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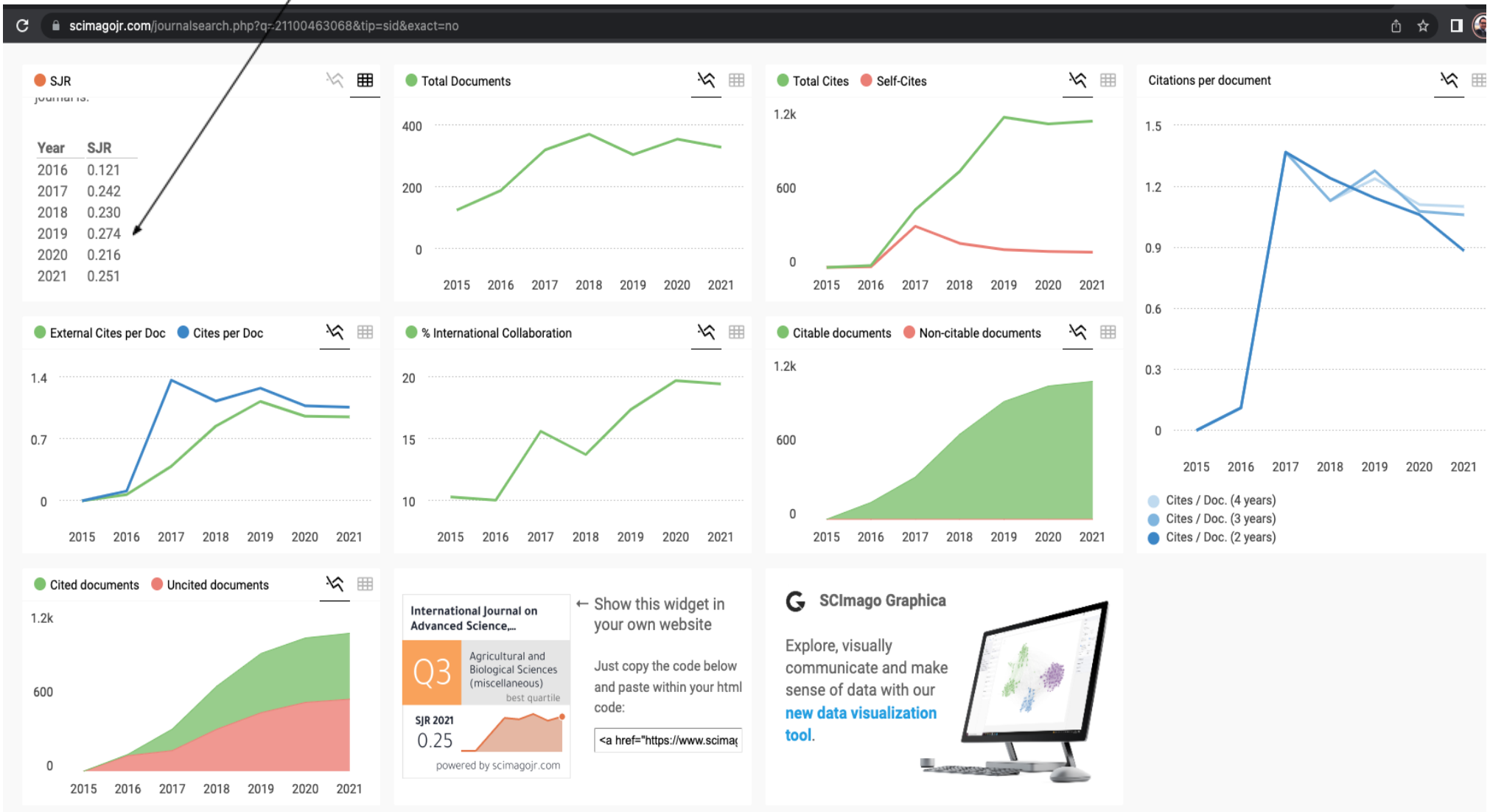

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Abstract

This paper presents the current development supportive tool for both lecturers and students that conduct Project Based Learning (PBL) and Lab Based Education (LBE) on Higher Education Institution (HEI). For PBL and LBE implementations, lecturer needs to monitor, evaluate the learning process. And, students need to publish the learning outcomes in the public domain. In this research, we propose the supportive tool that will be used by lecturer which is taught on different academic courses. Also, the proposed supportive tool had designed to used by the student as a particular group. These groups were formed of the student from several academic courses that supervises by the same lecturer. The developed supportive tool are microframework based which mean it could be implemented on mini devices. The current development supportive tool could be an alternative software assistant that support lecturer to implement Project Based Learning (PBL) and Lab Based Education (LBE). The developed supportive tool has been introduced to 135 students and 16 lecturers as a participant to evaluate the system usability. The results from the questionnaire show more than 90% of users state the benefit of the use supportive tool. Also from analyzing Log metric, users on average complete a designated task in just less than 5 minutes. It indicates that the developed supportive tool is easy to use and shows the effectiveness of the developed supportive tools. © 2019 Insight Society.

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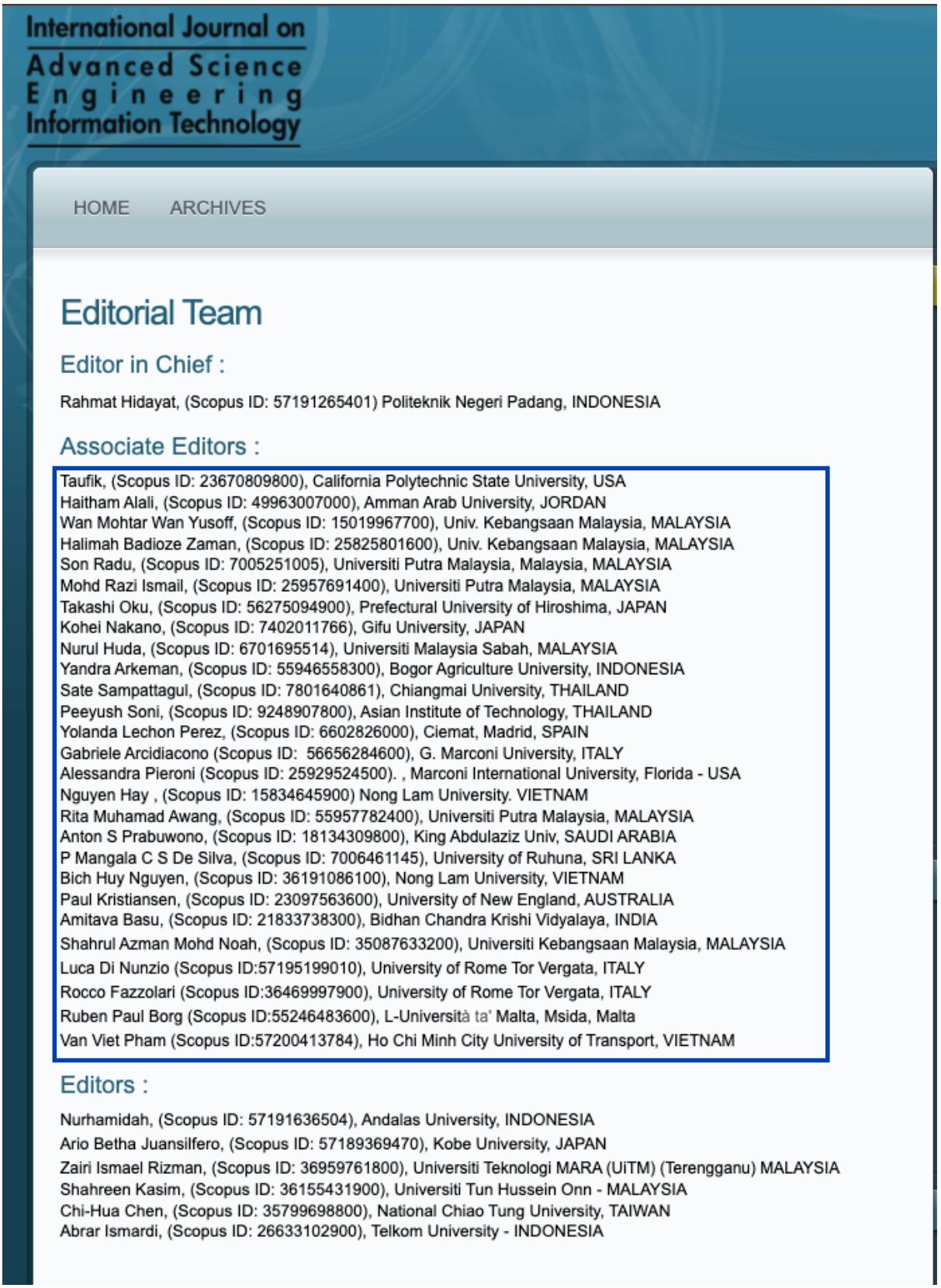

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On Tackling Real-Life Optimization Problems

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***Abstract*—Most real-world applications are concerned with minimizing or maximizing some quantity so as to enhance some result. This emphasizes the importance of optimization and subsequently the significance of the optimization methods that are able to tackle these real-life optimization problems. There are a number of practical reasons for which traditional optimization and exhaustive algorithms cannot deal with a variety of these real-life optimization applications although there are numerous optimization problems that can benefit from applying these traditional optimization algorithms to handle them. Therefore, their is a need for propsong new optimization algorithms (such as nature inspired optimization methods) and optimize the capabilities of the existing ones (such as hybridization and parallelization) as well. This paper investigates the most recent optimization directions for dealing with the real-life optimization problems with an application to one of the most common and important optimization problems in a variety of financial fields and other fields which is the portfolio optimization problem since it is considered one of the most crucial problems in the modern financial management and has a variety of applications such as asset management and building strategic asset allocation. The computational results were got utilizing benchmark data from the OR library with the use of modern optimization algorithms. In addition, the article highlights the differences and similarities among the utilized optimization methods. In addition, recent advancements to the utilized optimization methods are highlighted.**

***Keywords*—real-world problems; nature-inspired algorithms; differential evolution (DE); particle swarm optimization (PSO).**

I. INTRODUCTION

While there are numerous optimization problems that can benefit from applying traditional optimization algorithms to handle them, there is a number of practical reasons behind which these methods cannot deal with a variety of real-life applications. These methods are mostly local search ones that can not ensure getting the global optimum (except when handling convex and linear problems). This is because their outcomes are on the basis of the initial starting points [1].

Besides, exhaustive algorithms (looking through all of the conceivable solutions) are usually time-consuming and hence intractable. This is because it has been proven that they are not appropriate for tackling complex and large optimization problems such as real-life ones as they do not get optimal results in a reasonable time [2]-[3].

This has motivated the advancement of recent heuristic optimization algorithms (such as recent evolutionary algorithms such as differential evolution) and new features to the current ones (such as hybridization and parallelization).

Heuristic search refers to the possibility of making some smart decisions without considering the whole picture but on the basis of the minimum given information. The term heuristic is utilized for the methods that discover solutions among all conceivable ones without ensuring discovering the best one. Consequently they get roughly close results.

When utilizing a heuristic method for tackling an optimization problem, it is required to tell whether the ideal solution convergence will take place in the closest future (will the present solution get closer to the best one?) or will always be a gap to the best solution? [4].

Metaheuristics are not problem-specific and are approximate strategies that guide the search procedure to efficiently investigate the search space. They get within acceptable time satisfying solution rather than ensuring discovering the best one [5].

A good instance of modern metaheuristics is nature-inspired optimization methods that are a set of novel algorithms whose ideas are motivated from nature. This is because there has been a common belief that nature provides optimal results for a variety of complicated problems. Ideas and concepts existed in nature have been studied in order to propose algorithms that simulating these ideas and concepts and can handle successfully these difficult problems. Nature-inspired optimization methods have successfully handled a variety of real-life optimization problems. Therefore, they have attracted considerable attention from numerous researchers from a variety of domains. Examples are evolutionary and swarm intelligence methods [2], [6].

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Design and Evaluation of a Scalable Engine for 3D-FFT Computation in an FPGA Cluster

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Abstract— **The Three Dimensional Fast Fourier Transform (3D-FFT) is commonly used to solve the partial differential equations describing the system evolution in several physical phenomena, such as the motion of viscous fluids described by the Navier–Stokes equations. Simulation of such problems requires the use of a parallel High-Performance Computing architecture since the size of the problem grows with the cube of the FFT size, and the representation of the single point comprises several double precision floating-point complex numbers. Modern High-Performance Computing (HPC) systems are considering the inclusion of FPGAs as components of this computing architecture because they can combine effective hardware acceleration capabilities and dedicated communication facilities. Furthermore, the network topology can be optimized for the specific calculation that the cluster must perform, especially in the case of algorithms limited by the data exchange delay between the processors. In this paper, we explore an HPC design that uses FPGA accelerators to compute the 3DFFT. We devise a scalable FFT engine based on a custom radix-2 double-precision core that is used to implement the Decimation in Frequency version of the Cooley–Tukey FFT algorithm. The FFT engine can be adapted to different technology constraints and networking topologies by adjusting the number of cores and configuration parameters in order to minimize the overall calculation time. We compare the various possible configurations with the technological limits of available hardware. Finally, we evaluate the bandwidth required for continuous FFT execution in the APEnet toroidal mesh network.**

Keywords— **3D-FFT; FPGA; high-performance computing; cluster.**

I. INTRODUCTION

Continuous demand for efficient computing power is pushing designers into integrating dedicated hardware components in High-Performance Computing (HPC) architectures to improve computational efficiency. General-purpose CPUs can delegate specific tasks to the hardware accelerator decreasing the latency of computationally demanding task such as the training of neural networks [1]-[4], video or audio processing [5]-[8], environmental forecasting [9]-[11], security algorithms [12], automotive applications [13], etc. In other scenarios, hardware accelerators are used to reduce system power consumption [14]-[15].

Modern HPC systems are evaluating the inclusion of FPGAs as components of their system architectures because they can combine effective hardware acceleration capabilities and dedicated communication facilities in a single device. The resulting design is suitable to execute distributed tasks in computer clusters effectively. An actual example is Microsoft Catapult [16], a data center able to act as an HPC system thanks to the introduction of FPGA accelerators. In this context, FPGAs also allows optimizing the data exchange among the hardware acceleration modules thanks to the direct connections supported by the network controllers which are integrated into the programmable hardware.

A. FFT for simulations

A widely used algorithm in the simulations of physical phenomena is the Multidimensional FFT and in particular the 3D FFT [17] that are employed in solving the partial differential equations of physical models, such as the Navier–Stokes equations that describe the motion of viscous fluids [18] or Newtonian mechanics equations of Molecular Dynamics [19]. Simulation of such problems requires the use of HPC since the size of the problem grows rapidly and this is mainly due to three reasons:

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A Supportive Tool for Project Based Learning and Laboratory Based Education

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***Abstract*— This paper presents the current development supportive tool for both lecturers and students that conduct Project Based Learning (PBL) and Lab Based Education (LBE) on Higher Education Institution (HEI). For PBL and LBE implementations, lecturer needs to monitor, evaluate the learning process. And, students need to publish the learning outcomes in the public domain. In this research, we propose the supportive tool that will be used by lecturer which is taught on different academic courses. Also, the proposed supportive tool had designed to used by the student as a particular group. These groups were formed of the student from several academic courses that supervises by the same lecturer. The developed supportive tool are microframework based which mean it could be implemented on mini devices. The current development supportive tool could be an alternative software assistant that support lecturer to implement Project Based Learning (PBL) and Lab Based Education (LBE). The developed supportive tool has been introduced to 135 students and 16 lecturers as a participant to evaluate the system usability. The results from the questionnaire show more than 90% of users state the benefit of the use supportive tool. Also from analyzing Log metric, users on average complete a designated task in just less than 5 minutes. It indicates that the developed supportive tool is easy to use and shows the effectiveness of the developed supportive tools.**

***Keywords*— supportive tool; Project Based Learning; Laboratory Based Education; PBL; LBE.**

I. INTRODUCTION

With the era of the Industry 4.0 revolution, Higher Education Institutions will have been challenging to provide experience to its student for having skill and knowledge to solve world reality problem in a digital manner [1]–[4]. The need for skill and knowledge in Industry 4.0 era is an ability to design a system to preserve vast amount data from digital products and made it (machine) to learn the future needs (automation) [5], [6].

The implementation of Project Based Learning (PBL) in an academic course could be as a solution to give the student experience to working as a team and having the experience to involve on some IT projects or develop an applications [7].

As a complement to the success of Laboratory-Based Education that implemented on mostly University in Japan show that shifting conventional academic course (face to face model in the academic course) to peer teaching that could be as a solution to increase research publications [8], [9]. For implementing both learning methods in the daily academic courses, the lecturers need to be assisted by the supportive tool that not only monitors the learning process but also scores and publishes learning results on the public domain. From our previous research, we present Lecturer Based Supportive Tools (LBST) which enable lecturers to create learning content through a web-based application that can be accessed in online and offline condition (no need internet connection) [10]. And, it presents interoperability between the existing Learning Management System (LMS) and the developed supportive tool using service-based architecture [11]–[13]. As an addition, this paper proposed a supportive tool that supports lecturers to implement Project Based Learning (PBL) and Lab Based Educations (LBE).

II. MATERIAL AND METHOD

In this section, we will provide a brief explanation of Project Based Learning and Laboratory Based Education. Also, we present the use of Microframework as development method and the proposed architecture.

A. Project Based Learning

Project Based Learning (PBL) is a learning model that encourage students as a learner to solve real-world problems by applying the knowledge and the skill from academic

course [7], [9], [14]. For the PBL experience, we deliver an assignment to all students to make software with topics: "A Software As Service for College Students". In short, all software that will be proposed by students as their final project are software that needed by students itself in order to support their academic activities. Furthermore, students also required to publish a final report, presentation, and poster according to the proposed software.

B. Laboratory Based Education

The goal of Laboratory-Based Education is to provide student as a learner for having self-centered learning [8]. The idea is to give a student a laboratory environment that student could direct access and start research as soon as possible. The key in Laboratory-Based Education is a peer teaching. The faculty member only helps undergraduate students when there is a problem that could not be solved by postgraduate students. This pyramid role of the LBE is illustrated in the Fig. 1.

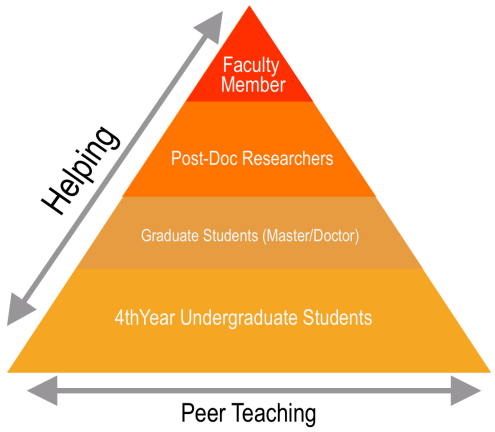

Fig. 1 LBE Pyramid of Peer Teaching

From Fig. 1, the undergraduate students, the graduate student and the post doctoral researcher are learning together with their peers. A faculty member only helps/supervise when needed. LBE is targeting students not only an expertise in their fields, but also developing soft skill such as communication, management, cooperativeness and leadership.

C. Experimental Methods

The experiments have been conducted at Informatics Department, Faculty of Engineering, Universitas Muhammadiyah Sidoarjo and held on Academic Year 2017/2018.

TABLE I
CLASSROOM IMPLEMENTATION FOR LBE AND PBL EXPERIMENTS

Class Code	Class Name
HCI-8A3 HCI-8B4	Human Computer Interaction (HCI) (8th Semester)
ADSI-6A1 ADSI-6A2	Analysis and Design Information Systems (ADSI) (6th Semester)
SI-4A3 SI-4A4	Information System (IS) (4th Semester)

Next, for the implementation of Lab Based Education (LBE), we obligate to each class to finding a partner from designated class. From 6 class groups, we divide into two main groups which are class code with an odd number and class code with an even number. Table 1 shows 6 classes groups in which the experiment have been conducted.

Also, we set rules that 8th-semester main task is to develop UX/UI design (as the implementation of their HCI courses). The main task of 6th-semester students is to design the complete diagram (as the implementation of their ADSI courses). The main task of 4th-semester students is software prototyping that based on the UX/UI design and the development diagram as the implementation of their IS courses. The pyramid of designated class that experimenting LBE shown on the Fig. 2.

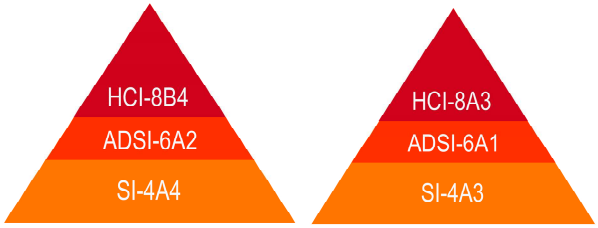

Fig. 2 Classroom implementation of LBE and PBL experiments

D. Development Method

In early-stage supportive tool development, we had implemented rapid prototyping using Google Design Sprint (GDS) [15]. The key in DS are answering main features (or from original GDS definition called the business questions) through design, build prototype, and test it with user. The GDS methodology itself is inline with six phases: Understand, Define, Sketch, Decide and Validate.

To build the prototype, Flask Microframework has chosen for developing the proposed supportive tool [16]. As python based microframework, the developed supportive tool could serve as a web server. With running a single python script, it can be run independently as web application without hosted at the web server. This mean, the lecturer could use the developed supportive tool directly and no need to install Apache/Nginx web server.

Flask is adapting MVC (Model-View-Controller) framework that separate application layer and presentation layer. This mean, the *.py file and *.html file is in the different directory. The MVC model is suitable for future developments. Because of its separate database, control layer, and presentation layer. Fig. 3 shown the directory structure of web-based application using Flask MVC. All the database definition (as a Model) and the routing as the Controller are written in app.py. The static directory contains all static file such as *.js, *.css. And the templates directory is the directory to store *.html files as a View part from MVC framework.

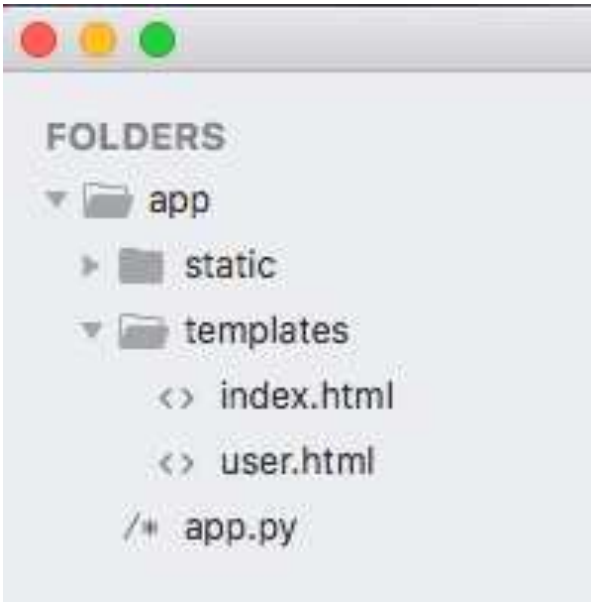

Fig. 3 MVC Model Directory on Flask Microframework

All request from the client will be routed according to the designated URL that configured in *.py files. For an example, we have index.html and hello.html in the templates directory:

1) Example index.html.

```
<!DOCTYPE html>
<html>
    <head>
        <title>Suppotive
Tool</title>
    </head>
    <body>
        <h1>Server Status:</h1>
        <p>Ready!</p>
    </body>
</html>
```

2) Example hello.html

```
<!DOCTYPE html>
<html>
    <head>
        <title>Suppotive
Tool</title>
    </head>
    <body>
        <h2>Welcome {{user}}</h2>
    </body>
</html>
```

To configure the request from the client, it uses "route()" decorator. To route the request and view the targeted HTML, the URL needs to be registered in "@app.route". For an example, when it needs to set up the index (main page) to access index.html, it uses the scripts as shown at Fig. 4.

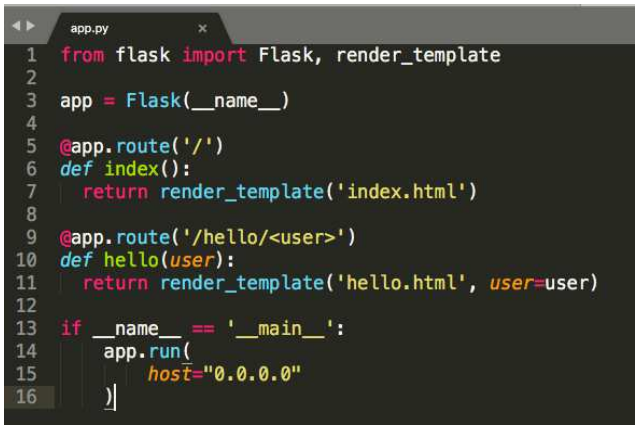

Fig. 4 Example ".py" file as main application

From the above script, line 5 to 7 are used to route all request when need access an index homepage (top level directory of its web application). Line 9 to 11 are used to response a request from URL: http://domain/hello/paramater. At line 9 to 11, it is shown that the designated URL could give a parameter.

To start the server, the user need to execute main ".py" file. If ".py" file from Fig. 4 has executed, Fig. 5 shown the WSGI server is ready to accept a request.

Fig. 5 WSGI server has been activated

By default, WSGI using port 5000 to serve its web requests. At local access, a user can request by accessing "http://localhost:5000/" (as shown at the Fig. 6).

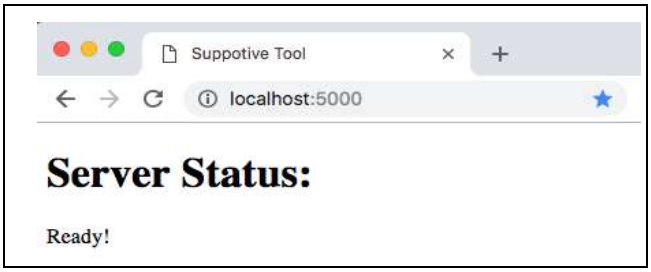

Fig. 6 Response from the WSGI server

If user access "http://localhost:5000/hello/Alice", the server will recognize the parameter after "/hello", as configured in "app.py" (Fig. 4). The WSGI will respond "hello.html" as shown at Fig. 7.

Fig. 7 Response from the WSGI server with parameter

With the above methods, it will be easier to design and implement a user requirement that needs to be developed in the proposed supportive tool.

E. User Interactions

The prospective user for the developed supportive tool is lecturers, student as the project manager and students as a team member. The interactions of the user and developed supportive tool are described in the Fig. 8.

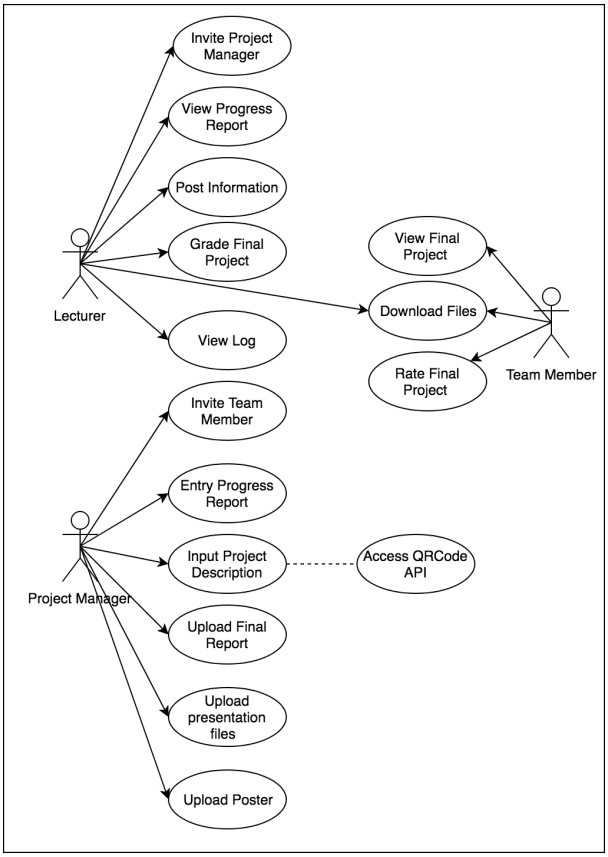

Fig. 8 User interaction diagram on the proposed supportive tooler

The prospective user for the developed supportive tool is lecturers, student The students had been provided with many features. From Fig. 8, The final project materials are uploaded by a student with project manager level access. And a student with no level access can view, download, and uploaded final project where not only from their groups but also from other groups.

F. Proposed Architecture

To adapt bandwidth limitation that might happen during implementation, the proposed supportive tool will be developed into two versions. First, it will develop for self-hosting or deploy on the low-end machine. Second, it will develop into a server machine as usual. Both versions are using Flask. The differences are the database engine being used. For the self-hosted version using SQLite and for server machine using MySQL. Another differences are the developed supportive for server machine is provided by Web Service using Flask-REST API. The architecture of the current development supportive tool is shown in the Fig. 9.

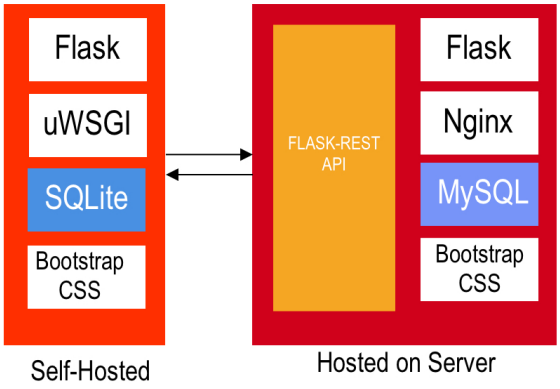

Fig. 9 User interaction diagram on the proposed supportive tool

III. Results and Discussion

A. Supportive Tools For Lecturer

Any tools that assist learner while learning the process and track the achievement could be labeled as a ePortfolio. The ePortfolio also used as storage system on any learning model that evidence-based as the results. even though the current developed supportive tool main feature is similar to evidence collection, the proposed supportive tool main feature is not only assisting a student to submit and publish their final project but also designated for lecturers to track the process when final project was conducted by many groups of students.

To use the supportive tools, lecturers only need to send an invitation through email to one of an appointed group member as their Project Manager (PM). In these experiments, we use the existing Google Mail Account to send the invitations and Flask-Mail module to sent email over SMTP.

After lecturers send the invitations, a PM should activate the link and start to add the group member. Other features that provide in lecturers dashboard are Post Information, View Progress Report, and Grading Page. The activity diagram of lecturers as a user shown on the Fig. 10.

Lecturers also provide with invitation status of the PM. After PM accept the invitation, it will notify lecturer that PM account has been activated. Fig. 11 shown the PM account that has been activated or not.

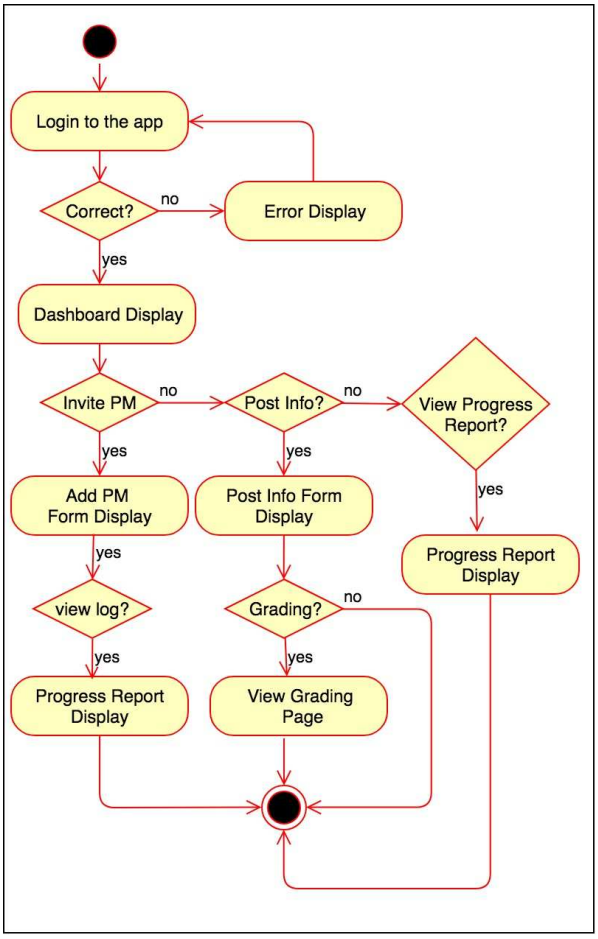

Fig. 10 Lecturer activity diagram

#	ID	EMAIL		INVITATION TIME	STATUS
1	117182041532578420	16'	'@umsida.ac.id	26-07-2018 11:13:40	Activated 26-07-2018 11:40:54
2	117183501530153840	riz	@gmail.com	28-06-2018 09:44:00	Activated 20-07-2018 08:57:18
3	117187241531721298	ari	n421997@gmail.com	16-07-2018 13:08:18	Activated 16-07-2018 14:10:17
4	117181971531230632	pri	mmadyulianwahyu@gmail.com	10-07-2018 20:50:32	Activated 10-07-2018 20:51:04
5	117181781531179714	ris	@gmail.com	10-07-2018 06:41:54	Activated 10-07-2018 14:49:04
6	117182661530762413	Ye	116@gmail.com	05-07-2018 10:46:53	Activated 05-07-2018 11:22:42
36	117188251530154753	Dis	rs@gmail.com	28-06-2018 09:59:13	Activated 28-06-2018 15:54:43
37	117189591530153793	azi	nail.com	28-06-2018 09:43:13	Activated 28-06-2018 09:50:29
38	117186571530153808	Tol	il.com	28-06-2018 09:43:28	InActive
39	117188931530153951	Rif	ail.com	28-06-2018 09:45:51	InActive
40	117185781530154764	Ich	g@gmail.com	28-06-2018 09:59:24	InActive
41	117188081530154791	Ye	16@gmail.com	28-06-2018 09:59:51	InActive
42	117187561530176087	kor		28-06-2018 15:54:47	Activated 04-07-2018 00:11:23
43	117182841532350245	ha	1@gmail.com	23-07-2018 19:50:45	InActive

Fig. 11 Account activation status of students as the project manager

B. Progress Report

The key success of the PBL and LBE implementations are lecturer roles in monitoring the learning process. To address these need, the current development supportive tool provides Progress Report Form where students obligated to input it in every week. Fig. 12 shows progress report table that has been inputted by students.

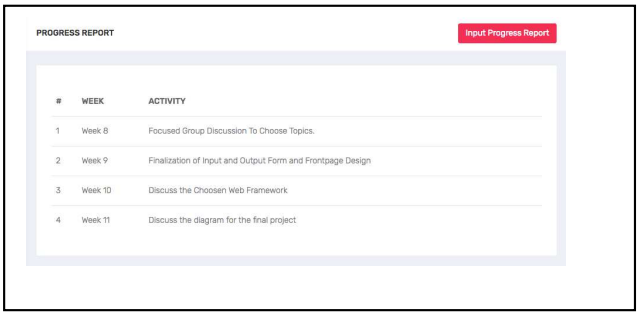

Fig. 12 Progress report inputted by students

C. Log Report

Lecturers have been provided not only the information about progress report from each team but also the log information that can be accessed by lecturer only. By using the log, its hopes to help lecturers could analyze the learning process.

Form log itself, it stores the log with the value of URL Address that has been accessed, the timestamp of the accessed page and the IP address. To make these possible, it needs to insert a log table every each request which is different routes that have configured from .py files. As a result, a full activity from a user has been logged. Fig. 13 show an example log result.

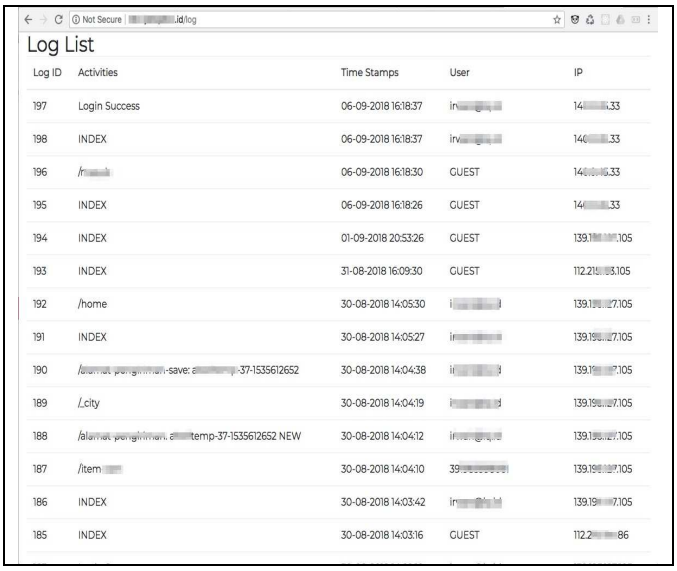

Fig. 13 Log of user activities

The log from user interaction will be useful for meta-analysis as part of post-production evaluation. The exploration of the log-based metric can complete and validate the usability evaluation conducted by interview or questionnaire [17], [18].

D. Project Publishing

As a result of Project Based Learning, students need to publish their final project in the public domain. This mean, the developed supportive tool need to provide an input form which enables students to input the project detail/description, the project repository. Fig. 14 showing the form to input project description.

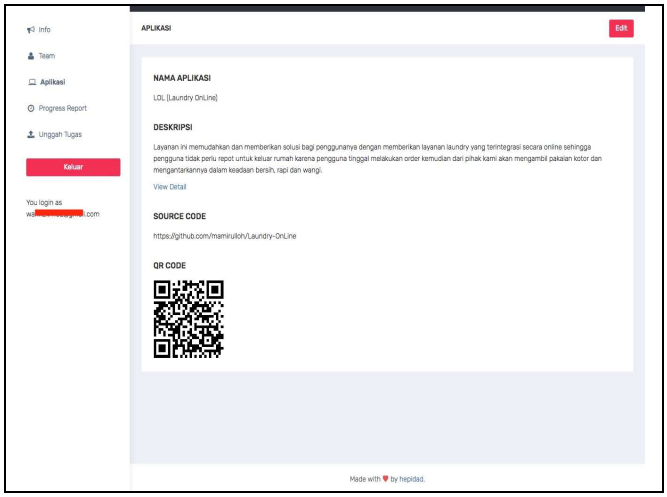

Fig. 14 Project description form

Also, as a result of Lab Based Education activities, the developed supportive tool need to provide an unloading mechanism for store final report, presentation and poster in digital formats. Fig. 15 shows the input form for uploading the digital documents.

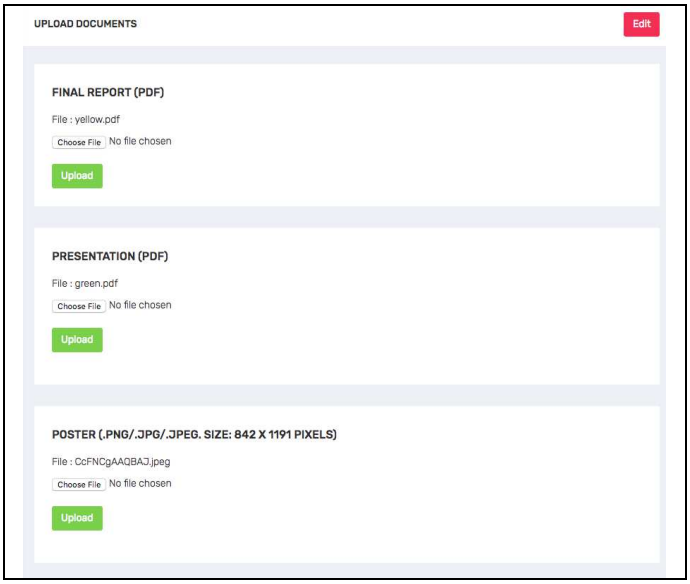

Fig. 15 Form for upload final report, presentation and poster

After students have been finished to uploads the document, the uploaded documents will be accessible to the public. Fig 16 shown the front page of the developed supportive tool.

E. Lecturer Grading

When students have been finished to publish their final reports, presentations and posters, it is time for lecturers to give an evaluations. Because of each groups consist of different students from different class, lecturers need to be provided with one single form entry to give a score to whole team member. Fig. 17 shown an example process evaluation for one of student groups.

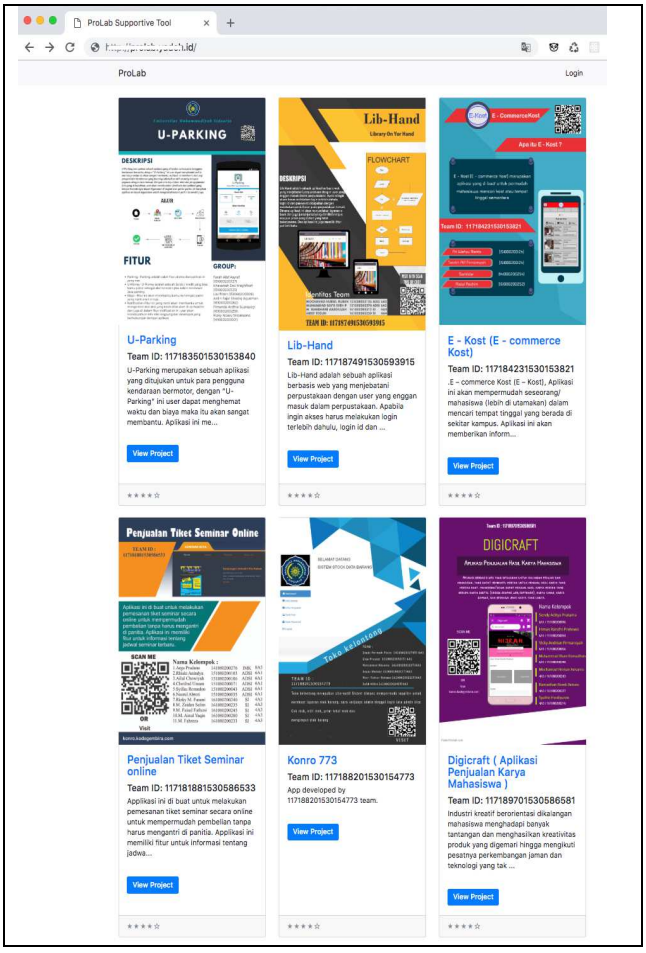

Fig. 16 Homepage of developed supportive tool

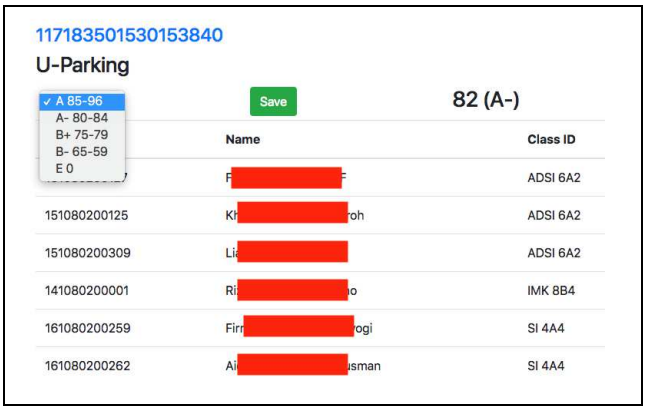

Fig. 17 Scoring form for each groups

F. Supportive Tool Deployment

1) Self Hosted

The use of Microframework brings other advantages. The developed supportive tool application size is less than 20 MB. This made possible to deploy it at the mini device. The term mini device is a hand on carrying pc board that helps lecturers mobility to use the supportive tool in the different classroom.

In these experiments, the proposed supportive tool has been deployed at the APC board and connect it into the access point. Fig. 18 show the network topology and the supportive tool deployment to the APC Board.

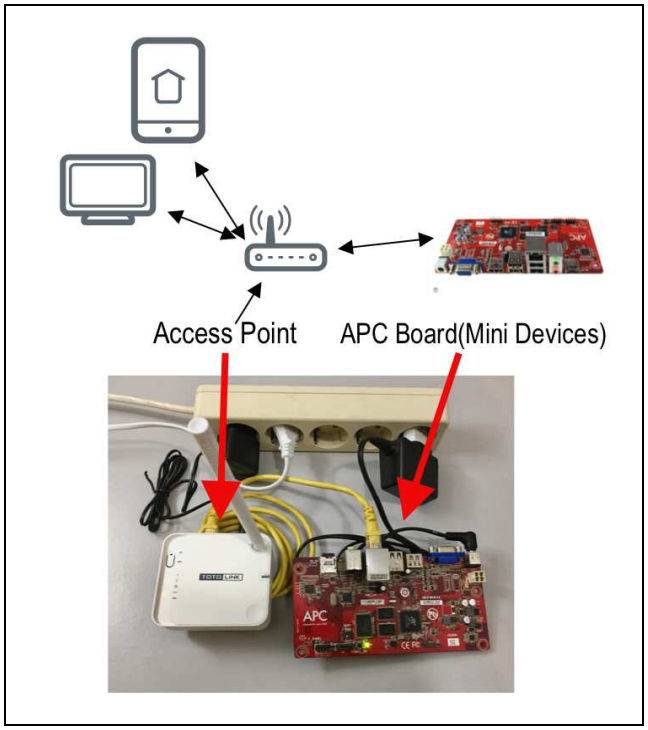

Fig. 18 Self hosted deployment of developed supportive tool

By default, the Werkzeug module used by Flask as request handler, it can only serve one request only. Because the Werkzeug is designed to only development model [19]. To hosted on the mini device or other machine and serve many requests, it needs to use uWSGI as request handler [20]. To start using uWSGI, it needs "wsgi.py" file that imports an "app". The wsgi.py should be as in Fig. 19:

```
1 from modul_name import app
2 if __name__ == "__main__":
3     app.run()
```

Fig. 19 An example of wsgi.py

A "module_name" is the name of the .py file as the main program. To start a server, it needs to execute the command in Fig 20.

```
uwsgi --socket 0.0.0.0:5000 --protocol=http -
wsgi:app
```

Fig. 20 The uWSGI command to start a server

With the above command, the proposed supportive tool can be accessed from "http://server_IP_address:5000".

2) Hosted on Machine Server

In this experiments, developed supportive tool will be deployed on a server with Ubuntu 14.04 as operating system and Nginx as the web server.

Even though it uses Nginx as the default web server, it needs to configure Nginx to pass a request to application socket using uwsgi protocol. The configuration starts with creating a ".ini" file in the project directory to activate the uWSGI. Example of ".ini" files is in the Fig. 21.

```
[uwsgi]
module = wsgi

master = true
processes = 5

socket = app.sock
chmod-socket = 660
vacuum = true
```

Fig. 21 Example uwsgi.ini for uWSGI configuration

Next, it needs to create an upstart script to start the uWSGI. The upstart script will allow operating system init system to automatically start uWSGI and serve the Flask application whenever the server machine boots. The upstart script needs to save in ".conf" format at "/etc/init/projectname.conf". Example of the upstart file is in Fig. 22.

```
start on runlevel [2345]
stop on runlevel [!2345]

setuid username
setgid www-data

env
PATH=/home/username/projectname/projectenv/bin
chdir /home/username/projectname
exec uwsgi --ini projectname.ini
```

Fig. 22 Example ".conf" in Nginx as upstart file

The final part of server machine configuration is to create server block and order Nginx to listen on the port 80 and use this block for incoming requests to our server's domain name or IP address.

The configuration is done by creating ".conf" and saved on "/etc/nginx/conf.d/projectname.conf". Example server block that needs to be configured on the Nginx web server shown at Fig. 23.

```
server {
    listen 80;
    server_name domain.ourserver.com;

    location / {
        include uwsgi_params;
        uwsgi_pass
unix:/home/username/projectname/projectname.soc
k;
    }
}
```

Fig. 23 Nginx server block for domain configuration

From the above configuration, the developed supportive tool can be accessed directly by both lecturer and students from his/her mobile device. Because it was installed on a mini device and some Access Point (AP), all user need to connect their device with the access point.

G. Usability Evaluation and Log Metrics

Usability Evaluation is described as the measurement to which a product can be easily used by targeted users with efficiency and satisfaction to achieve certain objectives. To explore user satisfaction, an interview and a certain

experiment being conducted by 135 students and 16 lecturers as a participant.

During the experimental session, students were asked to finish several tasks as mentioned in Fig. 8 as the simulation of the use of the developed supportive tool with student level access. Lecturer as a participant also requested to finish several activities as mentioned in Fig. 10 as the simulation of the use of the developed supportive tool with lecturer level access. After finished the experiments, both lecturers and student are interviewed and asked to fill the questionnaire. Table II has shown the question that given to students.

The experiments had conducted within a laboratory where the participants use the supportive tool which installed in local machine server that available in the laboratory. To measure the effectiveness and difficulties, we analyzed the timestamp from the Log creation when participants were asked to accomplished the certain task as part of the experiments.

TABLE II
STUDENT QUESTIONNARE

No	Question
1	Before implementation of PBL-LBE class model I experience paper-based assignment (yes/no/not sure)
2	I prefer paperless assignment (yes/no/not sure)
3	The benefit using supportive tool for uploading final project material : A. I can upload the final project materials at times convenient to me B. No extra cost for report final project C. I like to know other groups final project D. I choose A, B, C E. I failed to see the benefit of using supportive tool
4	The interface of the supportive tool is easy to use (yes/no/not sure)
5	The error message was given by system (yes/no/not sure)
6	The supportive tools enable me to interact with other groups asynchronously (yes/no/not sure)
7	I become productive using the supportive tool (yes/no/not sure)
8	Knowing some group ideas and mockups, I felt need to collaborate with the group to develop the application to more mature version (yes/no/not sure)
9	Other groups ideas and mockups in their final report help me find a topic for my undergraduate final project (yes/no/not sure)
10	I would like to continue using proposed supportive tool on next semester (yes/no/not sure)

As results, students mostly opted "Yes" in question 1,2,4 until 10. Fig. 24 shown the dominance of opted Yes in the student's questionnaire.

For question 3 from the student's questionnaire, 90% of students opted A, B, C which shown the benefit of the use supportive tool in order to support the submitting final project materials. Fig. 25 show the percentage of question 3 from the student questionnaire.

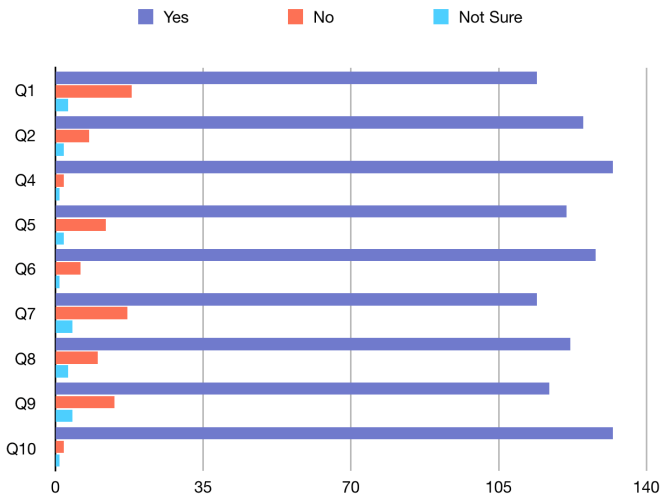

Fig. 24 Students rensponses from question 1,2,4 until 10

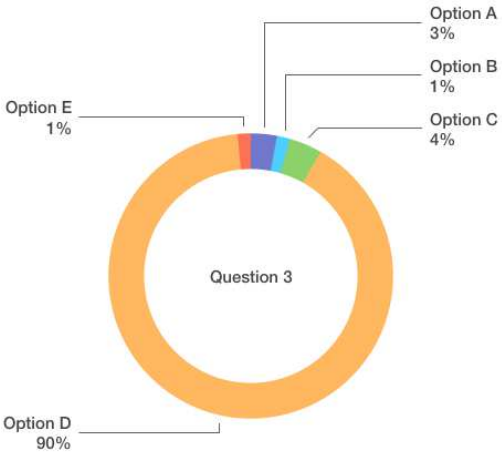

Fig. 25 Students rensponses from question 3

TABLE III
LECTURE QUESTIONNARE

No	Question
1	I always experience scoring students report with a paper-based assignment (yes/no/not sure)
2	I prefer to check students assignment in a paperless manner (yes/no/not sure)
3	The benefit using supportive tool check students final project material : A. I can check the final project materials at times convenient to me B. I could know the progress report while students finish their final projects C. Both A and B D. I failed to see the benefit of using supportive tool
4	The interface of the supportive tool is easy to use (yes/no/not sure)
5	The error message was given by the system (yes/no/not sure)
6	The supportive tools enable me to interact with students asynchronously (yes/no/not sure)
7	I become productive using the supportive tool (yes/no/not sure)

As the results of the lecturer's experiments, lecturers also mostly opted "Yes" in question 1,2,4 until 10. Fig. 26 shown

the dominancies of opted "Yes" in the lecturer's questionnaire.

For question 3 at the lecturer's questionnaire, 90% lectures opted C which shown the benefit of the use supportive tool in order to check and see the progress report of the submitted final project materials. Fig. 27 shown the percentage of Question 3 from the lecturer's questionnare.

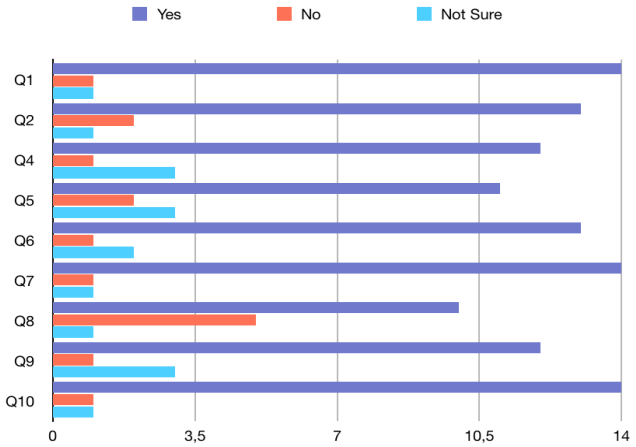

Fig. 26 Lecturer's rensponses from question 1,2,4 until 10

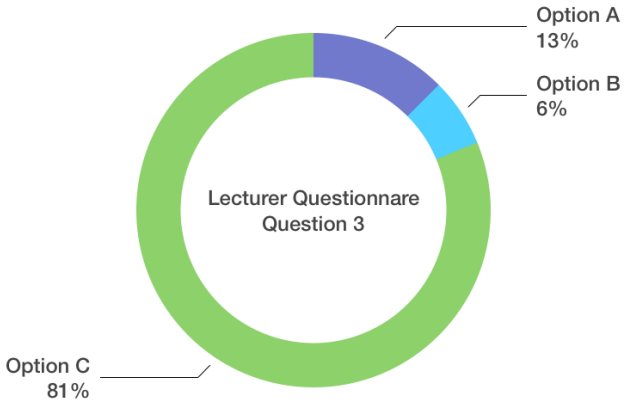

Fig. 27 Lecturer's rensponses from question 3

Next experiments were analyzed the created log while participants asked to do several tasks as mentioned in Fig. 8. Example log created as shown in Fig. 13.

As a result, all students in averages needs only less than 4 minutes to accomplish each given task. Fig. 28 shown the average time spent while students perform interaction in with the supportive tools. For lecturers itself, lecturers on average needs less than 3 minutes to finish each given task. Average time spent that lecturers need to accomplish the given task are shown in Fig. 29.

Remembering when there is no tutorial given before the experiments had conducted, all participants just needs a little time to accomplish the given task. It indicates that the developed supportive tool is easy to use and shows the effectiveness of the developed supportive tools.

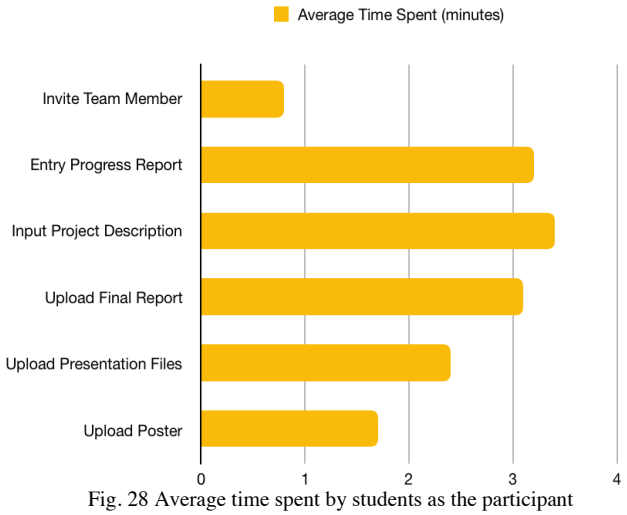

Fig. 28 Average time spent by students as the participant

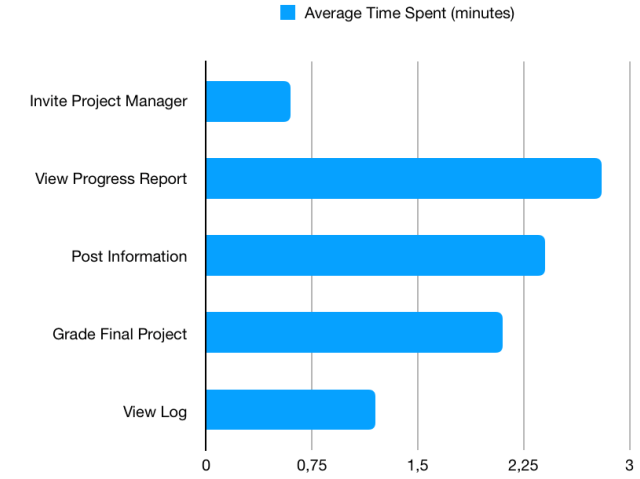

Fig. 29 Average time spent by lecturers as the participant

IV. Conclusions

This paper presents the current development web-based application used by lecturers as supportive tools for implement Project Based Learning and Lab Based Educations. Lecturers can monitor the learning process from progress report that has been inputted by students. Because each group is consist of different class groups, lecturers no need to input manually the score to each student. Lecturers only need the score for a whole group.

The developed supportive tool can be used by students as an online portfolio to show their project. Since all final project, presentation and poster are visible on the public domain, other students can also view other groups projects and download the uploaded documents. The developed supportive tool offer one-stop solution for lecturers that will implement Project Based Learning and Lab Based Education. Lecturers no need install blog engine for an announcement, Learning Management System to track students progress report and do grading, and ePortfolio to show students projects. All these features are provided at the developed supportive tool. From experiments results, the use of supportive tools has gain beneficial from both students dan lecturers. The use of supportive tools as an application for PBL and LBE implementations brought students and lecturers to build the submitted final project into better

version while they found an interesting project that really solves real-world problems.

As a result of one academic semester experiment with 6 class groups, we obtain 32 particular groups with 32 particular web-based applications as their final project. This experiment's results can be useful repositories for next year academic students. The repository can be used not only as a reference but also for a hub among students to develop the final projects into production level applications.

ACKNOWLEDGMENT

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2 messages

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We have reached a decision regarding your submission to International Journal on Advanced Science, Engineering and Information Technology, "A Supportive Tool for Project Based Learning and Laboratory Based Education".

Our decision is to: Revision Required

Please upload your revision in 20 days. More than 20 days of paper will be rejected from the system. Re-upload your revision into journal system NOT via email.

Editor

Reviewer A:

1. This is research report not article

2. Contribution is not clear

3. Methodology is not clear

Reviewer B:

A web-based application that used both lecturers and students as a supportive tool for Project Based Learning, and Lab Based Education on Higher Education, is presented in this paper.

The article title is appropriate, and it accurately reflects the content. The authors present a clear definition of the objectives and the scope of the work is well described in the abstract. The introduction provides a good generalized background of various previous work. The main notation and terms are well introduced and described.

In “Material and methods” section, the research about Project Based Learning and Laboratory Based Education, the use of Microframework as development method and the proposed architecture are described. To adapt bandwidth limitation that might happen during implementation, the proposed supportive tool is developed into two versions: a self-hosting software using SQLite, and a server machine using MySQL. In Figure 9 the interactions of the user and the proposed supportive tool are well presented.

“Results and discussion” section consists of some subsections: "Supportive tools for lecturer", "Progress report", "Log report", "Project publishing", "Lecturer grading", and "Supportive tool deployment "

The final section provides the conclusion and the future work regarding this subject matter. It is clear and well-written.

The manuscript content is structured correctly, but the authors should reformat the text according to the IJASEIT template. The table and figures are sufficient for the presentation of the data and the results of the research. The manuscript consists of 8 pages, 15 references, 1 table, and 18 figures.

Specific comments and suggestions:
• This paper has a lot of grammatical errors and typing errors. I would recommend that a native English speaker reads through the paper and makes the necessary corrections.
Some of the grammatical errors are:• “4.0 Industry Revolutions era” should be “the era of the Industry 4.0 revolution” or “4th Industry

revolution era”
• “era 4.0 industry” should be “Industry 4.0 era”, please see (https://www.sciencedirect.com/science/article/pii/S2405896317316117), (https://www.igi-global.com/chapter/the-role-of-universities-in-industry-40-era/210479)
• “Analysis and Desain Information Systems (ADSI)” should be “Analysis and Design Information Systems (ADSI)”
• And there are many other grammatical and typing errors.
• There are a lot of typing errors in the text. In some places, the spaces are missing, while the others there are too many spaces. The authors can reread all the text again.
• The table and figures are not well-formatted.
• All used images and tables with source code are added as float objects. The text in some of them does not well read. In some of them, the used fonts are with big size, and the others are of small size.
• I would like to propose to the authors that they should be use fonts like "Consolas" or "Courier New" for the writing of the source codes.
• The authors should think how to add the obtained results data to the abstract.
• The conclusion is very short. I would recommend that the authors should think about rewrite it.
• The authors should clearly define the "a mini device" term.

I recommend that the authors read the article carefully and make the corrections.

International Journal on Advanced Science, Engineering and Information Technology
http://insightsociety.org/ijaseit/index.php/ijaseit

Irwan Kautsar <irwan@umsida.ac.id> 7 February 2019 at 23:20
To: Rahmat Hidayat <rahmat@insightsociety.org>
Bcc: Irwan Kautsar <irwan@umsida.ac.id>

Dear Mr. Rahmat Hidayat,

Thank you for the email.

Fyi, A revised version has uploaded to the journal system.
Kindly inform us if there is any mistaken procedure while uploading the document of the revised version.

Thank you.

Regards,
Irwan

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[IJASEIT] Accepted with Minor Correction

Rahmat Hidayat <rahmat@insightsociety.org> 14 March 2019 at 06:29
To: "Mr. Irwan Alnarus Kautsar" <irwan@umsida.ac.id>

Mr. Irwan Alnarus Kautsar:

We have reached a decision regarding your submission to International Journal on Advanced Science, Engineering and Information Technology, "A Supportive Tool for Project Based Learning and Laboratory Based Education".

Our decision is to: Accepted with Minor Correction

Please submit your revision in 10 days. Re-upload your revision into journal system NOT via email.

Editor

Reviewer A:

In Project Based Learning and Lab-Based Learning, the lecturers should monitor and evaluate the learning process, and the students should publish the learning outcomes in the public domain. A web-based application that used both lecturers and students as a supportive tool for Project Based Learning, and Lab Based Education on Higher Education, is presented in this paper. The authors noted that 135 students and 16 lecturers have participated in evaluating the usability of the proposed web system. And according to more than 90% of users, the system was useful.

The article title is appropriate and accurately reflects the article's content. The abstract is short, clear and well-defined. It states the main goal of the manuscript and the obtained results. The used keywords are appropriate.

The introduction is clear, well-written and well organized. It is also referenced with up-to-date literature sources from a suitable range of citations and covering existing relevant works. The various previous studies are presented. The study is detailed and well structured.

In the “Material and methods” section, the research about Project Based Learning and Laboratory Based Education, the use of Microframework as development method and the proposed architecture are described. The authors well described the mean of project-based learning and the given students' tasks in the first subsection. The goals of laboratory-based education are presented in the second subsection. In the "Experimental methods" subsection, the authors have described the conditions of the experiments conducted. In the next subsections, the architecture and user interaction are described.

“Results and discussion” section consists of some subsections: "Supportive tools for lecturer", "Progress report", "Log report", "Project publishing", "Lecturer grading", and "Supportive tool deployment "

The conclusion (Section 4) is clear and well-written.

The manuscript content is structured correctly and contains all the relevant sections marked with subheadings. The tables and figures are well-formatted

and are enough for the presentation of the data and the results of the research. The manuscript consists of 10 pages, 20 references, 4 sections, 24 figures, and 3 tables.

Specific comments and suggestions:
• Table 3 should use the same font size as other tables.
• There are a lot of free space lines between a picture and a caption in most of the figures.
• The phrases "the following figure" or "the following scripts" should be replaced by specific figures.

IK-DOKLK400-KUMC-Paper#1

by Irwan Kautsar

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A Supportive Tool for Project Based Learning and Laboratory Based Education

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***Abstract*— This paper presents the current development supportive tool for both lecturers and students that conduct Project Based Learning (PBL) and Lab Based Education (LBE) on Higher Education Institution (HEI). For PBL and LBE implementations, lecturer needs to monitor, evaluate the learning process. And, students need to publish the learning outcomes in the public domain. In this research, we propose the supportive tool that will be used by lecturer which is taught on different academic courses. Also, the proposed supportive tool had designed to used by the student as a particular group. These groups were formed of the student from several academic courses that supervises by the same lecturer. The developed supportive tool are microframework based which mean it could be implemented on mini devices. The current development supportive tool could be an alternative software assistant that support lecturer to implement Project Based Learning (PBL) and Lab Based Education (LBE). The developed supportive tool has been introduced to 135 students and 16 lecturers as a participant to evaluate the system usability. The results from the questionnaire show more than 90 % of users state the benefit of the use supportive tool. Also from analyzing Log metric, users on average complete a designated task in just less than 5 minutes. It indicates that the developed supportive tool is easy to use and shows the effectiveness of the developed supportive tools.**

***Keywords*— supportive tool; Project Based Learning; Laboratory Based Education; PBL; LBE.**

I. INTRODUCTION

With the era of the Industry 4.0 revolution, Higher Education Institutions will have been challenging to provide experience to its student for having skill and knowledge to solve world reality problem in a digital manner [1]–[4]. The need for skill and knowledge in Industry 4.0 era is an ability to design a system to preserve vast amount data from digital products and made it (machine) to learn the future needs (automation) [5], [6].

The implementation of Project Based Learning (PBL) in an academic course could be as a solution to give the student experience to working as a team and having the experience to involve on some IT projects or develop an applications [7].

As a complement to the success of Laboratory-Based Education that implemented on mostly University in Japan show that shifting conventional academic course (face to face model in the academic course) to peer teaching that could be as a solution to increase research publications [8], [9]. For implementing both learning methods in the daily academic courses, the lecturers need to be assisted by the supportive tool that not only monitors the learning process but also scores and publishes learning results on the public domain. From our previous research, we present Lecturer Based Supportive Tools (LBST) which enable lecturers to create learning content through a web-based application that can be accessed in online and offline condition (no need internet connection) [10]. And, it presents interoperability between the existing Learning Management System (LMS) and the developed supportive tool using service-based architecture [11]–[13]. As an addition, this paper proposed a supportive tool that supports lecturers to implement Project Based Learning (PBL) and Lab Based Educations (LBE).

II. MATERIAL AND METHOD

In this section, we will provide a brief explanation of Project Based Learning and Laboratory Based Education. Also, we present the use of Microframework as development method and the proposed architecture.

A. *Project Based Learning*

Project Based Learning (PBL) is a learning model that encourage students as a learner to solve real-world problems by applying the knowledge and the skill from academic

course [7], [9], [14]. For the PBL experience, we deliver an assignment to all students to make software with topics: "A Software As Service for College Students". In short, all software that will be proposed by students as their final project are software that needed by students itself in order to support their academic activities. Furthermore, students also required to publish a final report, presentation, and poster according to the proposed software.

B. Laboratory Based Education

The goal of Laboratory-Based Education is to provide student as a learner for having self-centered learning [8]. The idea is to give a student a laboratory environment that student could direct access and start research as soon as possible. The key in Laboratory-Based Education is a peer teaching. The faculty member only helps undergraduate students when there is a problem that could not be solved by postgraduate students. This pyramid role of the LBE is illustrated in the Fig. 1.

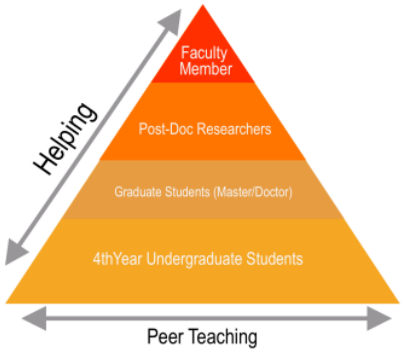

Fig. 1 LBE Pyramid of Peer Teaching

From Fig. 1, the undergraduate students, the graduate student and the post doctoral researcher are learning together with their peers. A faculty member only helps/supervise when needed. LBE is targeting students not only an expertise in their fields, but also developing soft skill such as communication, management, cooperativeness and leadership.

C. Experimental Methods

The experiments have been conducted at Informatics Department, Faculty of Engineering, Universitas Muhammadiyah Sidoarjo and held on Academic Year 2017/2018.

TABLE I
CLASSROOM IMPLEMENTATION FOR LBE AND PBL EXPERIMENTS

Class Code	Class Name
HCI-8A3 HCI-8B4	Human Computer Interaction (HCI) (8th Semester)
ADSI-6A1 ADSI-6A2	Analysis and Design Information Systems (ADSI) (6th Semester)
SI-4A3 SI-4A4	Information System (IS) (4th Semester)

Next, for the implementation of Lab Based Education (LBE), we obligate to each class to finding a partner from designated class. From 6 class groups, we divide into two main groups which are class code with an odd number and class code with an even number. Table 1 shows 6 classes groups in which the experiment have been conducted.

Also, we set rules that 8th-semester main task is to develop UX/UI design (as the implementation of their HCI courses). The main task of 6th-semester students is to design the complete diagram (as the implementation of their ADSI courses). The main task of 4th-semester students is software prototyping that based on the UX/UI design and the development diagram as the implementation of their IS courses. The pyramid of designated class that experimenting LBE shown on the Fig. 2.

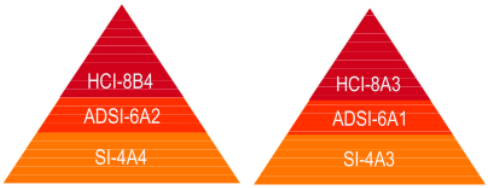

Fig. 2 Classroom implementation of LBE and PBL experiments

D. Development Method

In early-stage supportive tool development, we had implemented rapid prototyping using Google Design Sprint (GDS) [15]. The key in DS are answering main features (or from original GDS definition called the business questions) through design, build prototype, and test it with user. The GDS methodology itself is inline with six phases: Understand, Define, Sketch, Decide and Validate.

To build the prototype, Flask Microframework has chosen for developing the proposed supportive tool [16]. As python based microframework, the developed supportive tool could serve as a web server. With running a single python script, it can be run independently as web application without hosted at the web server. This mean, the lecturer could use the developed supportive tool directly and no need to install Apache/Nginx web server.

Flask is adapting MVC (Model-View-Controller) framework that separate application layer and presentation layer. This mean, the *.py file and *.html file is in the different directory. The MVC model is suitable for future developments. Because of its separate database, control layer, and presentation layer. Fig. 3 shown the directory structure of web-based application using Flask MVC. All the database definition (as a Model) and the routing as the Controller are written in app.py. The static directory contains all static file such as *.js, *.css. And the templates directory is the directory to store *.html files as a View part from MVC framework.

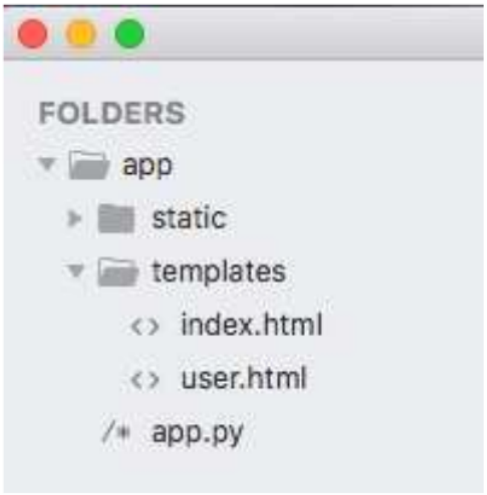

Fig. 3 MVC Model Directory on Flask Microframework

All request from the client will be routed according to the designated URL that configured in *.py files. For an example, we have index.html and hello.html in the templates directory:

1) Example index.html.

```
<!DOCTYPE html>
<html>
    <head>
        <title>Suppotive
Tool</title>
    </head>
    <body>
        <h1>Server Status:</h1>
        <p>Ready!</p>
    </body>
</html>
```

2) Example hello.html

```
<!DOCTYPE html>
<html>
    <head>
        <title>Suppotive
Tool</title>
    </head>
    <body>
        <h2>Welcome {{user}}</h2>
    </body>
</html>
```

To configure the request from the client, it uses "route()" decorator. To route the request and view the targeted HTML, the URL needs to be registered in "@app.route". For an example, when it needs to set up the index (main page) to access index.html, it uses the scripts as shown at Fig. 4.

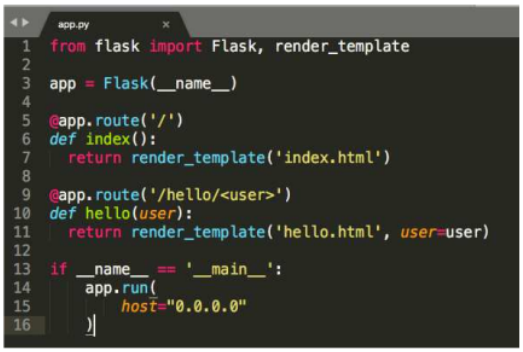

Fig. 4 Example ".py" file as main application

From the above script, line 5 to 7 are used to route all request when need access an index homepage (top level directory of its web application). Line 9 to 11 are used to response a request from URL: http://domain/hello/paramater. At line 9 to 11, it is shown that the designated URL could give a parameter.

To start the server, the user need to execute main ".py" file. If ".py" file from Fig. 4 has executed, Fig. 5 shown the WSGI server is ready to accept a request.

Fig. 5 WSGI server has been activated

By default, WSGI using port 5000 to serve its web requests. At local access, a user can request by accessing "http://localhost:5000/" (as shown at the Fig. 6).

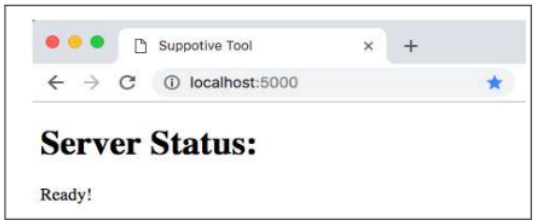

Fig. 6 Response from the WSGI server

If user access "http://localhost:5000/hello/Alice", the server will recognize the parameter after "/hello", as configured in "app.py" (Fig. 4). The WSGI will respond "hello.html" as shown at Fig. 7.

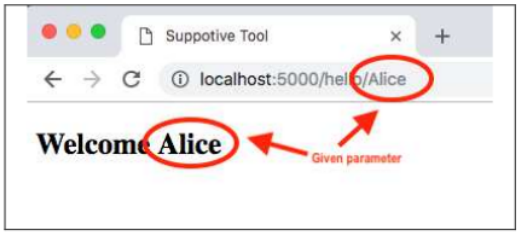

Fig. 7 Response from the WSGI server with parameter

With the above methods, it will be easier to design and implement a user requirement that needs to be developed in the proposed supportive tool.

E. User Interactions

The prospective user for the developed supportive tool is lecturers, student as the project manager and students as a team member. The interactions of the user and developed supportive tool are described in the Fig. 8.

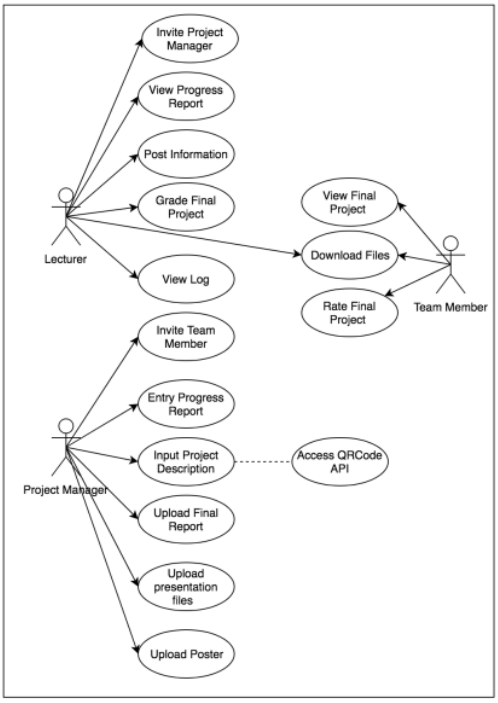

Fig. 8 User interaction diagram on the proposed supportive tooler

The prospective user for the developed supportive tool is lecturers, student The students had been provided with many features. From Fig. 8, The final project materials are uploaded by a student with project manager level access. And a student with no level access can view, download, and uploaded final project where not only from their groups but also from other groups.

F. Proposed Architecture

To adapt bandwidth limitation that might happen during implementation, the proposed supportive tool will be developed into two versions. First, it will develop for self-hosting or deploy on the low-end machine. Second, it will develop into a server machine as usual. Both versions are using Flask. The differences are the database engine being used. For the self-hosted version using SQLite and for server machine using MySQL. Another differences are the developed supportive for server machine is provided by Web Service using Flask-REST API. The architecture of the current development supportive tool is shown in the Fig. 9.

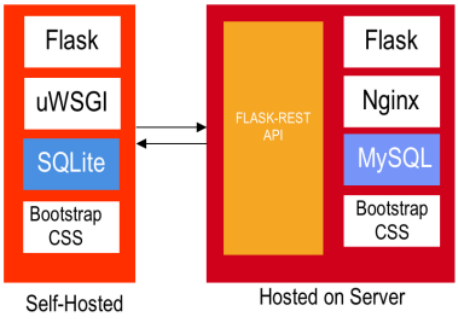

Fig. 9 User interaction diagram on the proposed supportive tool

III. Results and Discussion

A. Supportive Tools For Lecturer

Any tools that assist learner while learning the process and track the achievement could be labeled as a ePortfolio. The ePortfolio also used as storage system on any learning model that evidence-based as the results. even though the current developed supportive tool main feature is similar to evidence collection, the proposed supportive tool main feature is not only assisting a student to submit and publish their final project but also designated for lecturers to track the process when final project was conducted by many groups of students.

To use the supportive tools, lecturers only need to send an invitation through email to one of an appointed group member as their Project Manager (PM). In these experiments, we use the existing Google Mail Account to send the invitations and Flask-Mail module to sent email over SMTP.

After lecturers send the invitations, a PM should activate the link and start to add the group member. Other features that provide in lecturers dashboard are Post Information, View Progress Report, and Grading Page. The activity diagram of lecturers as a user shown on the Fig. 10.

Lecturers also provide with invitation status of the PM. After PM accept the invitation, it will notify lecturer that PM account has been activated. Fig. 11 shown the PM account that has been activated or not.

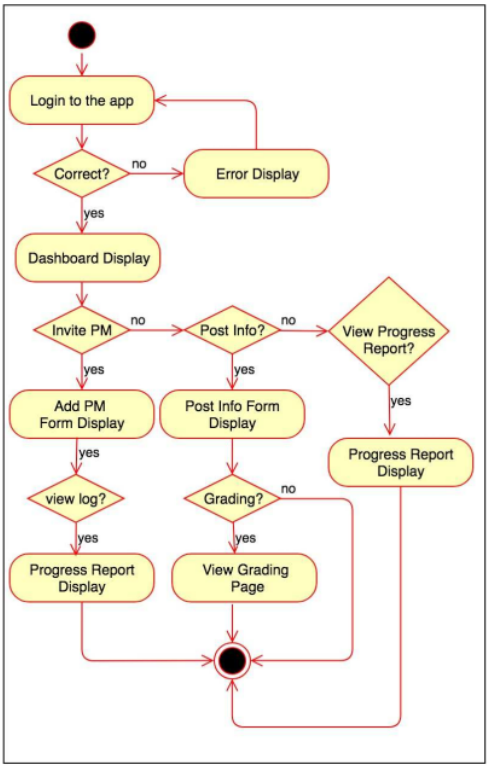

Fig. 10 Lecturer activity diagram

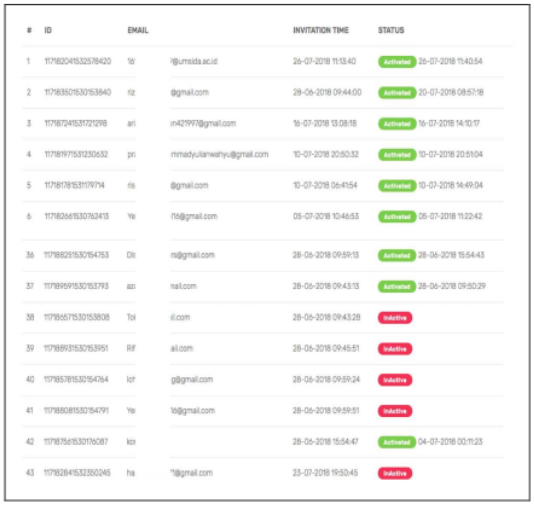

Fig. 11 Account activation status of students as the project manager

B. Progress Report

The key success of the PBL and LBE implementations are lecturer roles in monitoring the learning process. To address these need, the current development supportive tool provides Progress Report Form where students obligated to input it in every week. Fig. 12 shows progress report table that has been inputted by students.

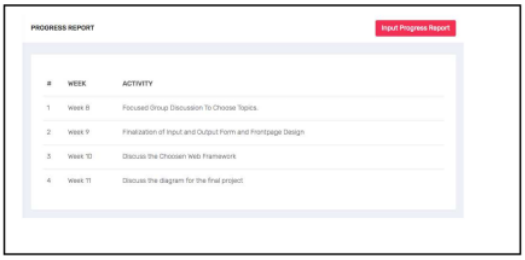

Fig. 12 Progress report inputted by students

C. Log Report

Lecturers have been provided not only the information about progress report from each team but also the log information that can be accessed by lecturer only. By using the log, its hopes to help lecturers could analyze the learning process.

Form log itself, it stores the log with the value of URL Address that has been accessed, the timestamp of the accessed page and the IP address. To make these possible, it needs to insert a log table every each request which is different routes that have configured from .py files. As a result, a full activity from a user has been logged. Fig. 13 show an example log result.

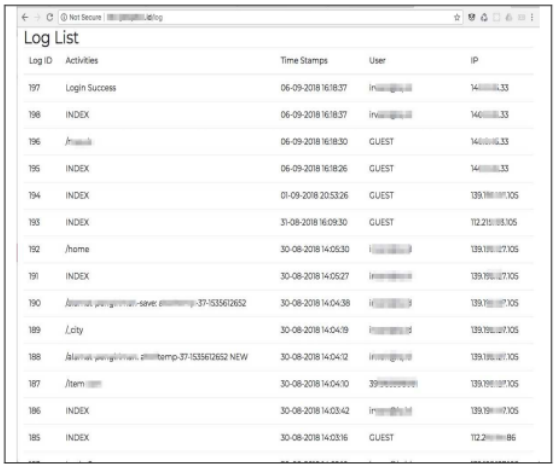

Fig. 13 Log of user activities

The log from user interaction will be useful for meta-analysis as part of post-production evaluation. The exploration of the log-based metric can complete and validate the usability evaluation conducted by interview or questionnaire [17], [18].

D. Project Publishing

As a result of Project Based Learning, students need to publish their final project in the public domain. This mean, the developed supportive tool need to provide an input form which enables students to input the project detail/description, the project repository. Fig. 14 showing the form to input project description.

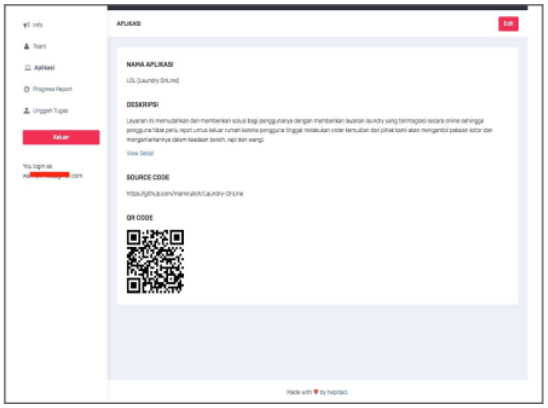

Fig. 14 Project description form

Also, as a result of Lab Based Education activities, the developed supportive tool need to provide an unloading mechanism for store final report, presentation and poster in digital formats. Fig. 15 shows the input form for uploading the digital documents.

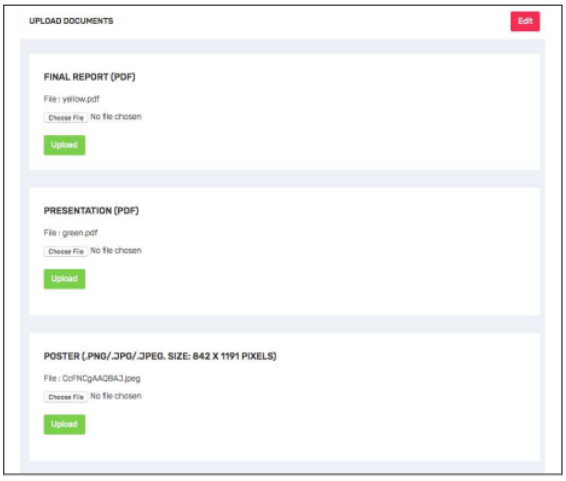

Fig. 15 Form for upload final report, presentation and poster

After students have been finished to uploads the document, the uploaded documents will be accessible to the public. Fig 16 shown the front page of the developed supportive tool.

E. Lecturer Grading

When students have been finished to publish their final reports, presentations and posters, it is time for lecturers to give an evaluations. Because of each groups consist of different students from different class, lecturers need to be provided with one single form entry to give a score to whole team member. Fig. 17 shown an example process evaluation for one of student groups.

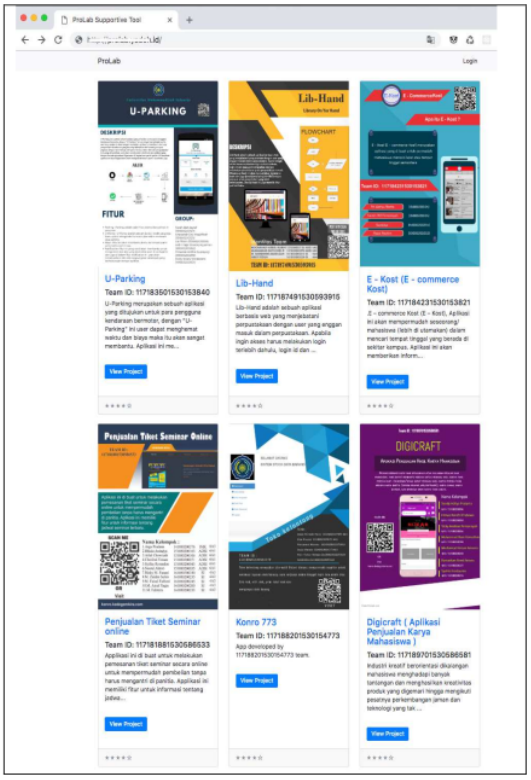

Fig. 16 Homepage of developed supportive tool

Fig. 17 Scoring form for each groups

F. Supportive Tool Deployment

1) Self Hosted

The use of Microframework brings other advantages. The developed supportive tool application size is less than 20 MB. This made possible to deploy it at the mini device. The term mini device is a hand on carrying pc board that helps lecturers mobility to use the supportive tool in the different classroom.

In these experiments, the proposed supportive tool has been deployed at the APC board and connect it into the access point. Fig. 18 show the network topology and the supportive tool deployment to the APC Board.

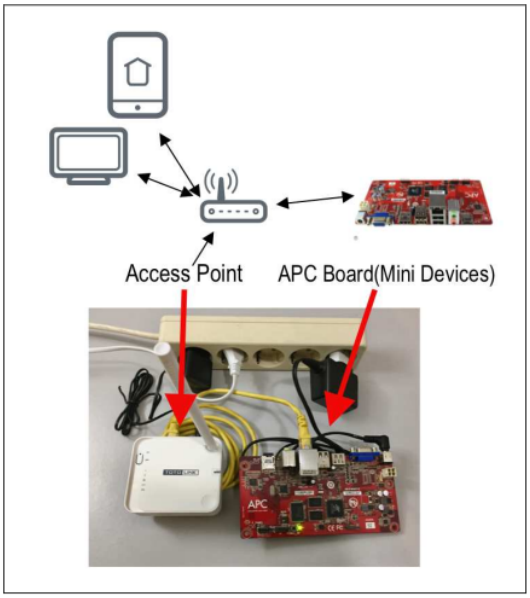

Fig. 18 Self hosted deployment of developed supportive tool

By default, the Werkzeug module used by Flask as request handler, it can only serve one request only. Because the Werkzeug is designed to only development model [19]. To hosted on the mini device or other machine and serve many requests, it needs to use uWSGI as request handler [20]. To start using uWSGI, it needs "wsgi.py" file that imports an "app". The wsgi.py should be as in Fig. 19:

```
1 from modul_name import app
2 if __name__ == "__main__":
3     app.run()
```

Fig. 19 An example of wsgi.py

A "module_name" is the name of the .py file as the main program. To start a server, it needs to execute the command in Fig 20.

```
uwsgi --socket 0.0.0.0:5000 --protocol=http -
wsgi:app
```

Fig. 20 The uWSGI command to start a server

With the above command, the proposed supportive tool can be accessed from "http://server_IP_address:5000".

2) Hosted on Machine Server

In this experiments, developed supportive tool will be deployed on a server with Ubuntu 14.04 as operating system and Nginx as the web server.

Even though it uses Nginx as the default web server, it needs to configure Nginx to pass a request to application socket using uwsgi protocol. The configuration starts with creating a ".ini" file in the project directory to activate the uWSGI. Example of ".ini" files is in the Fig. 21.

```
[uwsgi]
module = wsgi

master = true
processes = 5

socket = app.sock
chmod-socket = 660
vacuum = true
```

Fig. 21 Example uwsgi.ini for uWSGI configuration

Next, it needs to create an upstart script to start the uWSGI. The upstart script will allow operating system init system to automatically start uWSGI and serve the Flask application whenever the server machine boots. The upstart script needs to save in ".conf" format at "/etc/init/projectname.conf". Example of the upstart file is in Fig. 22.

```
start on runlevel [2345]
stop on runlevel [!2345]

setuid username
setgid www-data

env
PATH=/home/username/projectname/projectenv/bin
chdir /home/username/projectname
exec uwsgi --ini projectname.ini
```

Fig. 22 Example ".conf" in Nginx as upstart file

The final part of server machine configuration is to create server block and order Nginx to listen on the port 80 and use this block for incoming requests to our server's domain name or IP address.

The configuration is done by creating ".conf" and saved on "/etc/nginx/conf.d/projectname.conf". Example server block that needs to be configured on the Nginx web server shown at Fig. 23.

```
server {
    listen 80;
    server_name domain.ourserver.com;

    location / {
        include uwsgi_params;
        uwsgi_pass
unix:/home/username/projectname/projectname.soc
k;
    }
}
```

Fig. 23 Nginx server block for domain configuration

From the above configuration, the developed supportive tool can be accessed directly by both lecturer and students from his/her mobile device. Because it was installed on a mini device and some Access Point (AP), all user need to connect their device with the access point.

G. Usability Evaluation and Log Metrics

Usability Evaluation is described as the measurement to which a product can be easily used by targeted users with efficiency and satisfaction to achieve certain objectives. To explore user satisfaction, an interview and a certain

experiment being conducted by 135 students and 16 lecturers as a participant.

During the experimental session, students were asked to finish several tasks as mentioned in Fig. 8 as the simulation of the use of the developed supportive tool with student level access. Lecturer as a participant also requested to finish several activities as mentioned in Fig. 10 as the simulation of the use of the developed supportive tool with lecturer level access. After finished the experiments, both lecturers and student are interviewed and asked to fill the questionnaire. Table II has shown the question that given to students.

The experiments had conducted within a laboratory where the participants use the supportive tool which installed in local machine server that available in the laboratory. To measure the effectiveness and difficulties, we analyzed the timestamp from the Log creation when participants were asked to accomplished the certain task as part of the experiments.

TABLE II
STUDENT QUESTIONNARE

No	Question
1	Before implementation of PBL-LBE class model I experience paper-based assignment (yes/no/not sure)
2	I prefer paperless assignment (yes/no/not sure)
3	The benefit using supportive tool for uploading final project material : A. I can upload the final project materials at times convenient to me B. No extra cost for report final project C. I like to know other groups final project D. I choose A, B, C E. I failed to see the benefit of using supportive tool
4	The interface of the supportive tool is easy to use (yes/no/not sure)
5	The error message was given by system (yes/no/not sure)
6	The supportive tools enable me to interact with other groups asynchronously (yes/no/not sure)
7	I become productive using the supportive tool (yes/no/not sure)
8	Knowing some group ideas and mockups, I felt need to collaborate with the group to develop the application to more mature version (yes/no/not sure)
9	Other groups ideas and mockups in their final report help me find a topic for my undergraduate final project (yes/no/not sure)
10	I would like to continue using proposed supportive tool on next semester (yes/no/not sure)

As results, students mostly opted “Yes” in question 1,2,4 until 10. Fig. 24 shown the dominance of opted Yes in the student's questionnaire.

For question 3 from the student's questionnaire, 90% of students opted A, B, C which shown the benefit of the use supportive tool in order to support the submitting final project materials. Fig. 25 show the percentage of question 3 from the student questionnaire.

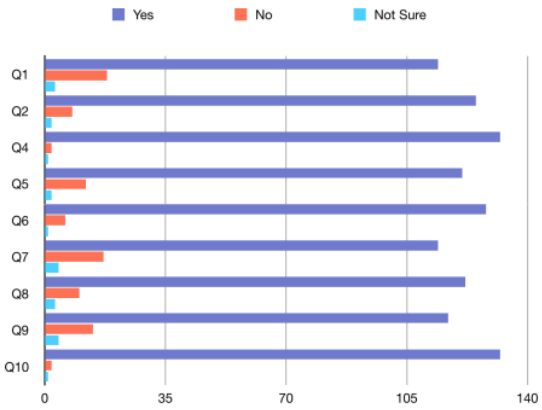

Fig. 24 Students rensponses from question 1,2,4 until 10

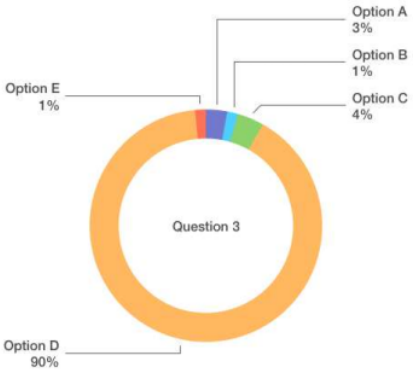

Fig. 25 Students rensponses from question 3

TABLE III
LECTURE QUESTIONNARE

No	Question
1	I always experience scoring students report with a paper-based assignment (yes/no/not sure)
2	I prefer to check students assignment in a paperless manner (yes/no/not sure)
3	The benefit using supportive tool check students final project material : A. I can check the final project materials at times convenient to me B. I could know the progress report while students finish their final projects C. Both A and B D. I failed to see the benefit of using supportive tool
4	The interface of the supportive tool is easy to use (yes/no/not sure)
5	The error message was given by the system (yes/no/not sure)
6	The supportive tools enable me to interact with students asynchronously (yes/no/not sure)
7	I become productive using the supportive tool (yes/no/not sure)

As the results of the lecturer’s experiments, lecturers also mostly opted “Yes” in question 1,2,4 until 10. Fig. 26 shown

the dominancies of opted "Yes" in the lecturer's questionnaire.

For question 3 at the lecturer's questionnaire, 90% lectures opted C which shown the benefit of the use supportive tool in order to check and see the progress report of the submitted final project materials. Fig. 27 shown the percentage of Question 3 from the lecturer's questionnare.

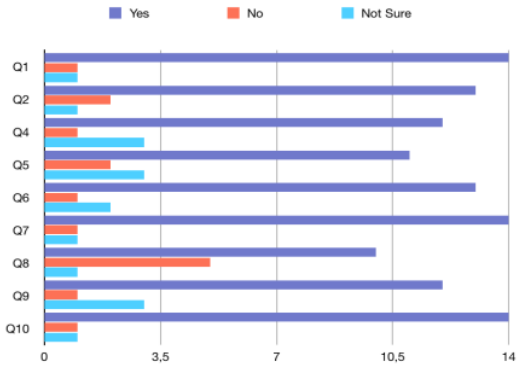

Fig. 26 Lecturer's rensponses from question 1,2,4 until 10

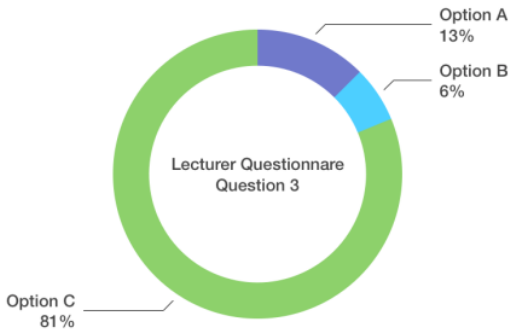

Fig. 27 Lecturer's rensponses from question 3

Next experiments were analyzed the created log while participants asked to do several tasks as mentioned in Fig. 8. Example log created as shown in Fig. 13.

As a result, all students in averages needs only less than 4 minutes to accomplish each given task. Fig. 28 shown the average time spent while students perform interaction in with the supportive tools. For lecturers itself, lecturers on average needs less than 3 minutes to finish each given task. Average time spent that lecturers need to accomplish the given task are shown in Fig. 29.

Remembering when there is no tutorial given before the experiments had conducted, all participants just needs a little time to accomplish the given task. It indicates that the developed supportive tool is easy to use and shows the effectiveness of the developed supportive tools.

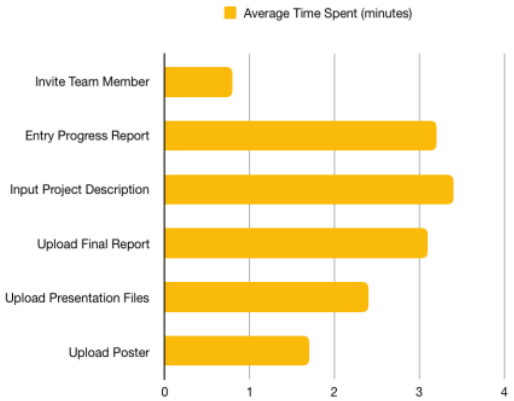

Fig. 28 Average time spent by students as the participant

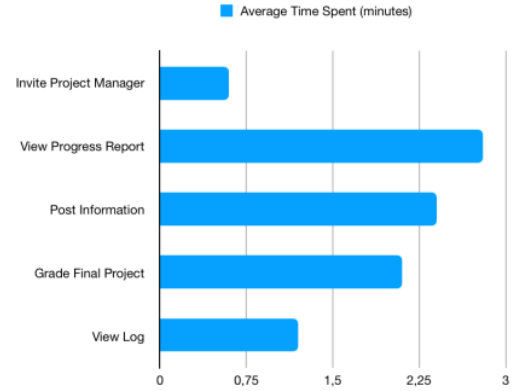

Fig. 29 Average time spent by lecturers as the participant

IV. CONCLUSIONS

This paper presents the current development web-based application used by lecturers as supportive tools for implement Project Based Learning and Lab Based Educations. Lecturers can monitor the learning process from progress report that has been inputted by students. Because each group is consist of different class groups, lecturers no need to input manually the score to each student. Lecturers only need the score for a whole group.

The developed supportive tool can be used by students as an online portfolio to show their project. Since all final project, presentation and poster are visible on the public domain, other students can also view other groups projects and download the uploaded documents. The developed supportive tool offer one-stop solution for lecturers that will implement Project Based Learning and Lab Based Education. Lecturers no need install blog engine for an announcement, Learning Management System to track students progress report and do grading, and ePortfolio to show students projects. All these features are provided at the developed supportive tool. From experiments results, the use of supportive tools has gain beneficial from both students dan lecturers. The use of supportive tools as an application for PBL and LBE implementations brought students and lecturers to build the submitted final project into better

version while they found an interesting project that really solves real-world problems.

As a result of one academic semester experiment with 6 class groups, we obtain 32 particular groups with 32 particular web-based applications as their final project. This experiment's results can be useful repositories for next year academic students. The repository can be used not only as a reference but also for a hub among students to develop the final projects into production level applications.

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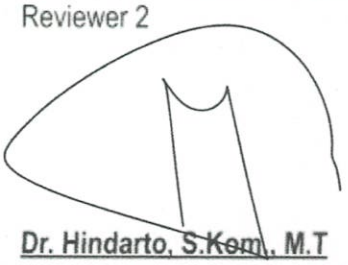

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