

The University of Hong Kong

CAES9542 Technical English for Computer Science

# **Interim Report**

Topic: An e-learning platform for teaching JavaScript and React Native

Name: Hui Lok Tung, Jennifer

UID: 3035176274

Supervisor: Dr Chim T W

## **Abstract**

This paper introduces an e-learning platform that teaches beginners on writing JavaScript and React Native. The platform is trying to promote programming and encourage people to write codes by providing interesting tutorials of the two programming languages. After finishing the tutorials, people can test their knowledge by taking quizzes and receiving a performance report. They can also practice their knowledge by developing a personal website or application. The platform provides functions like registering as member and searching for a particular function. It also makes use of colorful design and relevant images to attract users. Technical designs are discussed in the paper, including the design for user interface, database, security and test cases. Moreover, it compares other e-learning platforms and summarizes the features that worth for referencing. The paper ends with the discussion on the constraints of the project. Currently, the project is under investigation and designing. After the preparation of tutorials, the implementation of the application will be started. The user interface will be implemented first, followed by adding other functions. At the end of the project, there will be multiple tests and further maintenance is also possible in the future.

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# 1 Introduction

This chapter provides a general perspective on the project. It explains the motivation and benefits of the project, and indicates the main features. Scope and deliverables are also clearly stated in this chapter, in order to advance the development of the project.

## 1.1 Background

In the digital age, computers and smart devices are prevalent. People use them to play games, browse social networking sites or search learning resources. Although they spend lots of time on using the software or websites, the majority may not know how those functions actually work. People are usually scared of programming and have a stereotype that writing codes is complicated and boring. However, it is necessary for modern people to get in touch with programming. By understanding the operations of computers, people can use the machines in a more effective way and develop a sense of computational thinking. Computers are different from humans, it only follows the step-by-step instructions and executes correspondingly. All powerful functions are actually the sequences of commands. When people encounter a complicated problem, computational thinking helps them to divide the problem into small pieces which will be easier to solve. This technique can be applied in any discipline including commerce, archeology and music. For example, people engaged in commerce can investigate the market rules by computational analysis, thereby making a better decision [1]. Therefore, computational thinking is a skill that is beneficial and worthwhile for wide promotion.

Career-wise, people who know programming have the advantages over the others. In United States, 8 of the top 25 jobs are related to technology, including mobile developer and software engineer.

These jobs have high salaries and better career opportunities, while the market is also seeking for IT professionals and engineers [2]. In Hong Kong, there is also a rising demand on software and network engineers. Since the development of Hong Kong highly relies on the financial industry, the transformation of business models will directly affect the job market. When the companies are making everything online and digital, they need to hire more computer scientists for technical support, including data analysts. Therefore, encouraging the students to learn programming is not only beneficial to their future career, but also helping the sustainable development of Hong Kong society.

## **1.2 Objective**

This project aims to enhance people's learning motivation of programming. Since the target user of the platform will be the general public who are beginners as a programmer, it will consider the user experience for both old and young people. Through the use of multimedia and games, the platform will be able to attract users in different age groups. Furthermore, knowledge checkpoints are also included to ensure the user has fully understood the codes.

In the long term, this project also tries to promote the importance of programming in Hong Kong. At this moment, many people still are not aware of how computer science will affect their daily lives and do not interest in computer science. This project offers a more interesting way of studying programming to people and tries to help changing people's attitude towards computer science.

### **1.3 Scope**

E-learning is a popular issue and many educational organizations make an effort to make study easier for everyone. Instead of traditional studying that students need to sit in a classroom and listen to the teachers, e-learning allows students from all ages to study anywhere at anytime. For example, the Chinese University has set up an e-learning center that converts the learning materials of engineering and mathematics courses into e-learning formats and makes them accessible to secondary students [3]. It helps promoting self-learning and encourages students to study on their own.

This project can be regarded as a realization of e-learning that creates an interesting learning experience for beginners on programming. The application provides organized and interactive tutorials that help the user to understand and practice the programming scripts. It also generates a feedback report automatically for checking the learning performance. In addition, the application contains a membership system and allows the user to search for a particular tutorial. It also applies gamification features and academic knowledge into the tutorials in order to keep the balance between studying and entertaining.

### **1.4 Deliverables**

The application consists of two parts: the tutorials and the user interface. Both the well-designed tutorials and the user-friendly interface aim to enhance the user experience for users in any age group and maximize the effectiveness of learning programming. In this stage, this project will only focus on teaching JavaScript and React Native. These two languages are suitable for beginners to



get started with programming because their syntaxes are easy to understand. They also have a similar scripting style and users can choose to learn them together or separately depending on their personal interests. Moreover, the tutorials will be a set of step-by-step tasks. The user can drag or drop the blocks to achieve specific goals and observe the corresponding changes in code by clicking the buttons. The design of tasks can give a sense of satisfaction to the user and thereby enhancing their motivations to complete the remaining tasks and study more about the language. After finishing a tutorial, the user is required to have a quiz and obtained an automatically generated report is provided for one's reference. In addition, each tutorial is designed to be able to finish within 30 minutes, which cater for the fast pace of living of Hong Kong people.

In order to have a better management of the tutorials, the platform uses different tags to classify the tutorials. Users are allowed to search for a particular tutorial by typing the script in the input field provided. Furthermore, the scripts will be divided into different groups by their functions. For instance, 'for loop' and 'while loop' will be grouped together under 'JavaScript looping'. The groups are also sorted by their difficulties. The easiest tutorial will be shown at the top of the list. This helps improving the user experience by studying from easy level to difficult level. Due to the time constraint, there will be only 3 tutorials for JavaScript and React Native respectively.

A login system will also be implemented to control the access right of registered accounts. There are two kinds of accounts: student and teacher account. The study progress and average performance will be stored for a student, while the teacher account can add a tutorial for the platform. However, only the administrator can edit or delete any existing tutorials.

The interface is user-friendly with clear navigations and pleasant design. There are instructions for each function of the platform and each step in the tutorials. Contrasting colors and multimedia are also used to increase the readability. Customized interface may be developed in the future and users can choose a color theme with their preference.

This project will only focus on developing the computer version of the application. It adopts the most common display resolution of computer monitors, which is 1366 X 768. This was suggested by the survey done by StatCounter. Figure 1 shows the statistics of global desktop screen resolution and nearly 30% desktop computers are using 1366 X 768 as display resolution. It is clear that using the display resolution of 1366 X 768 will gain a better user experience.

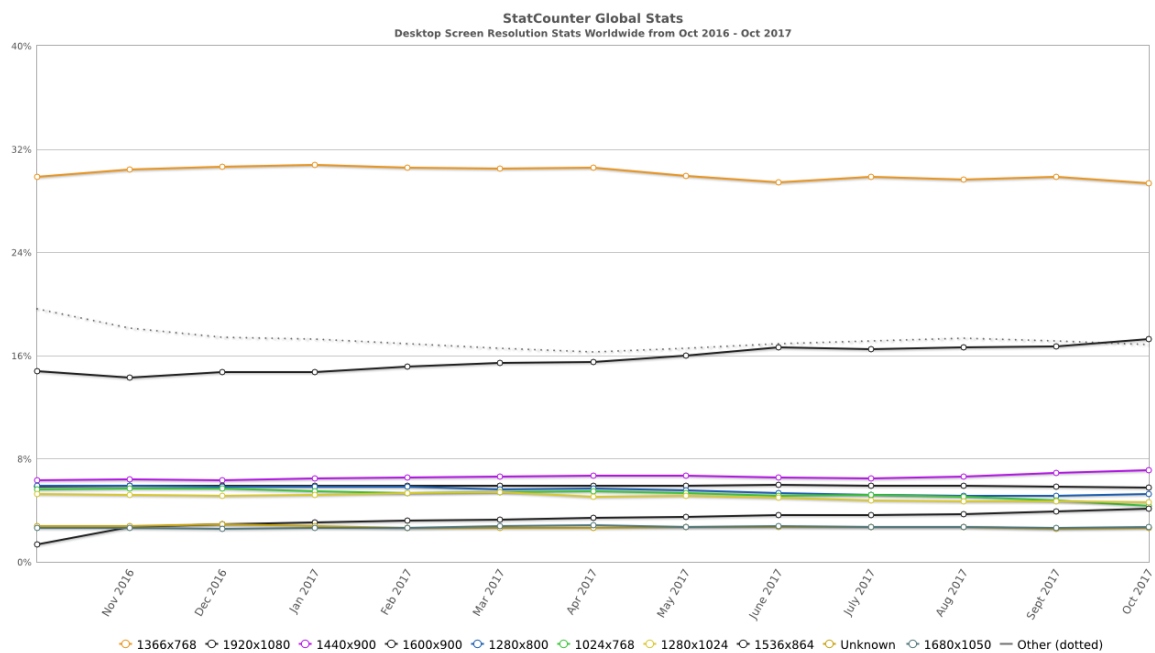


Figure 1. The Desktop Screen Resolution Stats Worldwide

In the remaining parts of this paper, it will provide a literature review of the project, and then discuss the methodology and initial findings. The literature review chapter compares the features of two existing e-learning platforms, Scratch and W3Schools.com in section 2.1 and 2.2 respectively. In the methodology chapter, it introduces the software used in section 3.1, and then presents the designs of content, user interface, database, security and test cases. Next, the constraints and current progress of the project will be discussed in chapter 4. As the project is still under development, this chapter only focuses on the early research. Finally, the paper will end by a short conclusion and giving the future plan for the project.

## **2 Literature review**

In the researching stage, the study on other e-learning platforms was served as an inspiration of the design and development of the project. There are many famous platforms teaching computer science and programming, such as Scratch, W3Schools.com and Code.Org. This chapter lists their main features and introduces the similar elements that were applied into the platform.

### **2.1 Scratch**

The greatest feature of Scratch is the powerful functions that allow the user to show their creativity. Without downloading any software, users can write a program by moving or combining the blocks on this online platform. They can work individually or cooperate with friends. The platform also provides tutorials of some simple games, including catch game and hide and seek. Users can follow the clear instructions to create their own games and make changes to the original design.

Figure 2 is the environment when the user is creating a new project in Scratch. The page is divided into several parts with different functions, including the navigation bar, the stage, the block palette and the script area. The scripts are grouped by their functions, such as ‘Sound’ and ‘Operators’. If the user chooses to follow the step-by-step tutorial, there will be clear instructions with text and animations. These designs will be implemented into the platform to help beginners getting familiar with the platform in a short time. Meanwhile, an output area also contributes to the learning of beginners. Since the platform can compile the codes and show the result immediately, it helps the user to understand how the scripts actually work in a website or an application. The color palette of grey and blue is also worth for referencing as a comfortable design in user interface.

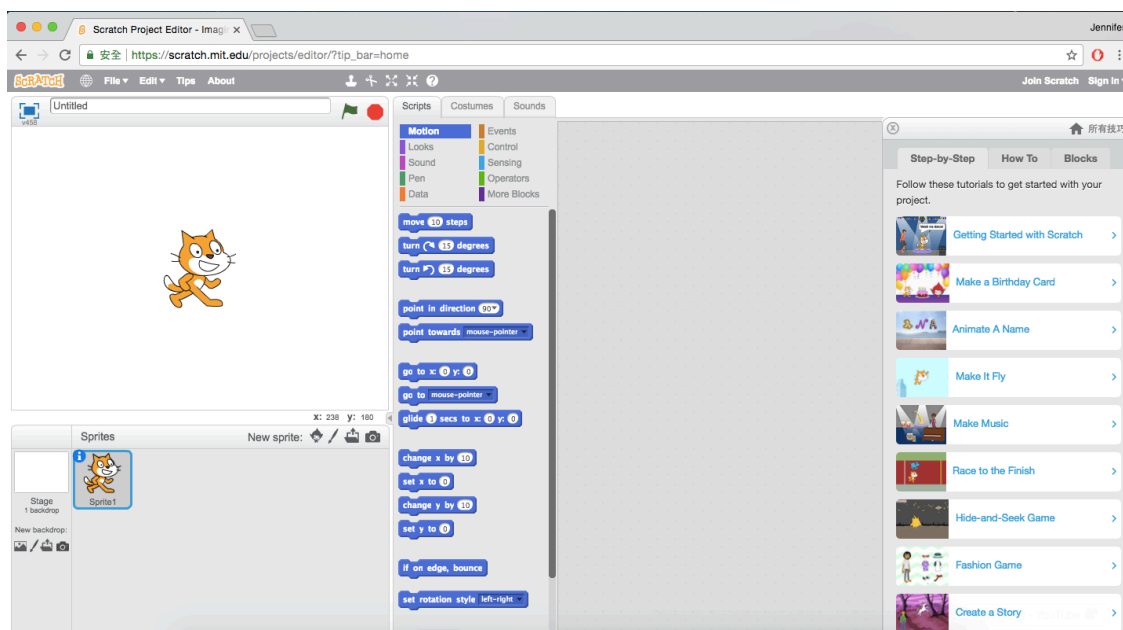


Figure 2. The interface of Scratch Project Editor

## **2.2 Code.Org**

The one-hour tutorial and learning courses in Code.Org are well-organized and attractive to users with different backgrounds. “Hour of Code” is a list of lessons designed to be complete in a limited time. It is more convenient for the user to manage the time for studying the programming language. There is also a short introduction video before each lesson, it helps the user to clearly understand the learning outcome and has an overall view of the lesson. In addition, Code.Org also offers some tutorials with well-known themes such as Minecraft and Frozen. It is an effective way to arouse the curiosity of users and encourage them to explore the behind logic and codes of a game.

It is obvious that the presentation of programming scripts in Code.Org is intelligible and attractive for beginners. Therefore, this project considers a similar approach. Each tutorial will contain adequate interactive components with a specific theme. For example, the user can follow the steps to program an online calculator. Because of the practical program, more users may enjoy the process of programming and obtain a sense of pleasure.

## **2.3 W3Schools.com**

In W3Schools.com, users can find many tutorials related to web design. The tutorials are divided into groups, such as ‘HTML and CSS’, ‘JavaScript’ and ‘Server Side’. Under these groups, the scripts are further subdivided by their functions. For example, the user can see ‘Learn SQL’ and ‘Learn PHP’ under the tag of ‘Server Side’. This design of navigation bar is clear and convenient for the user to search for a particular programming script.

In the tutorials, it explains the reason of learning the language and introduces the scripts with various examples. The user can also try to edit the codes to observe the changes. Figure 3 shows the interface of the Tryit Editor provided by W3Schools.com. For each example, user can modify the code and compile it online. The result will be displayed on the right-hand-side after the user clicks the 'Run' button. Similar to Scratch, this feature is effective for learning by helping the user to understand how modification of codes affect the operation of a website or an application.

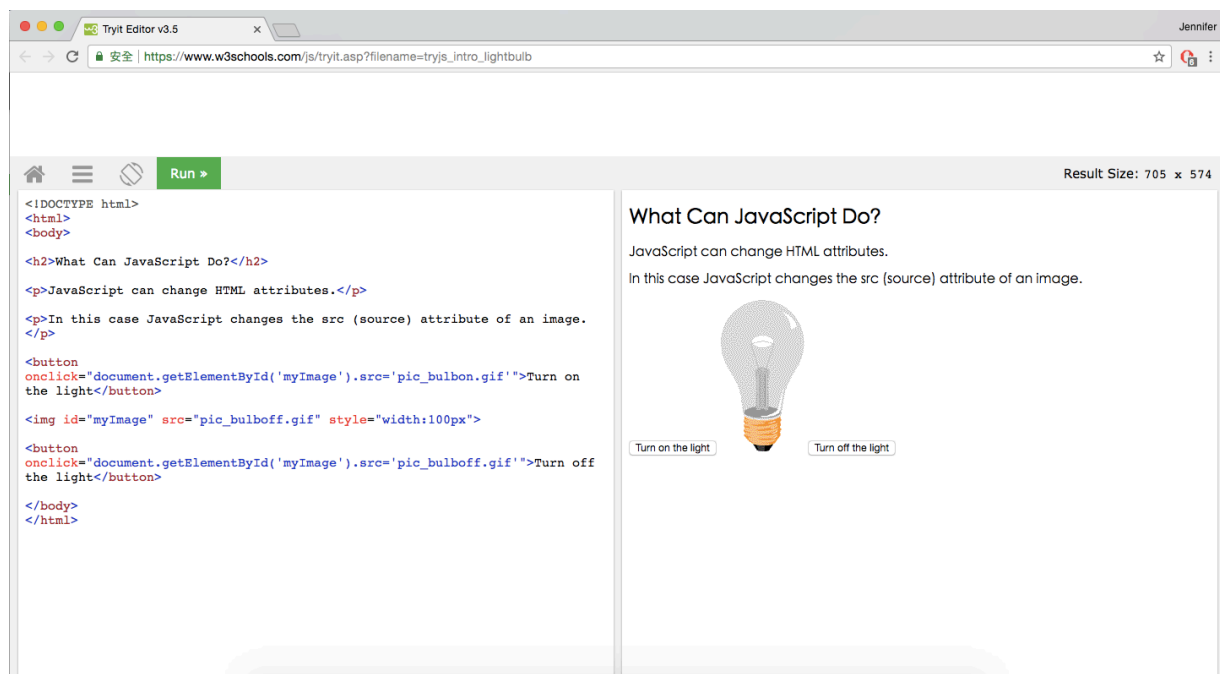


Figure 3. The Tryit Editor in W3Schools.com

This project divides the tutorials into two main groups: JavaScript and React Native. There will be a page for introducing the language respectively and therefore, the user can have a basic concept of the language. The scripts are subdivided by their functions and ordered by difficulties. These features are believed to be user-friendly to beginners on programming.

### **3 Methodology**

In this chapter, the realization of the project is discussed and the current design of the whole application is shown. Any modification is possible in the future as the project is currently on the research stage. If there are unpredictable constraints encountered during the development, the design may be changed to achieve a better performance.

#### **3.1 Software**

Unity is the main developing tool in this project. Although it is a game engine, it provides powerful functions that meet all requirements for implementing the e-learning platform. Additionally, Unity can port on different devices, such as Mac, iOS and Android systems. It helps the future maintenance of the project for enlarging the user groups. For the tutorials, they will be some step-by-step tasks which is similar to the different levels in games. Through this design, the user will feel like playing a game and does not get bored when studying the codes. Interactive components can also be implemented in Unity. The platform also includes a feedback system, which shows the learning outcome of the user. When the user is completing the tasks, a behind algorithm will calculate the time used and the correctness of the quizzes. Therefore, the platform can grade the performance and allow the user to evaluate the effectiveness of his self-learning.

### 3.2 Content design

According to the features mentioned in chapter 2, the design of tutorials will be academic and entertaining. In general, each tutorial is a set of step-by-step tasks and teaches the scripts with similar function. For example, the user will learn data type, which includes number and string, in the same tutorial. The user can follow the instructions and try to understand the syntax in order to complete the tasks. Figure 4 shows the design of the tutorial. The page will be divided into four fields with different functions. The user can drag and drop the functional blocks in the provided area to achieve the goal, and observe the corresponding code and display clearly.

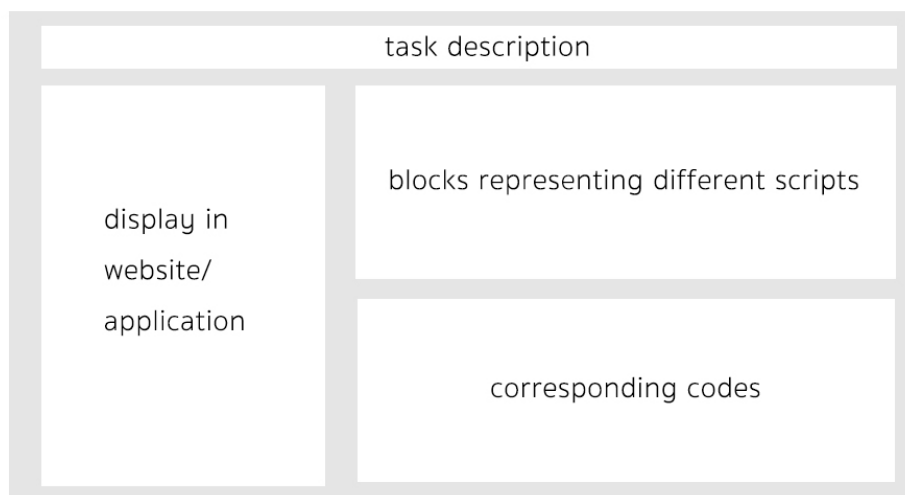


Figure 4. Layout of the tutorial

After finishing a tutorial, there will be a short quiz for testing the knowledge of the user. The format will be either some short questions or a real-life situation. For example, users may be required to implement a login form on their own. A feedback report will be automatically generated for the user to check his learning performance.



### 3.3 User interface design

Considering of any potential user of the platform, it uses an interface that is user-friendly to any age group. It provides clear instructions for children or the elderly to follow, and a comfortable design for everyone to use. Figure 5 shows the general design of the user interface. The name of the e-learning platform is on the top of the screen. A navigation bar is shown on the left, listing all functions such as login, search and the tutorials. If the user has logged in to the platform, a personal information box will then be shown at the top of the navigation bar. Otherwise, it only displays a 'login' button. On the right hand side, there is a content box which displays the corresponding page after the user has clicked on one of the buttons.

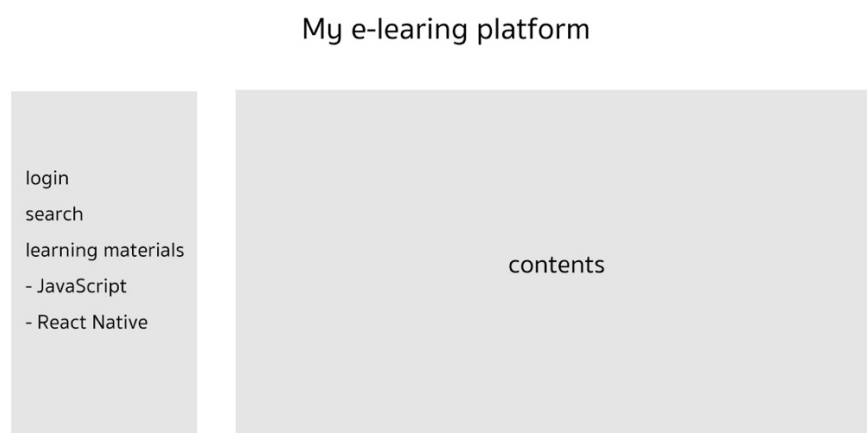


Figure 5. The interface design of the application

After the user clicks on the search button, the results will be displayed in the content box and sorted by relevance. The calculating algorithm depends on the tags of each tutorial. Moreover, if the user clicks on the 'JavaScript' or 'React Native' button, the navigation bar will display a list of tutorials

and sorted by the difficulties below the selected button. The content box also displays an introduction of the programming language and explains why the user should learn about this language.

If the user clicks on login, the content box will display as Figure 6. The left-hand side serves as a login form, while the right-hand side allows a registration for a student or teacher account. The user will need to send additional information to the administrator if he registers as a teacher, since the teacher account can create new tutorials for any of the two programming languages. It is essential for controlling the quality of all tutorials provided in this application.

The image shows a user interface for login and registration. It is divided into two main sections by a vertical line. The left section, titled "Login", has two input fields: "Username:" and "Password:". Below these fields is a black button with the text "LOGIN" in white. The right section, titled "Register", has three input fields: "Username:", "Password:", and "Confirm password:". Below these fields is a "Register as:" label followed by two black buttons: "STUDENT" and "TEACHER", both with white text.

Figure 6. The Login and Register page

### 3.4 Database design

This project uses a XML file instead of a relational database to verify the login accounts. The reason of using a XML file is that it is easier to implement. It is also adequate for storing all

necessary information for the membership system, including the username, password, personal information and learning progress for the student account. The learning progress is in the format of chapter numbers for JavaScript and React Native respectively. If the user does not finish any tutorials, the progress would be 0. XML file is also flexible enough for updating the learning progress at the current stage. The user is allowed to access the tutorials without registration. Therefore, the XML file may not be large and can be efficient as relational database [4].

### **3.5 Security design**

A security system is used to avoid unauthorized access to the application. Since the application is open to the public, there are potential threats such as DoS attacks, which will disrupt the service temporarily by sending superfluous requests to the server. One of the solutions is blackhole routing. It is a technique that directs the redundant requests to a null interface. However, it is still possible that the service continues to be disrupted if the developer cannot distinguish the source IP address of the attacker [5]. Due to the difficulty of developing a defending system, this project only attempt to filter the unauthorized access with unknown IP address.

Apart from the cyber-attack, it is also essential to control the access right of users. The function of adding tutorials is only available for teacher accounts, therefore the setting for access right is different between teacher and student accounts. Furthermore, the teacher account will only be given the right to add a tutorial, but not delete or modify any other existing tutorials. After a teacher account is logged in, there will be an additional function of 'Write Tutorials' shown in the navigation bar.

### **3.6 Test case design**

After the development of the application, there will be sets of test cases to ensure all functions work as expected. The test cases can be divided into four groups: test for login system, registration system, search function and displaying the tutorials. They will be designed as follows:

For the login system, there will be different pairs of username and password, including valid and invalid accounts, and teacher and student accounts. The invalid account refers to wrong username, wrong password or non-existent accounts. There are also test cases with null input for the login form.

Test cases for registration system will consider null input, duplicated username, inconsistent input for the two password input fields. There are also test cases for registering a teacher account, the application should display another form for detailed verification of professions.

To test the search function, there are cases for null input, exact and similar wording of existing tags and also non-existing tags. It is tested by checking whether the results are displayed and sorted correctly.

The display of tutorials can be tested by changing the difficulties and groups of tutorials. The order in the navigation bar should be changed after the modification. In addition, each button should link to the corresponding tutorial in the content box, and display the correct descriptions and instructions for the user.

## **4 Results**

Since this project is currently on the researching stage, this chapter only focuses on the difficulties encountered and discusses the possible solution. The progress is also clearly stated for reference.

### **4.1 Constraints**

Due to the limited developing time, this project may not be able to support functions such as multi-platform, multi-language and a completed security system. Through the consideration of user experience and potential device, this project only focuses on the computer version. According to a survey by GO-Globe, the percentage of usage of non-mobile web device is 90.9% while the one of mobile web device is 77.4%. Among all devices, desktop computer is the most common device used for internet service [6]. Although there is a trend on using smart phones because of its convenience, computer which has a larger screen will be more preferable for learning purpose. It improves user experience when the user wants to try coding and observe the result immediately. Furthermore, a computer application can be used by schools to teach programming during lessons. Therefore, this project develops the application with display on desktop computers.

In the 21<sup>st</sup> century, people living in different countries share online resources. It is better to provide several languages for the user interface and tutorials. However, it would cost much more time and dilute the resources of developing the functions. Consequently, this project only provides an English version, which is the international language and can increase the number of users as much

as possible. It is also easier for the user to learn a programming language in English as some syntaxes are not able to translate into Chinese or other languages.

As mentioned in the security design section, it is hard to implement a full security system to avoid cyber-attacks. This project will try to control the unauthorized access of unknown IP addresses and reject any redundant requests to protect the server. The source code of the applications and tutorials are also not visible to all users for safety purpose.

## 4.2 Current progress

Phase 1: Designing and researching	
Design user interface	Completed
Design layout of tutorial	Completed
Design the essential function for application	Completed
Design database	Completed
Design security system	Completed
Design test cases	Completed
Study JavaScript	Completed
Study React Native	In Progress
Phase 2: Building and Implementing	
Build the user interface	In Progress
Implement the functions	Not Started

Program the tutorials	Not Started
Phase 3: Testing	
Test the login system	Not Started
Test the registration system	Not Started
Test all functions	Not Started
Test the display and operation of tutorials	Not Started

The above table indicated the progress of this project. The designs and functions of the application are finalized and the study on JavaScript is finished. The study on React Native costs more time since it is a relatively new programming language. Meanwhile, the development of the platform is in progress. The user interface will be first implemented, followed by the various functions and the tutorials. The tutorial of JavaScript will be programmed before the one of React Native. It is ideal that the user interface will be developed completely before early February and the implementation of tutorials can be finished before the end of March. After the full development, the platform will be tested for all functions and corresponding modifications will be implemented to obtain a better user experience.

## 5 Conclusion

Currently, this project is on the designing and researching stage. This paper provides a general view for the functions of the applications, including a membership system, searching function and

the design of the tutorials. The tentative design of the user interface is also shown in the methodology section. Due to the time constraint or other unexpected factors, the functions may have minor adjustments and new functions may also be added to the application. In the following stage, this project will first start implementing the user interface and writing the tutorials for JavaScript and React Native. After building the prototype of the platform, all functions will be tested and the platform will ask for feedback from other engineers and people in different age groups. This project will finalize the product by April 2018.

Although it is hard to change people's attitude towards programming in a short time, this project encourages more people to write codes by using an entertaining way to introduce programming. By learning JavaScript and React Native, people are able to write their own websites and phone applications. This is attractive because people can practice their knowledge into something they are familiar with. It also stimulates innovation as the user may have different backgrounds. Furthermore, this project hopes to promote the importance of programming to the general public and maintain the sustainable development of computer science in Hong Kong.

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