CHAPTER 7

CONCLUSION AND FUTURE WORK

7.1 INTRODUCTION

On the completion of testing and evaluation of ESCA-Math, the conclusion and future work are discussed in this chapter. This is crucial to evaluate processes of the developed prototype to identify the research contribution, strengths of the prototype, limitations of the prototype and objective achieved. Finally, future enhancements are suggested to improve the prototype ability as to minimize all constraints and limitations found.

7.2 RESEARCH CONTRIBUTIONS

This research is concerning with the development of a study companion to Form 4 and Form 5 students. Educational system consists of two groups of involvement namely; the teachers and the students. Consequently, ESCA-Math has contributed to these two groups. The contributions towards the students can be seen in the following ways;

- By providing a study companion to the students for mathematics subject.
- By helping in tracking down students’ performance as they use the prototype along the way.
- By helping in decreasing the ‘peer pressure’ environment where students only have to compete with themselves to bring out their true potential.
• By helping in decreasing the ‘mathematics anxiety’ among students by giving them the means to properly revise and evaluate their understanding in the mathematics subject.

• By helping in decreasing the ‘test anxiety’ as well among the students by giving them the chance to practice properly and getting them prepared for tests and examinations.

• By helping in improving their English language by developing ESCA-Math in English.

• By increasing students’ computer skills along the way.

The contributions towards the teacher can be seen in the following ways;

• By providing the teachers with more time in class for other social activities such as class project, or mathematical games since the students are able to revise by themselves in their own pace outside the classroom.

• By easing the teacher to concentrate in creating two way interactions with the students since they do not have to rush to finish the syllabus since the revision can be done by the students themselves.

7.3 RESEARCH PUBLICATIONS

This research has been published in two proceedings namely ICE’06 and ICC’07 as the following;


The details of the paper works can be referred in Appendix F, Appendix G and Appendix H respectively.

### 7.4 STRENGTH OF ESCA-MATH PROTOTYPE

Although e-learning website has been in the Internet for more than a decade now, ESCA-Math is developed in such a way that it is different from any other e-learning. This distinguishable strength of ESCA-Math is as below:

- Taking a different approach than other e-learning website which is the concept of the study companion.
- Providing user with their own progress record where they can evaluate their understanding in mathematics subject.
- User friendly and easy to use interface
- Administrator control feature for future addition and maintenance

1. **Uniqueness of the study companion concept**

ESCA-Math concentrates on a different approach than other existing e-learning. Instead of simply providing another way for students to revise and
seek help in homework, ESCA-Math goes one step further by providing a study companion to the student. All of the modules consist in ESCA-Math encompass the whole of students’ learning process, from help with mathematics topic, to testing their understanding and recreational activities for them when they want to take a break for a while.

2. **Progress record to evaluate ones understanding**

ESCA-Math provides the students with their own progress record. This record will keep students’ performance as they use ESCA-Math along the way. Apart from a record of their performance, ESCA-Math also provide with a list of strong and weak topic for guidance for them to start and carry on with the revision.

3. **User friendly and easy to use interface**

The evaluation test in Chapter 6 shows that students agree with 4.30 and 4.25 of mean respectively that ESCA-Math interfaces are easy to use and user friendly. Students only need to choose from the provided modules on the left side of the screen and click on them for the content to be displayed. There is also a ‘Site Map’ and ‘Help’ section to assist students in using ESCA-Math.

4. **Administrator control feature**

ESCA-Math will be provided with administrator control feature for future addition and maintenance. Mathematics KBSM syllabus will be bound to be upgraded by the ministry sooner or later. When this happens, ESCA-Math will
not be obsolete since there is an administrator account to update all of the changes.

7.5 LIMITATIONS OF ESCA-MATH PROTOTYPE

Despite the various strengths of the prototype mentioned previously, it does have limitations. This prototype is not yet perfect as it lacks several important aspects. The limitations of ESCA-Math are:

- It focuses on several topics within mathematics subject
- It focuses for Form 4 and Form 5 students only
- Only provide objective-formatted questions

1. **It focuses on several topics within mathematics subject**

Since ESCA-Math concentrate on developing other features such as the progress record and other modules like quick references and fun and games, not all mathematics topics will be included in this prototype. However with administrator control, this can be addressed easily when the appointed administrator has the ability to insert the learning material for other topics.

2. **It focuses for Form 4 and Form 5 students only**

ESCA-Math focuses on students in Form 4 and Form 5 only. However, these students are at the right age to be given the freedom to have a study companion where they may proceed in their own pace. Schools’ computer laboratories also prioritize them over other students (Form 1 to Form 3 students) in computer usage.
3. **Only provide objective-formatted questions**

Question bank module in ESCA-Math provides students with objective-formatted questions only. Subjective-formatted questions are not provided in this prototype.

### 7.6 OBJECTIVES ACHIEVED

ESCA-Math has three main objectives as described in Chapter 1. The objectives of this research have been successfully achieved based on;

i) **Objective 1: To investigate the problems that resulted in low to moderate percentage of satisfaction in the usage of Internet and online system for educational pursuit among students.**

Based on the questionnaire result and analysis, the current problem that resulted in low to moderate percentage of satisfaction in the usage of Internet and online system for educational pursuit among students are identified. The result in the questionnaire result shows that students do use the Internet and online system for educational pursuit but their satisfaction level is either low to moderate. The problem that has been identified includes the little time they have to properly use the system, the lack of enjoyable feature within the system and the inability for the system to personalize students’ history of usage.

ii) **Objective 2: To create a viable framework based on the qualitative and quantitative research and analysis as a means of consideration in order to suggest for a solution to the problem.**
From the analysis in Chapter 2 to Chapter 4, a framework has been created as part of the design process. This framework emphasize on the absence of teacher and peer pressure presence and focus on providing students with the study companion for them to proceed in their own pace. Each student will have their own account to keep their history of usage and they may pause and save at any time to continue at a later time. Recreational activities module provide the students with enjoyable activities as part of their learning process.

iii) Objective 3: To develop a workable prototype based on the framework created which is called “E-learning using the Study Companion Approach: Mathematics (ESCA-Math)” that the user would use.

Based on the evaluation and user acceptance testing in Chapter 6, it shows that students are satisfied with ESCA-Math. In Table 6.7, ESCA-Math received a Mean value of 4.70 for overall assessment, which is leaning towards ‘excellent’. This also shows that students will very likely use ESCA-Math when it is implemented in the educational system.

7.7 RESEARCH QUESTIONS ANSWERED

In Chapter 1, two research questions have been identified. At the end of this research, the answers to these questions have been discovered. Below are the research questions and their answers:

i) Could the low to moderate level of satisfaction in Internet usage for educational purpose due to impersonalized e-learning system or because students did not know how to get the best benefits out of e-learning?
After analyzing the data gathered from the survey, several inputs have been gained to give some insight on why students are less satisfied with e-learning system. It has been found out that e-learning system that does not regard the students as an individual person or in other words, e-learning system that does not personalize itself to students does contribute to the low to moderate level of satisfaction. Students do not have much time to spend on the Internet, what with curricular activities and homework to allocate their time to, thus, it is essential for the e-learning system to ‘remember’ these students or else it will be hard for them to benefit from the system. Students do realize the benefits they could gain from e-learning system, however, some of the system require monthly or yearly fees to provide these facilities. This causes them to shy away from these systems.

ii) Would an e-learning using the study companion approach that treats its user as an individual person instead of any typical user able to address this situation?

Based on the user acceptance result and analysis in Chapter 6, it shows that students are mostly satisfied with ESCA-Math that uses the study companion concept – a system that focuses on the students themselves, instead of having other parties such as the teachers and their parents breathing down their neck – and the personalize account offered in it so that they can carry on with their learning process as soon as they logged in into the system.
7.8 **FUTURE ENHANCEMENT**

Future enhancement can be done in order to ensure ESCA-Math with more advancement. It is found that the system has a number of deficiencies. Thus, it is suggested here that several enhancements are made to ESCA-Math in the future to ensure that it is more powerful, robust, easy to use, more flexible, secure, effective and efficient. These suggestions include users’ suggestions from the acceptance survey result which was carried out in Chapter 6 (Prototype Testing and Evaluation).

The suggested future enhancements for ESCA-Math are:

- The ability for ESCA-Math to have and mark subjective-formatted questions
- The ability for students to draw graphs and other figures as requested in the questions

1. **The ability for ESCA-Math to have and mark subjective-formatted questions**

   At the moment, ESCA-Math only provide students with objective-formatted questions for them to evaluate their understanding in mathematics topics. In future, ESCA-Math can be enhanced to include subjective-formatted questions as well.

2. **The ability for the students to draw graphs and other figures**

   With objective-formatted questions, ESCA-Math does not need to provide students with the ability to draw graphs and figures; however, with the enhancement of subjective-formatted questions, it is necessary to include this facility as well.
7.9 CONCLUSION

From this research, the following conclusions can be drawn.

As mentioned in Chapter 1, the first objective of ESCA-Math which is to investigate the problems that resulted in low to moderate percentage of satisfaction in the usage of Internet for educational pursuit such as e-learning among students has been identified. They include the lack of time they have to spend on the system, which failing them to use to its fullest capabilities. Another problem is the lack of enjoyable feature within the system and the inability for the system to personalize students’ history of usage.

The second objective mentioned is the development of viable framework based on the qualitative and quantitative research and analysis as a means of considerations in order to suggest for a solution to the problem identified. Chapter 4 outlined this framework that was formulated based on the research that has been detailed in Chapter 2 to Chapter 4.

And the third objective is the development of workable prototype based on the framework created which is ESCA-Math as the learning tool that the students would use.

From the research that has been done, it can be concluded that all of these objectives has been achieved. It can be seen in Chapter 6 from where the testing was conducted. From the user acceptance testing, the overall rating shows that 70% of the students rated ESCA-Math as ‘excellent’ while the other 30% rated it as ‘good’. The user
acceptance test among administrator shows that 60% rated the administrator feature as ‘excellent’, 20% rated it as ‘good’ while the remaining rated it as ‘satisfactory’.

In the qualitative research and analysis of Chapter 2, a list of issues was mapped into existing systems and several weaknesses from these systems are discovered (see Section 2.8.6). ESCA-Math has successfully overcome these weaknesses and they are as follows;

- Most of the existing systems do not contain a clear course and learning objectives. This will make it hard for the students to get a clear understanding of the significant purpose of the system and the full benefit the system offer. ESCA-Math provides a clear course and learning objectives to emphasize the structure of the prototype and provide the students a clear understanding of how they can benefits from it.

- Most of the existing systems focus too much on the purpose to provide learning tools to the students that they fail to recognize other support activities that the student could endeavor as part of the learning process. Some of the existing systems provide examination questions without a companion of learning notes for the students to revise, while the other existing systems only provide learning notes without examination questions for them to evaluate their understanding. ESCA-Math provides both of the learning notes and examinations questions together with other supporting activities such as the timer facility and English to Malay dictionary.

- Not only do some of the existing systems do not contain supporting activities, the ones they provide are often incomplete. With the administrator feature in
ESCA-Math, it is updatable for future maintenance. Any incomplete content can be filled in even after the prototype has been installed and implemented.

- Apart from that, most of the existing systems also do not provide the starting point which is very essential as guidance for the students to proceed with their learning process. Without this starting point, it will make it hard for the students to pinpoint where they should start and it will be a waste of time, where time, unfortunately is not a luxury for them. When students log-in to ESCA-Math, they will be presented with their progress record together with a list of their strong and weak topics so they know which topics to concentrate on. This will be their starting point to proceed with their learning process. It also acts as a reminder of their status and progress on their last login into the system.

In Chapter 6, it can be concluded that the testing conducted was successful where no error was found. In the integration testing, all the prototype components worked together as pre-defined by the functional and non-functional requirement. In terms of the prototype testing, the entire prototype had been tested with all possible triggers in which it is found that the prototype is capable and succeeds in handling all the triggers. As for the user acceptance testing, majority of the users were satisfied with the prototype. However, a few improvements need to be applied to this system.

As explained in Section 7.8 which is the future enhancement section, there are ample possibilities to expand this prototype. Continuous improvements are the key to build an enhanced system and to ultimately produce more satisfied users. Last but not least, the completion of the prototype in this research has shown that there are still many
areas for improvement as in depth and wider research needs to be carried out. It is also hoped that with the creation of this prototype, it would initiate more ideas for other researchers to develop an e-learning system with more features in the future to benefit the students in order for them achieved better grade in their examination.

As a conclusion, ESCA-Math has achieved and fulfilled the objectives and requirements as an e-learning system with the study companion approach for secondary school mathematics as determined at the early stage of this project and during system analysis.

There was a lot of knowledge gained throughout the development of this system. This includes knowledge in Internet environment, Internet technologies, various e-learning approaches and system development process. Developing ESCA-Math using Macromedia Flash with Actionscript programming proved to be a valuable experience. Even though programming and techniques are important in system development, good system engineering techniques must also be applied. Here, theories and knowledge gained throughout the course of computer science studies like system analysis and design, web development, and server were literally put into practice.