VP-Lab : A Virtual Way to Stay Connected with Programming Laboratory

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Abstract—**The VP-lab is built to accommodate the need of virtual laboratory of programming language. The system compiles the program, stored and transferred the data, and marked the exam in an online manner. This kind of approach gives benefits to the parties involved in how utilizing the internet technology to give access to the laboratory that is not limited by space and time. Moreover, the students can optimize their time to do the experiment on Javascript, HTML, and PHP language. This system is developed by the help of Javascript language and node.js as the server.**

Keywords—virtual laboratory; simulation; programming; javascript.

I. INTRODUCTION

The growth of the internet and mobile communication technologies has influenced education system in many ways. The teaching media, for instance, has transformed from personal computer to web-based and printed book to digital. The way of communication between teacher and student has been improved as well; it was physically met, now through electronic mail, chat forum, and virtual class.

The need to have borderless classrooms to share any resources in any forms of laboratory experiments has led to the development of virtual laboratory. The Virtual laboratory or V-Lab is expected to be a cheap way [1] to give an easy access to the student to study about particular issues to let them have a better understanding in ways of virtualization through web/app interface or remote the actual device [2].

The programming skills are needed to be trained continuously for hours. For our students, the office hours in the laboratory, are not enough to let them understand and practice all the necessary instruction. To overcome this, the virtual laboratory for programming subject, called it VP-Lab, has been developed to be embedded on the academic system to give them more time to practice with real cases as if they were in the real laboratory.

The VP-Lab itself stands as a gateway for the lecturer and the students to access the server laboratory virtually. Thus, it provides a 24 hours access for the lecturer to post the questions, assignments, or check the students' answer. The students also have unlimited time to do the trial and error activities to sharpen their skills.

II. RELATED WORK

As now we are living in the digital decades, where the majority of the students tend to carry their textbooks, lab modules, and assignments on their laptop. The students tend to deliver a question "can we get it online?", when the teacher talk about the list of books they need to read or assignment to do to help them understand the subject.

This situation has become one of the reasons for the educational institution to build an integrated online academic system to accommodate the online needs, where some of the services are e-library and e-learning.

As now, the online transformation is not only happening in the classroom, but also in the laboratory, as the result, the method of teaching in the laboratory is improved as well. The physical meet for teaching and supervising are no longer the only option. Numbers of virtual laboratories have been proposed, developed, and adapted in the universities as part of the online era and to get the benefits such as [3]: 1) Resources sharing, improving the utilization of costly equipment, 2) easier access to educational and research material, 3) The establishment of scientific investigation standard if the experimentation is part of research, and 4) high productivity due to travel time reduction.

To get the advantage of these benefits, Authors in [3] offered REAL a virtual laboratory for mobile experiments. This V-Lab has feature WWW interactivity and video support of supervision as well as allows users to perform complex robotics experiments, such as controlling the robot with a user-supplied navigation algorithm.

The programming subjects are also on the list of V-Lab when Ciepiela, et al [4], published their V-Lab called GridSpace 2 to support exploratory programming, where each

experiment consists of snippets programmed interactively in multiple programming languages using a web console.

In 2015, Li, et al [5], published their work about the using of V-Lab in computer science curricula. The various V-Lab has been developed such as the principle of computer organization, digital image processing, digital circuit, digital signal processing, and cryptography. They used java applet technology for the client side and Java web server for the server side. The students are allowed to choose either java components or web service components to do the experiment.

Another V-Lab was proposed in 2017 by Stark, et al [2]. They used Node.js server that running the simulation of Matlab programming via the web server and the communication is delivered through socket.io library channel.

Our work is developing a virtual laboratory that emphases on web development programming languages such as Javascript, HTML, and PHP. The work is allowing the students to do coding at anytime and anywhere and getting an immediate result as long as they are connected to the internet.

III. PROPOSED SCHEME

Our work is focused on the development of web programming virtual laboratory called VP-Lab to support the physical laboratory, not as a substitution. This system is built under javascript language and server node.js. For the database, we are using MySQL because of free and easy use. The system can be accessed via personal computer, laptop, even smartphone as well, as long the device has internet connection and proper monitor size to write the code comfortably.
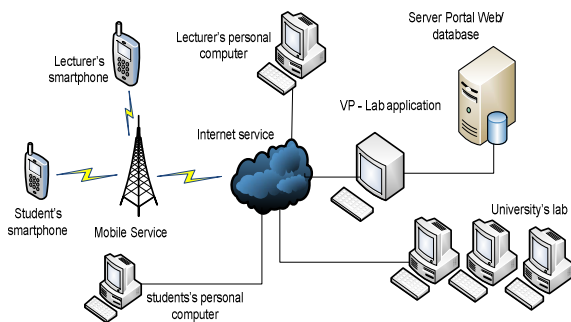

Figure 1 VP-Laboratory Architecture System

The architecture above shows types of devices that able to access the system through the internet service. The application is sitting between internet service and web and database server. The system is not available offline to maximize the function of a 24 hours' access and online compiler to test the code.

When the lecture is delivered in the laboratory, both Lecturer and Students can open the VP-Lab by using either the computer laboratory or laptop/PDA or both. Since the system is updated in a real-time fashion, any changes will give immediate effect. Thus, when the Students are doing their assignment via smartphone or personal computer not in a laboratory, it will be recorded and marked as well. This is a good way to let the students choose their best time to practice with less risk and limit [6]. This kind of system gives benefit to the students because during the lecture in the class they can focus on instruction and rules of coding or understanding the cases.

Figure 2 shows how the system flows from lecturers' side. First, the Lecturer needs to log on to pass the authentication stage. After that, the system will display the dashboard page where the user can choose the action he wants to do. When he finishes input the questions, material, and exams, the system will save them in the database. Afterward, when the students have submitted their works, the Lecturer can view it and give the mark or grade.
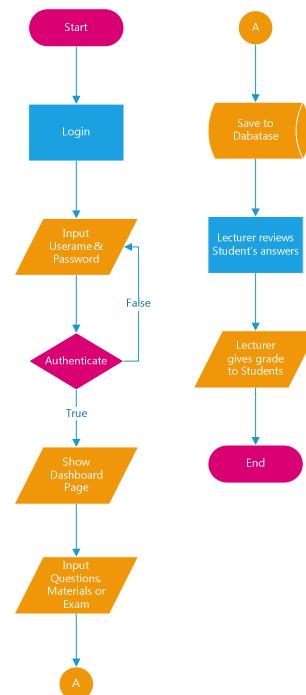

Figure 2 Flow System of Lecturer Side

Figure 3 demonstrates the flow of the system from student's side. Just like a lecturer, then the student must perform the authentication process first before he can view the dashboard. Once he passed the process, he can do the experiment by writing the code on the online compiler based on the cases that have been posted by the Lecturer or read the assignment he needs to do on practice page.

If the process on the online compiler has finished, the system towards to the practice page to upload the answer. If the questions on exam page have been published, the student can access it and provide the answers. The answers on exam page will be responded and marked in real time.
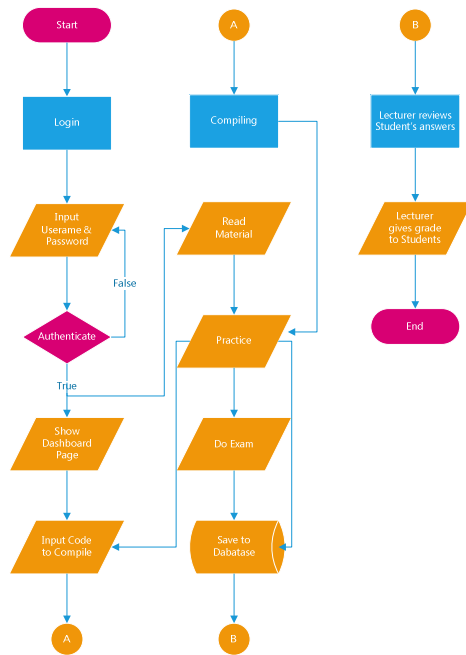
Figure 3 Flow System of Student Side

IV. RESULT AND DISCUSSION

To help the students to get the best learning experience with available resources and low cost, the Virtual Programming Laboratory (VP Lab) application has been developed successfully. The VP lab is built as supplementary media for programming laboratory that consists of PHP, Javascript, and HMTL language. These languages are common to be used to develop website and mobile and desktop application.

The VP-Lab has two main users, lecturer as administrator of the class and student as the member of the class. Each of them has its own page with different login for user management and security reasons. On the lecturer's page, the menu will be the list of registered students, the list of questions, the list of materials, the list of the exam, and discussion (fig. 4). On the student side, the menu is profile, online compiler, language programming, material, practice, exam, and discussion (fig. 5).
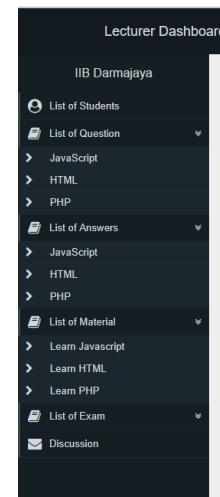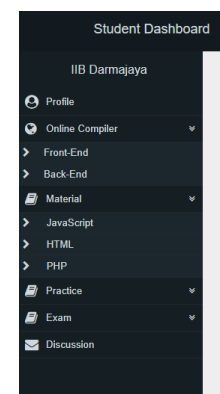

Figure 4 Page Lecturer's Menu

Figure 5 Page Student's Menu

To post the questions, the Lecturer can click the Menu List of Questions. Write the title to make it recognizable, type the questions and expected result, then save it by click add questions, in this case, for the PHP language.
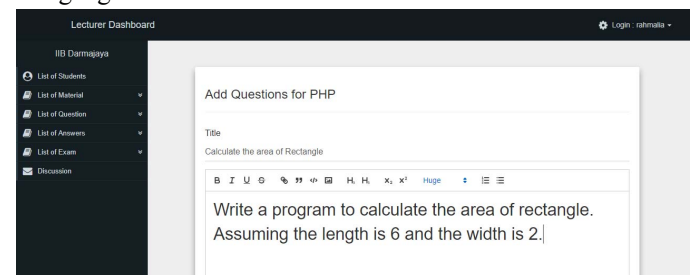

Figure 6 (a) Page to add the Question

Figure 6 (b) Provide Expected Answer on Page Add the Question

When the new question(s) has been posted, The student can access it on practice menu. To do this work, we have provided online compiler for two ends: front (Javascript, CSS, and HTML) and back (PHP). The students write the language on the online compiler code and execute it by hitting the Exceute My Code button. This page is meant to be an exercise page for the students to experiment with the language.
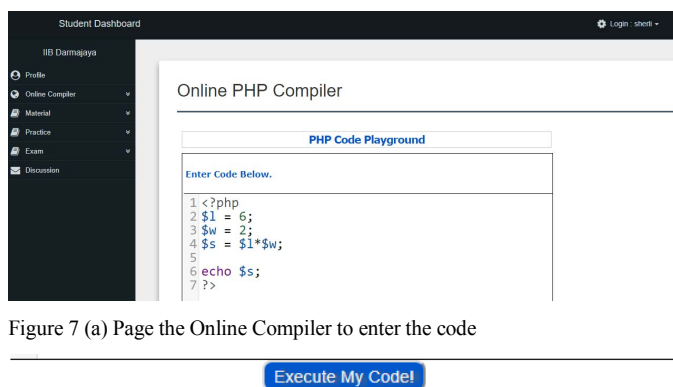

Figure 7 (a) Page the Online Compiler to enter the code

Figure 7 (b) Page the Online Compile to execute the code

Once he confident with the code, he then goes back to the page of practice to submit the answer by pasting the answer, then save it to enable the Lecturer views and marks the answer.
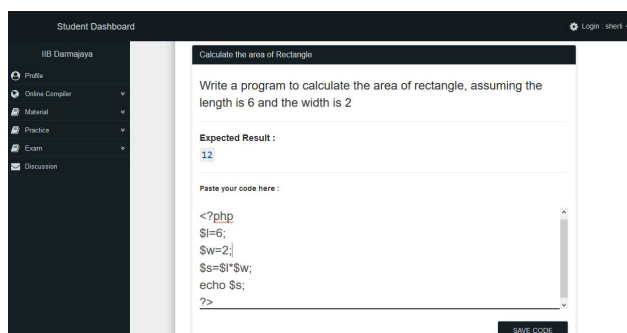

Figure 8 Page of Submiting the Answer

Lecturers can check the answer under the menu list of answer and click the detail to see all the code written.
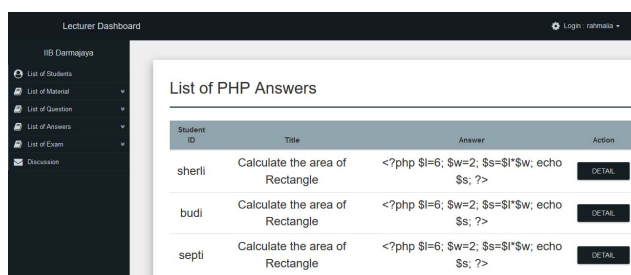

Figure 9 Page View the Students' Answer

The lecturer can undergo the exam through this VP-Lab, however, different from the practice menu, the exam will be in multiple-choice approach. The system will synchronize the student answer with the provided answer in the database. The student will get immediate answer and mark he gets.

The advantage of this VP-lab is the simplicity of use or fewer buttons and structured well. There is a discussion feature that allows all the users to interact virtually to share their thoughts about a particular issue; hence, it will improve the interaction between students and lecturer.

V. CONCLUSION

In conclusion, to overcome the need of a 24 hours access and to optimize the use of internet technology, a virtual laboratory of programming language, called VP-Lab, has been developed successfully. The VP-Lab is intended as a media to enable the Lecturers and Students have unlimited time to access the laboratory and do the experiments or simulations as if they were in actual laboratory. To get these benefits, some features have been equipped onto the system, such as, online material, compiler and exam.

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