DEVELOPMENT OF ONLINE TC COMPILER EXERCISE FOR C PROGRAMMING BY AJAX

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Abstract

The instructional process of computer programming via internet, it must motivate learners' intention and the pattern of interactive activities. As a result, we developed the online exercise for the subject of C Programming. For this online exercise, some problems are given with blanks to allow learners to fill out the missing Commands, Statements, or Expressions. Thus, learners have chance in improving their skills, knowledge, understanding and memory in accordance with contents. We used the PHP for developing the online TC Compiler exercise for subject of C Computer Programming by AJAX. Evaluation results by experts are at very good level. This tool can respond and give feedback results for learners regardless the Platform, making the learning and instruction process more efficient, and gives the most satisfaction of learners.

Keywords: TC Compiler, C Programming, Dynamic Web Page, AJAX

Introduction

The curriculum of Diploma degree of Year 2003 imposes C Programming as specific occupation Business Computer (Ministry of Education, 2003) but there is a lack of instruction media of interesting and immediately responsible features for learner to provoke their intention. The access to instruction media requires the support of operation with many Platforms and with differences of Hardware, Software and/or Operation Systems because learners use different devices to access data such as personal Computers, Tablets, Smart Phones, Smart TVs, Mobile Phones, etc., making the existing media unable to work completely, for example, cannot run the Script Program on the iOS, or if the learner use Tablet with Android, it cannot support the TC Compiler for exercise, thus, to be consistent with the behaviors of today learners who use a wide variety of access devices, we studied and developed solution for problem in doing the online exercise, which support the access to the network system from many platforms.

The objectives of this article are: 1) propose method for developing the online TC Compiler exercise for C Programming by AJAX, 2) find the quality of the developed online PC Compiler exercise, and 3) fine the learner satisfaction for learning by the online TC Compiler exercise.

As the objectives above, we intend to create the online exercise to be a part of the research on "A development of Instruction model follow through Multiple Intelligences theory via internet", to extend the learning capability of learners to fulfill their potentially.
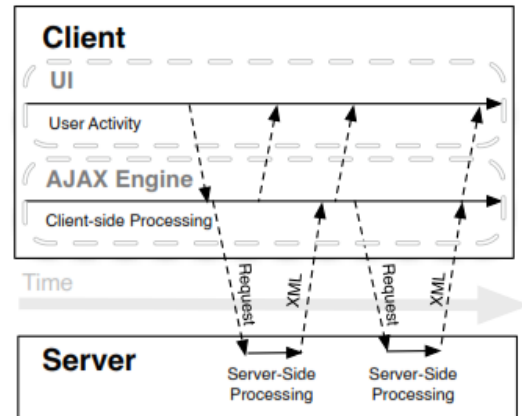
Research Methods

1. Literature Review
This section provides an overview of AJAX technology and terminology.
Overview of AJAX Concepts
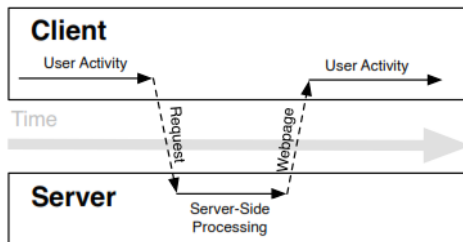
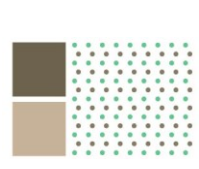**Figure 1** Event Flow in Classic Web Applications.

Figure 2 Event Flow in AJAX Web Applications.

Figure 1 and 2 comparison of the flow of events in AJAX and classic web applications. Under the classic web application model, a user points a web browser at a Uniform Resource Locator (URL), which sends a HyperText Transfer Protocol (HTTP) request to a web server. The web server processes the request by executing server-side scripts and potentially contacting back-end databases. The server constructs an HTML response and sends it to the client. The user's browser is then reloaded with the new HTML document. The user may not simultaneously interact with the web page while the request is being sent or processed, since the web page in view will be discarded once the response is received, and subsequent interaction will simply override previous interactions.

The AJAX design reduces idle user time by allowing the user to interact with a dynamic web page while new content is being retrieved and processed. In the AJAX model (Figure 2), the user triggers a JavaScript event by interacting with web page elements. The JavaScript code sends an asynchronous HTTP request to the web server. The web server processes the request using a procedure similar to the classic server model, with the exception that the response is sent in XML. Once the response is entirely received, the AJAX engine will trigger a JavaScript callback function that may dynamically update the browser by manipulating the data structure representing the HTML elements of the current web page (i.e., the DOM). The user may continue to interact with the page in view while the DOM is being updated, since the page will not be discarded.

AJAX Application Components
As shown in Figure 2, a typical AJAX application is composed of two client side components [1], i.e., the user interface and AJAX engine. These components communicate asynchronously with the web server component. The User Interface (UI) is made up of components that are laid out in HTML and decorated using CSS. The AJAX engine is a JavaScript component that handles the

user-triggered events and sends asynchronous requests to the web server. The asynchronous request transmission details and callback function are encoded using the XMLHttpRequest object (XHR) specified by the W3C (W3C, 2011). The XHR has five possible states with the following values:

1) The initial state (UNSENT),

2) The open connection state (OPENED),

3) The state indicating that the server response headers have been received (HEADERS RECEIVED),

4) The state that indicates that the response body is being retrieved (LOADING), and

5) The state that indicates that the server response has been received (DONE).

The web server component consists of server-side request-processing scripts. The server component may communicate with back-end databases to fulfill a request and subsequently respond to the client, triggering a callback function in the AJAX engine to update the UI.

C Programing

C Programing Language is a general-purpose programming language initially developed by Dennis Ritchie between 1969 and 1973 at Bell Labs. Its design provides constructs that map efficiently to typical machine instructions, and therefore it found lasting use in applications that had formerly been coded in assembly language, most notably system software like the Unix computer operating system. C is one of the most widely used programming languages of all time, and there are very few computer architectures for which a C compiler does not exist [13].

2. Development Methods

2.1 Studying from related documents and other researches such as AJAX, TC Compiler, System analysis and design, System evaluation, C-Programming and High vocational certificate program in 2003 of office of vocational education committee.

2.2 Drafting a basic framework of online TC compiler exercise system on C-Programming course by AJAX which synthesized from related documents, textbooks and other researches.

2.3 Design questionnaire to evaluate technical efficiency of online TC Compiler exercise, Evaluation form of online TC Compiler exercise's contents, Evaluation form of learner's satisfaction and find out the efficiency of evaluation form by IOC method from experts.

2.4 Setting the qualification of related expert that are 1) an instructor or a scholar in computer sciences 2) person who has working experience more than 2 years 3) person who hold a master degree as a minimum education. Selecting 5 samples of experts by specified selection

2.5 Selecting 30 samples of learners from high vocational students who took the course of C Programming by specified selection.

2.6 The design of the development of the TC Compiler is to use as the online exercise on C Programming course by AJAX.

From Fig. 3, the online TC Compiler exercise system is divided into two sides, Server-Side System and Browser client. For their function, the Server-Side System has the Web Server Module for receiving the Script Program to store in Script Database. Then, the TC Compiler draws the Script program for Processing, gives results to store them in the Output Database, sends received results to the Browser Client with the AJAX engine for coordinating the user and Server-Side system, i.e., sends the Script Program to the Server-Side System when is requested by user and sends results back, from the Server-Side System to user who requests them.
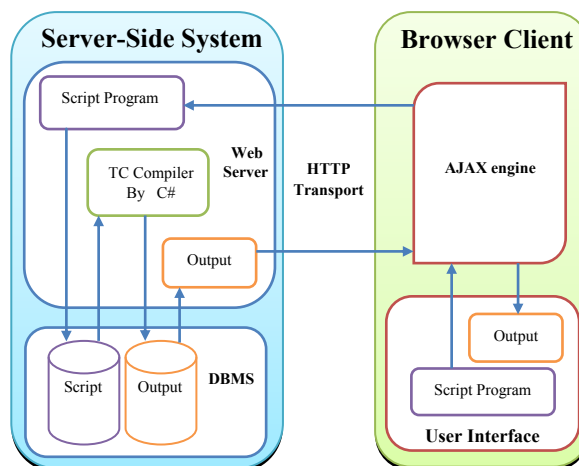
Figure 3 Online TC-Compiler Exercise model

1) User Interface
· The Script Program is the display which corresponds with the learner and the learner can see some parts of the program appearance only. The learner has to enter the missing parts of Source Code into the webpage.
· The output is the results of compile of the C Program.
2) AJAX engine
· Java Script is used for programming on client side with the browser being the interpreter and can be use for webpage in various applications among calculation, display, data sending and receiving and especially the ability of immediate correspondence with learner.
· XML (Extensible Markup Language) helps facilitate communication management with users. From data structure, we can take several sources of data to display and process at the same time.
· CSS (Cascading Style Sheets) is the tool to indicate how document is identified, and to be used for decorate the documents of the HTML/ XHTML to the specified features of appearance, color, border line, space, etc. by defining the attributes of various Elements of the HTML.
· DOM (Document Object Model) is used to prepare the interface for data access in the HTML or AML documents by the Java script.
· XMLHttpRequest is the API which can call to be used from the JavaScript, V.B. Script and other languages for the exchange and adjustment of the XML from the Web Server by the use of The HTTP which creates the connection between the Web Browser and the Web Server.
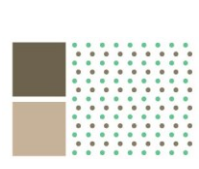3) HTTP (Hypertext Transport Protocol)
HTTP (Hypertext Transport Protocol) is the data communication via new form of the computer network, called "hypertext" by the use of the protocol of HTTP (Hypertext Transport Protocol) type to be used for sending the various information which is design in new form, called "HTML (HyperText Markup Language)". The communication and inquiry of information in this form gives ability of fast communication for every type including image message and vice message.
4) Web Server
Web Server is the computer which acts as a webpage service machine for the requesters by the programs of Web Browser types which requests the data via the HTTP protocol.
· Script Program is the Source Code of the C Program which is entered into the system by learners.
· TC Compiler by C# uses the C# language for programming to draw the TC commands for processing and communicating with the database on the Web Server.

· Output is the result from the compile of the C Program, not from the module TC Compiler by C#. The system will keep the obtained results in the output database and will be drawn out for displaying when user request them.

5) DBMS is the database system which uses the MySQL for storing the Source Code of the program and storing the results from the runs or the F Program.

2.7 System Development Life Cycle

All of information systems have the same life cycle from the emergence till the end and in sequence from the start point till the completed point of the usable system. The system designer must understand what and how to do in each step. The system development has 7 steps as follows:

1) Problem Recognition: Lists the problems and requirements for the exercise of C Programming. The summary is: for most of doing exercise, problems in form of work sheets are given to allow learner to write commands or answers after waiting for some period of time for the check by instructor first. This waiting period results in the lack of learners' motivation. For immediate feedback of learner, results from this step are obtained from the interview, observation and asking the learners, and also referring to the instruction experiences on the C Programming of the researcher.

2) Feasibility Study: As the problems are known, i.e. the skill exercise of the C Programming without immediate response for learners' actions and feedbacks. For this step, researcher collects data of the system and estimates the system requirements.

3) Analysis: In this step, researcher studies the feasibility from documents, literatures, and various researches to find techniques for the construction the exercise or the online practice on the C programming and can immediately know the results from the run.

4) Design: Design new system to be in accordance with learner requirements and objectives in doing exercise to help contribute learners to skill of programming. We designs the User Interface, Input Format, Report Format, and Screen Format. The concept of designing the Input Format is easy-to-use fashion, probably occurred error prevention ability with respect to the safety of the system. Tools prepared for this step are Data Dictionary, Data Flow Diagram, Process Specification, Data Model, System Model, System Flow Charts, Structure Charts, HIPO Chart, Incoming Data Form, and Report.

5) System Construction and Development - Do programming according to the designed model. Prepare tools including Editor Compiler and Structure Walkthrough. Construct database and start programming. Then do program test to see whether it can work or not by testing with the selected real data. If everything is complete, it gives the Online TC Compiler Exercise ready for real applications.

6) Conversion is taking the online practice from the C Program to be a part of the intelligent learning and instruction fashion in accordance with the poly intellect concept on the Module Practice which is one of the research.

7) Maintenance is the correction of the program after use. Major reasons for program correction after use are the problem (bug) with the program and the change in case the exercise of database is too difficult or too easy.

2.8 Experiment

1) Have the TC-Compiler evaluated by 5 experts for its quality of system both in technical and content aspects of the online exercise.

2) Take the online TC Compiler exercise into tests with samples and evaluate the satisfaction by that sample.

2.9 Analysis and explanation

Gather data from the quality evaluation of the system both in technical and content aspects of the online exercise and then gather data from the satisfaction evaluation of learners for analysis and translation of results.

Results

1. Development Result

   After the experiment, we have the online TC-Compiler exercise for C Programming by AJAX ready for setting up the learning and instruction process via internet.
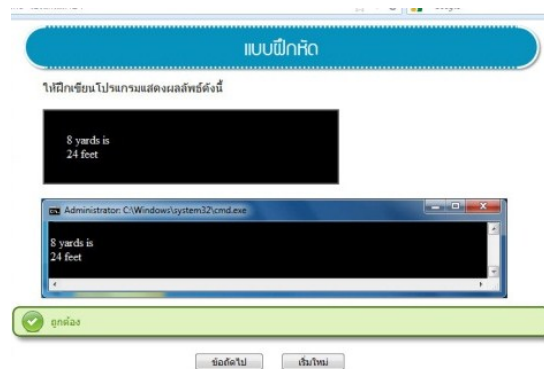

Figure 2 User Interface of Online Practice
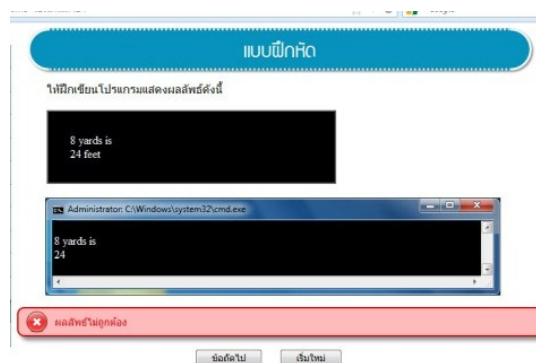

Figure 3 Output of correct programming

Figure 4 Output of incorrect programming

2. Evaluation from Experts

After the tests is completed, we took the online TC Compiler exercise into evaluation for C programming by AJAX by 5 experts both in content of exercise and development technique aspects. Evaluation results are at very good level for both aspects.

Table 1 Evaluation results on contents of online exercise

Evaluation items of online exercise contents	$\bar{x}$	Data analysis result
1. Validation of contents and online exercise	4.80	Very good
2. Consistency of contents and online exercise with learning objectives	4.80	Very good
3. Contents of online exercise are consecutive.	4.40	Good
4. Contents of online exercise are appropriate to learners.	4.80	Very good
5. Suitability of amount of contents of online exercise in each learning unit	4.60	Very good
6. Consistency of exercise contents and learning contents in each learning unit	4.60	Very good
7. Consistency of contents with sub-tests of each learning unit	4.80	Very good

Table 2 Evaluation of Online TC Compiler exercise

Subject of technique evaluation of system development	$\bar{x}$	Data analysis result
1. Function Requirement Test is evaluation of validity and efficiency of system to find how much they meet user requirements.	4.80	Very good
2. Functional Test is evaluation of validity and efficiency of system operation to find how much the system can operate according to its function.	4.60	Very good
3. Usability Test is evaluation of system design to find how much it is easy for use.	4.60	Very good
4. Security Test is evaluation of system for security guard of data in the system to find how much it is safe.	4.60	Very good

3. Evaluation results of Learner Satisfaction

Satisfaction of learner for learning by TC Compiler used as exercise for C Programming by AJAX is measured by the satisfaction questionnaire constructed by us and used with sample of 30 students of Diploma degree. It gave the highest satisfaction level.

Table 3 Evaluation of learners' satisfaction for Online TC Compiler exercise

Subject of Satisfaction parts	$\bar{x}$	Data analysis result
1. Content- It is suited for learner and consistent with learning contents and learning objectives.	4.50	Very good
2. Use - It is easy to use, immediately respond and able to use with every platform.	4.63	Very good
3. Knowledge - It helps contribute learner understanding and enhances programming skill.	4.53	Very good
4. Attitude - Online exercise provokes learner intention and gives feeling of desire to learn, satisfaction and willingness.	4.67	Very good

Discussion and Conclusion

Form research objective of to develop the online TC-Compiler for C-Programming by AJAX, It is shown that this online exercise has high quality for setting up the learning and instruction process via network in accordance with the learning subject and learner requirements and gives result feedback regardless platform.

Evaluation results by experts are at very good level both in development technique aspect of the TC Compiler for use and online exercise and content aspect of the online exercise. By the use of AJAX technique for online exercise for C Programming, it gives quality exercise in accordance with learner requirement and lightens instructor workload. It can immediately respond to learner and therefore learner can receive feedback for the system and knows the results for pass or failure of that exercise. If learner can pass exercise, he or she can go for next contents of next exercise. This online exercise can be worked regardless platform and gives easy access to it. Evaluation results on contents of the online exercise by experts are at very good level due to the fact that after testing with sample, we adjusted contents to be consistent with leaning objectives and subject requirements. Contents of this online exercise are synthesized by experts, exacted from questionnaires, sample interviews Thus evaluation results on contents of exercise are at very good level, consistent with research objectives of Case2.

Evaluation results on learner satisfaction for the constructed online exercise are at highest level. This is due to the fact that learners are most teenagers. The setting up of learning and instruction process via internet network needs activity establishment capable of immediate, brief and rapid responding and able to access to a wide variety of platforms, making learner immediately knows the result of doing exercise, thus helps activate learner to learn, achieves and responds for work, creates incentive in learning desire to be achieved according to the top standard he or she set, knows how to evaluate works and uses feedback data for self improvement.

It is concluded that the online TC Compiler for C Programming by AJAX evaluated by experts both in development technique and contents of exercise are at very good level. It can be used for setting up the learning and instruction process. Sample learners satisfy learning by this online TC Compiler with highest satisfaction.

Acknowledgments

References

1. A. Mesbah and A. van Deursen, (2008) "A Component and Push-based Architectural Style for AJAX Applications," Journal of Systems and Software, vol. 81, no.12, p. 2194–2209.
2. Bancha Pasilatesung. (2008) Web development techniques by AJAX and PHP. Bangkok: Se-ed Ucation. p. 45-48.
3. J. Garrett, "Ajax: A New Approach to Web Applications," http://adaptivepath.com/ideas/essays/archives/000385.php, viewed on: 12-Aug-2011.
4. Jeramy Behrouz A. Forouzan. (2006) Data Communications and Networking. Bangkok: Top Publishing. p. 209-420.
5. Keith. (2008) Bulletproof Ajax(P). Berkeley: New Riders Publishing. p. 7-30.
6. Kitti Pakdeewattanakul (2011) Data Communications and Network. 2nd edition. Bangkok: KTP. p 20-44.
7. Ministry of Education. (2003) High vocational certificate program. Printing Teachers Council, Bankkok. p.15.
8. Panera Panichkul. (2007) System Analysis and Design. Bangkok: KTP. p. 25-29.
9. Promlert Lorvijit. (2007) Handbook AJAX for beginners. Bangkok: Provision. p. 98-105.
10. Siros Supawita. (2007) The development of Web applications with Ajax (practical). Bangkok: Se-ed Ucation. p. 346-349.
11. Shane McIntosh. (2011). Using Indexed Sequence Diagrams to Recover the Behavior of AJAX Applications. Web Systems Evolution (WSE), 13th IEEE International Symposium on 30-30 Sept. 2011, p. 1-10.
12. Sripry Sakroongpongsakul. (2008) Information systems and knowledge management technology. 10th edition. Bangkok: Se-ed Ucation. p. 227-245.
13. Surang Kaowtrakul. (2009) Educational Psychology. 8nd edition. Bangkok: Chulalongkorn University Press. p. 172-174.
14. Teerawat Prakobpol. (2011) C Programing Language. 3nd edition. Bangkok : Simplifly. p. 2-104.
15. Tisna Kaemanee. (2007) Instructional Knowledge to more effective learning process. 6st edition. Bangkok: Chulalongkorn University Press. p. 151-153.
16. W3C, "Xmlhttprequest," http://www.w3.org/TR/XMLHttpRequest/, viewed on: 12-Aug-2011.