for gathering information; • Skills for communication, specifically, in the use of e-mails, discussion forums and wikis; • Skills in the use of mobile phones, specifically in charging, opening and deleting text messages, Obtain information on usage of technology equipment • Frequency of use of device for specific purposes such as ICT for research, or for communication Determine the learners' perception towards technology to determine value of the tool: • impression of the usability of the tool (discussion forum, wiki, mobile phones)
2.	Devices and other equipment which is owned or can be accessed by learner both in school and out of school (Devices use to leverage on computers from other ICT initiatives in the school, personal mobile phones with text messaging function)	Identify type of equipment that learner can access at home or in school: • Information on ownership of device, • Portable or static devices • Shared or personal Personal and portable devices are most ideal for anywhere learning. However collaborative learning can still be carried out in a static environment.

Table 7.1 (*continued*)

Guidelines for Development of a Collaborative mLearning Module

No.	Areas	Description
3.	Design of activities for collaborative mLearning	Utilize learning tools that cater for collaboration and personalized learning • discussion forum, • collaborative workspace (wiki), and • text messaging. Identify the advantages and disadvantages of the technology from the pedagogical approach, learning needs and goals Design tasks that are authentic and are meaningful • real-life tasks and problems using first principles of instruction (Merrill, 2002). • one main problem tasks with many smaller problem tasks • relate to learners' experiences and interests • Activities to provide opportunities for reflection Apply cognitive tools: • Use advance organizers • Chunk of information that is presented online Allow learner freedom to negotiate on specific items like dead lines Provide guidance through printed and/ or online students' guide, and tutor scaffolding • guidelines of the course, • lessons and tasks • Heterogeneous small groups of 4 or 5 students
4.	Text message design	Use text messaging for • Alerts • Reminders • Quiz questions • Other collaborations.

Table 7.1 (*continued*)

Guidelines for Development of a Collaborative mLearning Module

No.	Areas	Description
4.	Text message design (continued)	Use the following when designing message for SMS on mobiles: • Chunking of information, • Limit of number of characters in message • Ensure appropriate design for screen display on different models of mobile phone Design SMS Quiz with answers and responses that allow: • short or multiple choice answers so that learner need not type too long a text message • different devices with different length of message displayed on screen • convenience of copying response to another system to capture data and calculate marks of individual learners
5.	Collaborative learning environment	Allow for platform for discussions for group discussions • on wiki, and for the whole class, • on discussion forum. Initialize online and face to face session with introductory activities for orientation • Have discussion on learners' views and expectations of learning but within rules in the environment • Provide opportunities for feedback, and inquiry on areas of interest • Use a blend of online and face to face discussion
6.	Scaffolding	Use more instructional scaffolding in the early stages, but consider to withdraw later Allow for personalization: cater to individual differences in learning styles of learner

A collaborative mLearning environment can be implemented using freeware tools (see Figure 7.6). *Freewebs* and *Yahoo* groups were used in this study. There are many other free resources being developed that the teacher must be aware of the different types of tools available to maximize learning. In general, for collaborative mLearning, a problem task is given for authentic and meaningful learning. Activation of knowledge is through discussion questions on forums while demonstration of knowledge is given through instructional modules. Application and integration are through further questions and the problem task. The stages are shown in Figure 7.7.

This module has been shown to be beneficial for learners as it caters to individual learning styles and preferences, allowing for the learner the choice of materials and tools to use for individualized learning. This motivates the learner to continue learning using this module.

Limitations of the Study

This study was context-specific (Driscoll, & Burner, 2005; Richey, Klein, & Nelson, 2004; Wang, & Hanafin, 2005) to the group of students in the context of the school in the study. The school selected in this study was a school with a multi-racial student population. The background of the learner would differ in other schools. However, these findings could still be useful as many schools were similar.

There was a lack of multimedia elements and animation in the content and activities in this study. The web-pages had graphic elements, but not much animation, and text messages were limited to text. Principles of learning, such as advance organizers and chunking were used but learners with visual and auditory modalities of learning who were attracted to multimedia might not be interested in

the module. This was addressed by providing the choice of linking to other sites with media elements.

In this study, devices which were readily available were used. This was to reduce the cost of the study. However, some learners did not own a personal mobile phone and used other family member's phone. Hence, the lack of funds may have influenced participation in using the mobile phone. In addition, participants who did not have sufficient credit balance could not participate in the Quiz.

Computers and laptops were provided for use in the school for learners who did not have access to computers. However, this may not be convenient for the learners who share computers with others. The cost of the devices and the use of the device may have influenced the participation in the collaborative mLearning module.

Parental control was cited as one of the reasons for lack of participation and drop-outs. The amount of time spent on the internet was limited by most parents. This seemed to be because the internet was seen as a "vice," and students were considered to be using the internet for socialization and playing games, and not for learning.

The learners' perception of learning also influenced their participation. Some learners seemed to value learning that was transmitted, rather than constructed. They had to be convinced that construction of knowledge could be achieved through social interaction. The learners' motivation influenced the participation. The learners and their parents' perceptions of learning using technology seem to have influence the participation in the collaborative mLearning module.

These limitations should be addressed by further research in the areas of concern.

Further Research

The implementation of collaborative mLearning module can be conducted in other schools with different characteristics: a school with a single race majority student population, a rural school, or, a school with no electricity. The perception of learners and the issues that are faced may differ in these schools.

The collaborative mLearning module can be implemented with standardized devices. All participants must be given mobile phone and laptop with the same features and functions to enable a standardized training in the use of the device to be conducted before implementation. It can then be determined if training using standardize devices increased participation in attempting the activities in the module.

The collaborative mLearning module was designed to cater for learners with different learning styles. The instructional module was designed to include links to media elements. Hence, further studies can be done to investigate the perception and engagement with learners of different learning styles.

In addition, multimedia elements can be included in the design of the content. Interactive content with graphics and animation could be developed for the mobile phone using software like *HotLava.* However, the delivery of content with graphics and animation requires mobile devices with internet access. Hence, a more comprehensive study can be done with delivery of multimedia content on mobile phones with internet access.

A separate study can be conducted with mobile phones with internet access or PDAs provided to all students to investigate how a personal device for accessing

the internet anywhere and anytime could influence learning. The collaborative mLearning module could be conducted with participants using mobile devices.

Further studies can also be done on parents' perception towards the internet. Parental control seemed to influence the participants' participation in the module. It can be investigated whether positive perception towards the use of internet influenced learning and participation in the module.

Conclusion

Collaborative mLearning can be implemented in secondary schools. The present study has proven that it is important to have a variety of activities which may appeal to different learners with different preferences and learning styles. Learners should be given a choice on the tool required or wish to utilize for learning. This allows for freedom of choice and personalization. This research is important as it can assist the nation in achieving the vision of achieving a technologically-literate workforce, which makes use of existing technology for communication and problem-solving. The module will enable participants to develop critical and creative thinking skills as they perform problem-solving tasks. In addition, the collaborative nature of the module enables learners to collaborate in completing the tasks assigned. The skill of collaboration is required in a knowledge-based society, where collaboration among different areas and multiple skills is required in completing a project. Lastly, in this new era of globalization and fast-changing technology, the structure of knowledge is changing. New theories of learning and instruction are required to address these changes, and the need for a personalized learning environment has arisen among learners. This collaborative mLearning module is able to address these needs for the benefit of the future learners.