Code Pocket: Development of Interactive Online Learning of STEM’s Subject

Nurul Azma Zakaria, Muhammad Shamil Saharudin, Robiah Yusof, and Zaheera Zainal Abidin

Abstract: As to promote and develop STEM education in Malaysia, various approaches have been taken, including improving the curriculum of secondary school by enhancing the contents of the Technology subjects. In this paper, we are concentrating on the issues raised in learning and teaching the computer science subject specifically in supporting the students to understand the syllabus. We propose an interactive online learning application (Code Pocket) using Waterfall model to assist students in learning the subject and enables teachers to monitor the performance of the students. Code Pocket is a web-based application which acts as e-learning platform that consists of many modules such as notes, quiz and reporting. A dashboard menu panel is provided to enable easy navigation. This application provides alternative learning and teaching mechanisms by providing flexible learning environment that promotes online and mobile learning which can be accessed at anytime and anywhere. With interactive features, the learning experience will be better and interesting.

Index Terms: Interactive learning, Online learning, Teaching and learning, STEM.

I. INTRODUCTION

In this era of globalization, Information and Communication Technology (ICT) has become a common thing among young generation. They have been exposed to technology in their early ages and accessing online information have become popular among them. With increasing general ICT skills and knowledge, Technology subject in Science, Technology, Engineering and Mathematics (STEM) education which was introduced in 2001 [1] can be further improved and benefits the country in the future. Due to this aspiration, in 2017 the Ministry of Education Malaysia (KPM) has introduced the Curriculum of Secondary Schools (KSSM) through Malaysia Education Strategic Planning Development (2013-2025) [2]. In this new curriculum, a new subject named Basic of Computer Science (ASK) with additional technical contents is replacing the general ICT Literacy (ICTL) subject. It is an important subject for Form 1 students. The syllabus is more challenging as the aim is to develop a computational minded student. ASK focuses more on concept of computer science and creativity.

Students is introduced to the basic of programming as for preparation for more advanced programming in the following years.

However, a number of challenges and issues exist in teaching and learning areas of STEM education and various studies have been carried out by previous researches [3]-[9]. One of the key problem is the difficulty face by the students, especially for those who have very minimal knowledge in the subject, in this case is ICT knowledge, to understand the syllabus. They might be having trouble to understand as the syllabus introduces the basic of programming. Moreover, there are lack of resources related to this subject, other than the textbooks and modules given by the teachers and most of these are offline resources. There are also shortage of interesting and interactive medium to attract and keep the students’ interest and focus during learning session.

As most of the youngsters have been exposed to gadgets like laptops, smartphones and tabs, the use of E-learning and online materials have become an attractive solution to the issue as studies done by [10], [11]. In this paper, we propose an interactive online learning application, named Code Pocket which assists students in their learning and provides flexible mechanism for the teachers to manage the learning session and monitor students’ performance. With E-learning platform, the productivity can be increased as the subject can be accessed at anytime and anywhere. Code Pocket serves as a new medium that is highly intuitive and interactive for students and teachers in supporting the government’s vision in STEM education.

The rest of this paper is organized as follows. Section II laid out detailed explanation on the design and methodology of Code Pocket. This paper continues with Section III that describes the implementation and ends with a conclusion in Section IV.

II. DESIGN

Code Pocket consists of four (4) modules and two (2) user types. Table 1 and 2 show the details of modules and user types.

Table 1. Code pocket modules

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online Notes</td>
<td>There are four (4) chapters based on the syllabus</td>
</tr>
<tr>
<td>Online Quiz</td>
<td>Each of the chapters consists of quiz to test the students’ understanding</td>
</tr>
<tr>
<td>Report Analysis</td>
<td>Teachers able to generate report and graph for every completed quiz</td>
</tr>
<tr>
<td>Student Record</td>
<td>Teachers able to add new student, delete, update the record and search the</td>
</tr>
</tbody>
</table>

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The software development life cycle (SDLC) used in this application is Waterfall model [12]. Waterfall model is a sequence of seven (7) non-overlapping stages in which the output of each stage becomes the input for the next. The progress is seen as flowing steadily downwards through the phases of requirement, analysis, design, development, testing, implementation and maintenance.

The following subsections elaborate on structure chart, flow chart, pseudocode, entity-relation-diagram (ERD) and application interface of the Code Pocket application.

A. Structure Chart

Structure chart as depicted in Fig. 1, shows the overall connections between system modules and user types of Code Pocket. Each user type has its own modules as tabulated in Table 1 and 2. For example for user type Students, there are two (2) modules exist in this user type and for each module there is an activity allowed to be performed such as View Notes and Answer quiz.

B. Flow Chart

A flow chart is a diagram that represents the flow of the system, steps and also connections. There are three (3) main flow charts which illustrate the overall flow of the Code Pocket application. Fig. 2 demonstrates the flow chart of the Code Pocket’s Main page. At the Main page, users are able to view the information about the system, and login as Teachers or Students. Both user types have different level of access and functions.

Fig. 3 shows the flow chart of the user type Teachers. In this user type, the teacher serve as admin where the admin have full access of the modules in the system. There are four (4) modules which are Notes, Quiz, Manage Student, and Reporting.

Fig. 4 shows the flow chart of the user type Students. In Students login account, the student serve as user where the user has limited access to the system based on the module. The user can view the notes uploaded by the teacher and answer the quiz available in the application.

C. Pseudocode

Pseudocode shows the details and flow of the system in the form of algorithm where the statement are in human reading form rather than programming code. Fig. 5, 6 and 7 represents the samples of pseudocode for the flow of process illustrated in Fig. 2, 3 and 4.
D. Entity-Relationship Diagram

This subsection describes the entity-relationship diagram (ERD) which focuses on the relationship among tables in the database. Fig. 8 shows the ERD of the Code Pocket and Table 3 lists the business rule applied in this application. In total there are eight (8) tables namely teachers, students, notes, notes_has_quiz, quiz, quiz_has_students, results and category. Each table contains various attributes related to the table, primary and foreign keys, and types of the attributes such as integer (INT).

E. Interface Design

Interface designs illustrate in this subsection are the actual system interface design of the Code Pocket application. In general, the design of the interface is similar for both user types. However, there are slight differences which based on the modules and activities of the user types as illustrated in Figure 1.

Fig. 9 depicts the Main page of the Code Pocket application which provides the overview of the system and serves as the introduction to the subject for both user types account (Teachers and Students). Initially, the user types Teachers and Students were registered in the Signup page as presented in Fig. 10. The registration is required in order to record access details such as username and password and user’s information like name, e-mail and ID in the system. In order to access the application, username and password are required in the Login page of both user types for the authentication process, as shown in Fig. 11 and 12 respectively.

Table 3. ERD Business Rule

<table>
<thead>
<tr>
<th>Business Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>One teacher can have many students</td>
</tr>
<tr>
<td>Many students can have many quiz</td>
</tr>
<tr>
<td>Many notes can have many quiz</td>
</tr>
<tr>
<td>One quiz can only have one result</td>
</tr>
<tr>
<td>One quiz can only have one category</td>
</tr>
</tbody>
</table>

Fig. 5. Pseudocode of the Main page.

```
Begin
  Display Main page
  IF userlogin = "Student"
    IF login = "Student" AND verify = "Valid" then
      Go to B
    ELSE
      Go to A
    END
  ELSE
    Register new account
  END
End
```

Fig. 6. Pseudocode of the Teachers page.

```
Begin (A)
  Dashboard
  IF action = "Notes" then
    Display list of topic and subtopic
    IF action = "Add note" then
      Add note
    ELSE
      Edit/Update
      IF action = "Delete note" then
        Delete note
      END
    END
  ELSE
    "Quiz"
    IF action = "Add quiz" then
      Add note
    ELSE
      "Delete quiz"
    END
  END
  IF action = "Reporting" then
    Display report
  END
  Display help information
End
```

Fig. 7. Pseudocode of the Students page.

```
Begin (B)
  Dashboard
  IF action = "Notes"
    IF action = "View notes" then
      Display notes based on topic
    END
  IF action = "Quiz"
    Select topic
    Display question
    Input answer
    Display result
  END
  Display help information
End
```
Once the user was able to login into the application, the user’s Dashboard was displayed as the Main page of the specified user either Teachers or Students. Fig. 13 represents the example of Dashboard for user type Teachers. Elements on the left panel of the Dashboard page for both user types indicates the permitted activities for them as listed in Table 2. Elements on the right panel displays all contents such as notes and quiz related to the subject, where user type Teachers has full access (add, edit/update and delete) in this environment. User type Students is able to interact with the material available in this panel. For example, in Quiz section as shown in Fig. 14, Students was able to attempt the quiz by choosing the correct answer and at the end of the session, the summary result of the quiz was displayed. Fig. 15 displays the sample of Quiz Result interface. In addition, Fig. 16 shows the interface of students’ record that were managed by the Teachers. The details of the student was searched by using Name string.
III. IMPLEMENTATION

This section explains about the system implementation in terms of programming technique and error handling involved in the development of Code Pocket.

The programming language used to develop the function of the application is Hypertext Preprocessor (PHP) [13] and the web interface runs on HyperText Transfer Protocol (HTTP). Moreover, JavaScript [10] is used to make sure the flow and the process loaded run smoothly and Cascading Style Sheets (CSS) is used to design the presentation of the application so as to make it attractive. The following figures demonstrate the code snippets of the Code Pocket.

Fig. 17 shows the usage of IF statements that check the condition and generate the output once the requirement is fulfilled. For example, in line 272, the variables were used to connect to the database and line 274 checked the condition for database connection. After that, in line 284, when the user clicked the submit button, the data was updated and then the result was displayed as stated in line 292.

Fig. 18 describes sample code to search a record in the data listed. If the condition is fulfilled, the related record that have been fetched was displayed in the interface as requested. In this case, the search was performed in students table.

Error handling refers to the response and recovery procedures from error conditions present in the system. A pop-up message which describes the error message from the system is displayed for assisting further action from the user. It also helps in maintaining the normal flow of program execution. Examples of error handling are shown in Fig. 19 and 20 which are related to login credentials and 12-digit identification card (IC) number respectively.
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IV. CONCLUSION

Overall, the Code Pocket application was successfully developed for supporting the teaching and learning session of a newly introduced STEM’s subject, Basic of Computer Science (ASK). This work provides an online learning platform for improving the learning experience. With interactive design and user friendly application, Code Pocket becomes a good alternative from traditional learning method using printed materials. The subject’s contents can be accessed easily and the students’ performance can be monitored in real-time by the teachers. However, as Code Pocket is a type of online learning tool, thus the dependency to the network connectivity is very high. Without the Internet connection, Code Pocket is unable to function. Nevertheless, this development acts as an example for other implementation in STEM’s subjects such as Science and Mathematics. In the future, the contents and function of Code Pocket application can be extended and improved, and a mobile version of Code Pocket is able increase the portability and usability of the application.

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REFERENCES


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