8.0 Introduction

This last chapter will discuss the important facts that are determined through this research, objectives that were accomplished, advantages and limitations of the StuMOP tool. It also states few problems encountered during the research process. Besides that, the future improvements about this research in order to enhance the SCeL will be discussed. This is crucial for any research because it can help for continuous progress of this research field.

8.1 Important facts determined through this research

During the review of literature it was found that:

Personalization increases learning motivation, which can increase the learning effectiveness. It is a challenge in e-learning to achieve personalization; to customize the learning environment as per the student’s ability where the lecturers and student are apart. This can be achieved by regularly monitoring the student, developing a learner profile for each student and delivering instruction based on the individual student profile.

The monitoring features in existing e-learning products is primitive and the data provided through it such hits per page, time spent online etc. does not convey any direct information on whether the true learning happens.

Various students modeling and monitoring in intelligent tutoring systems utilized detailed model of the knowledge of the domain. Where as the mathematical student
modelling techniques used coarse-grained data from student’s test result and provided non-intrusive approach to gather information without affecting the learning process of student.

Though with the recent boom in e-learning and great efforts made to move these advancements into computer science education was ineffective due to very little pedagogical knowledge in the computer science domain.

In order to resolve the software-engineering crisis there is a need to produce quality programmers. Hence there is need to alter the way programming is taught and learnt in colleges. The students find programming subjects difficult to master and lecturers find it difficult to teach.

This research proposes the use of student monitoring, profiling techniques and customized learning through adaptive quizzes as a solution to contribute in a quantitative manner to effectively produce SCeL. Ultimately the research believes that this StuMOP tool will contribute in a positive way to improving the quality of student learning programming, thus in some way addressing some of the current industrial problems with the quality of software products.

8.2 Accomplished Objectives

The research aimed to provide SCeL by customizing the learning environment based on individual learner ability. This ensures the quality of education in e-learning where students and lecturers have a lesser degree of face to face interaction.
Chapter 8: Conclusion

The following objectives were achieved to fulfill the research aim as promised in chapter 1:

i) The existing SCeL tools were studied in Chapter 2 to find their role in providing the customized learning environment based on individual learning ability. The findings from the study were utilized to implement a tool with enhanced features.

ii) The StuMOP tool is capable of doing the following:

   a. The StuMOP tool profile and monitor the students’ learning progress in order to enhance SCeL. A profile is created for each student, thereby creating a student model.

   b. The StuMOP tool provides the student with customized learning environment to learn programming through adaptive quizzes. It also provides customized feedback on the progress the student makes with the concepts that have been examined in the e-learning tutorial.

   c. The StuMOP tool allows the lecturer to monitor the effort and to assess knowledge of the student and class in each concept.

   d. The StuMOP tool allows the students to monitor their own learning progress and to practice each concept learnt.

In order to provide the above features in the StuMOP tool
e. The requirements of SCeL were captured through literature review in chapter 2. A survey was also conducted to elicit the requirements from user. Survey is attached in Appendix A and B. The results were summarized in chapter 4.

f. An appropriate approach was designed to provide SCeL. This is documented in section 3.1.1.3 titled Researcher’s approach.

g. The StuMOP tool was designed with software engineering methodology Unified process.
   - Object-Oriented analysis, design models developed was documented in chapter 5.
   - The Model View Controller architecture (MVC architecture) using JSP model1 architecture was used to implement the tool. This is documented in chapter 6.

iii) The StuMOP tool was evaluated using questionnaire in Appendix D and Appendix E. The results were summarized in chapter 7.

8.3 Advantages of StuMOP Tool.

Designing and implementing SCeL courses is more challenging with respect to time and effort than conventional teaching; students who are allowed to learn in pace of their individual learning ability not only achieve better academic results but also develop more interest in the learning process. Evaluating the StuMOP tool among the lecturers and the students studying “C” programming revealed the following advantages.
8.3.2 Motivation

The tool increased the student interest to participate in the learning process. The tool provided the student to benchmark their results with the best performer of the class.

8.3.2 Allowed to practice

The tool permitted the student to practice a concept until a sufficient knowledge is attained in the concept. Random sets of questions were provided each time the student attempts a concept. Hence the tool was helpful to increase the understanding in the subject.

8.3.3 Customized the learning process.

The students were allowed to learn in the pace of their learning ability. The tool allows the student to gain a sufficient understanding in a prerequisite concept before proceeding to learn the subsequent concept.

8.3.4 Monitor the learning process of individual students.

A profile for each student is created that records the number of attempts made to learn each concept and its corresponding results.

8.3.5 Monitor the learning process of the entire class.

The lecturer is presented with a selection of ways to monitor the class progress:

i. Best performance of class in each concept.

ii. The result of class segregated by grades such as poor, good and excellent in each concept.

iii. The list of students who have passed all concepts.

iv. The list of students who have not passed any concepts.
v. The understanding of the class in each concept.

vi. The overall understanding of the class in the subject.

8.3.6 Easy to familiarize the tool.

The tool was designed taking into consideration of usability and user experience goals. The tool can be familiarized in less than half an hour, hence the lecturers and students has a fondness to use the tool. It takes lesser time for the lecturers to set up the course.

8.3.7 Usability Principles

Evaluating the StuMOP tool among the lecturers and the students studying “C” programming also revealed that Usability Principles were applied in the design of StuMOP tool. Where all the users felt

i. The screens were easy to navigate.

ii. The Error messages were comprehensible.

iii. The Performance reports were legible. The graphs were provided with color coding and results provided in column charts were attractive.

iv. Information presented is clear and easy to understand.

8.4 Limitations.

In spite of several advantages, StuMOP tool has limitations as described:

i) As the students are given unique set of random questions, a large pool of questions is needed for each concept.

ii) The order of concepts in concept list cannot be changed. Hence the lecturer should decide with great care the concept list considering the prerequisite concept in advance of creating in the tool.
8.5 Problems Encountered

i) Since a large pool of questions required for a concept to be tested. A great effort was made to collect maximum fifty questions in each concept. All the questions were keyed into the system with relevant choices and a correct answer.

ii) The students need to be given a random set of questions for a concept each time in order to avoid copying the answers for same questions. It also helps the student practice a concept. When this requirement was coded using java; since the random function picks questions randomly there were more chances for a question to repeat many times in a set of questions. Then the vector difference idea was used to overcome the above-mentioned problem.

iii) The idea to generate graphs to represent student performance using java was challenging. Then it was overcome by applet programming. Graphs were programmed to dynamically generate colors based on the students’ performance.

8.6 Future work

For any kind of research, some suggestions and recommendations are necessary for the improvement of the research in future. It is also important to give some ideas on how the research could be more effective in future and to reach certain objectives that could not be done at this stage.

i) An extension the researcher would like to perform on this project would be to introduce the questions of a concept at various levels of difficulty; on a
five point scale from one to five where one represents “no knowledge” and five represents the “sufficient knowledge”. The students need to successfully complete a minimum of certain questions at each level in the concept.

ii) The project took the input of multiple-choice, fill in the blanks and true or false test results as input that are particularly suitable for machine analysis, however any test that is based on exact input/exact output can easily be turned into a medium suitable for machine analysis. For a programming test, if the test specified that the answer would be the line of output from the user’s program, then the user could either upload the program, and the machine could run it and examine its output or type their program into a webpage, where it would be compiled and its execution could be examined. Such a feature could be very useful, as it would automate all practical laboratory tests.

8.7 Summary

In this research an approach to provide SCeL was proposed. The research also presented a web-based tool StuMOP to demonstrate the research objective. The features of StuMOP tool include a profiling module, monitoring module, automated quiz generation module, an adaptive quiz generation module, a quiz input module, a quiz edit module, an administrative module, and a report generation module. The questions in the student quiz module are randomly picked from a set of questions created by the researcher and presented in a non-repetitive manner. The StuMOP tool includes a mathematical analysis of quiz results, which are stored in an extensive database as well as various other student performance-related information.
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The evaluation on StuMOP tool provided a positive feedback towards the research objective. The result of this study can be used as a direction in providing quality education in e-learning.