DEVELOPMENT OF WEB-BASED VIRTUAL LAB PHARMACEUTICAL CHEMISTRY

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ABSTRAK

Pharmaceutical Chemicals (Basic Analysis of Pharmacy) is one of the chemical sciences that aim to determine the physical properties and chemistry of pharmaceuticals. The learning experimental chemistry, is accompanied by practical lessons in the laboratory to prove the theory they have learned in class.

Lab activities that take place in the laboratory in fact have some problems such as the lack of lab equipment and a limited time to do the practicum, so it is necessary to build a virtual laboratory applications as an alternative medium of learning that will help students to perform pharmaceutical chemistry lab.

Virtual laboratory applications are built web-based. Simulation on the application correspond with the lessons of pharmaceutical Chemistry laboratory at Sekolah Farmasi Bandung. Data collection techniques using literature study and observation. The analytical method used is the structured analysis.

Based on the results of tests that have been done, showing that the applications can facilitate and help the students to understand the course Pharmaceutical Chemistry (Basic Analysis of Pharmaceuticals).

Keywords : Virtual Lab, Practicum, Pharmaceutical Chemicals

1. INTRODUCTION

Pharmaceutical Chemistry is one of the sciences that aim to determine the physical properties and chemistry of pharmaceuticals. Especially for medicinal products derived from nature studied in Pharmacognosy and Phytochemical. While the process of to recognize the physical and chemical properties of this compound called identification or analysis (chemical analysis) [1]. Pharmaceutical chemical or chemical in the pharmaceutical world has many influences and disciplines including Basic Chemistry, Chemical Analysis, Organic Chemistry, Physical Chemistry and others - others. For Chemical Analysis or often called Basic Analysis of Pharmacy is one of the knowledge learned by students majoring in pharmacy. Pharmaceutical Chemicals (Basic Analysis of Pharmaceuticals) was studied based on the analysis and laboratory experiments.

Based on interviews with Ka. Prodi S1 Farmasi Sekolah Farmasi Bandung, claimed that the method of learning routine on campus still using conventional methods, in which the lecturer explained the lessons in class and also provides guidance to laboratory experiments, the lecturers also held discussions with students about the material covered and practicum will be performed in the lab, but sometimes the professor discovered the problem in lab lab equipment that is sometimes lacking, so that some of the students (in groups) cannot perform the lab or doing a practicum student by joining with other groups, This makes it difficult to perform student practicum, although with the practicum students are expected to understand the lessons that have been given and the time is not enough so that make the lecturer cannot explain all the lessons or lecturers explain the material but only partially. Also based on the results of a questionnaire distributed to students of Sekolah Farmasi Bandung, 100% of the students said that the practicum is very important, because the practicum can help improve students understanding of the course Pharmaceutical Chemistry (Basic Analysis of Pharmaceuticals), in addition to the 68% of students had difficulty in the course Pharmaceutical Chemistry (Basic Analysis of Pharmaceuticals) is because students need more time while performing the practicum, and also in the practicum usually necessary equipment is not always exist or is not always full, and as much as 88% of students always use the Internet as an additional material and references for the task, this shows that the students are still experiencing difficulties in this course and requires a media that can help students to carry out practicum anywhere and anytime.

With some of the problems that have been described, it is necessary to for of alternative learning media that is able to facilitate the students to understand and perform lab work, such as virtual

laboratories. Virtual Lab is a series of laboratory equipment in the form of software-based interactive multimedia computer operated with the a computer and can assist learning in the lab as if the user is in a real laboratory [3]. Based on these problems then made a web-based virtual laboratory simulation through the title "Development of Virtual Laboratory Web-Based Pharmaceutical Chemistry" which is expected later learning process can be performed easily anywhere and anytime.

2. CONTENTS OF RESEARCH

2.1 Virtual Laboratory

Virtual laboratory or virtual lab is a series of laboratory equipment in the form of software (software) computer-based interactive multimedia, which is operated with the computers and can simulate the learning activities in the laboratory as if the user is in a real laboratory.

Virtual laboratory is a product of superior results of advances in information technology laboratory, study by using virtual labs can be used as an alternative to eliminate the limitations of laboratory devices [2].

Virtual labs are within the software environment that comes from the needs to regulate and facilitate the simulation experiments in computer graphics. But virtual lab has also been used to support experiments in fractal geometry and the physical-based modeling. Regardless of differences in the content, virtual labs are very helpful in experiments.

The most ideal virtual lab is run on the Internet, so the user can perform experiments from anywhere and anytime. They may also run from within an intranet or standalone computers. Virtual laboratory is a laboratory by utilizing virtual media such as computer simulation or virtual laboratory media. Virtual laboratory is a visualization of concepts and natural phenomena in the form of interactive simulation through computer technology, in addition to the virtual laboratory is a laboratory component modeling of any real into the virtual simulation. With the virtual laboratory is expected the process of learning can be done anywhere and anytime, and also the learning process becomes more interesting and more interactive.

2.2 System Testing Methods

Testing of the system is a critical element of software quality assurance and represents a fundamental study of the design specifications and coding [3].

System testing methods to be carried are the Black-box testing. Black box testing focuses on functional perstaratan software. Thus, the black box testing software engineer possibility of getting a set of input conditions that fully utilizes all of the functional requirements for a program. Black box testing is not an alternative to white box techniques, but it is a complementary approach that is most likely able to uncover the mistake grade than white box method [3].

Black box testing trying to find errors in the following categories :

1. Function that are not correct or missing.
2. Errors in the interfaces.
3. Errors in data structures or external database access.
4. Error performance.
5. Initialization and termination errors.

2.3 Measurement scale

Measurement scale is an agreement that is used as a reference for determining the length of the short interval in measuring instruments, so that the instruments when used will produce data quantitative. With the scale of measurement, then the value of the variable that is measured with the a specific instrument can be expressed in numbers, so that would be more accurate, efficient and communicative. The scale used to perform this study is the Guttman Scale and Likert Scale.

Guttman scale is a scale of measurement obtained with the emphatic answer is "yes and no", "right and wrong". "Positive and negative" and others - others. The data obtained can be data interval or ratio of 11 dichotomy (two alternatives). So when a Likert scale there are 3, 4, 5, 6, 7 interval, from "strongly agree" to "strongly disagree" on a scale Guttman then there are only two intervals of "agree" and "disagree".

Likert scale is an agreement or disagreement with the each statement in the instrument. Each response was given a numerical score, showed favourableness or unfavourbleness and scores are summed to measure the attitude of the respondent, so the respondent in a position keselurahan a continuum favourableness or unfavourableness to the problem.

Table 1 Assessment Scale Likert

Alternative	Score
Sangat Setuju	5
Setuju	4
Ragu-ragu	3
Tidak Setuju	2
Sangat Tidak Setuju	1

Data from the questionnaire can be searched percentage of each answer by using the formula:

$$P = \frac{S}{Ideal\ Score} \times 100\%$$

Note:

P = Allocation of percentage points searched

S = Total value performed with the frequency response categories ($\sum = N$ x R)

N = The value of each answer
R = Frequency
Ideal Score = highest value multiplied by the number of samples (6 X Total Sample).

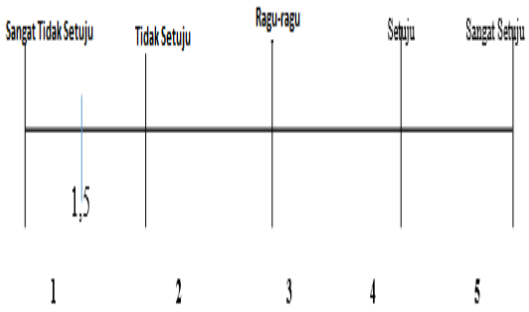
Afterwards with the questionnaire data collection techniques, the instrument was given to 30 people who were taken at random. Of the 30 people after analysis, for example:

1. A total of 15 people answered Sangat Setuju (SS).
2. A total of 5 people answer Setuju (S).
3. A total of 5 people answer Ragu-Ragu (RG).
4. A total of 2 people answer Tidak Setuju (TS).
5. A total of 3 people answer Sangat Tidak Setuju (STS) .

Interval data was later analyzed by calculating the average response by scoring each answer from the respondent. Based on predefined score can be calculated as follows:

The total score for the 15 people who answered SS = 15x5 = 75
The total score for the 5 people who answered S = 5x5 = 25
The total score for the 5 people who answered RG = 5x5 = 25
The total score for the 2 people who answered TS = 2x5 = 10
The total score for the 3 people who answered STS = 3x5 = 15
Total Value = 150

Number of scores obtained from the study is 150. So based on that data, the level of agreement that the amount of the total value divided by the total number of respondents = (150: 100) = 1.5 in continuum can be seen as in figure 1



Picture 1 Processing Questionnaires In Continuum

So based on data obtained from 30 respondents, the average of 1.5 lies in the area Disagree.

2.4 Analysis Systems

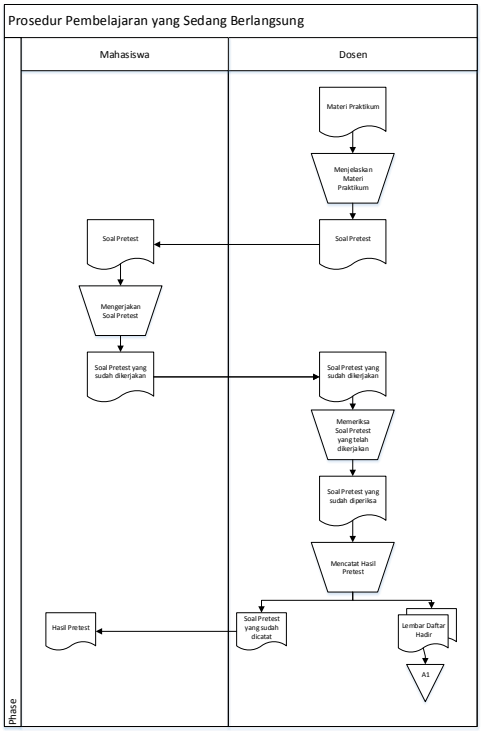
Analisis sistem adalah penguraian dari suatu sistem informasi yang utuh ke dalam bagian-bagian komponennya dengan maksud untuk mengidentifikasikan dan mengevaluasi permasalahan, kesempatan-kesempatan, hambatan yang terjadi dan kebutuhan yang diharapkan sehingga dapat diusulkan perbaikan-perbaikannya.

2.5 Problem Analysis

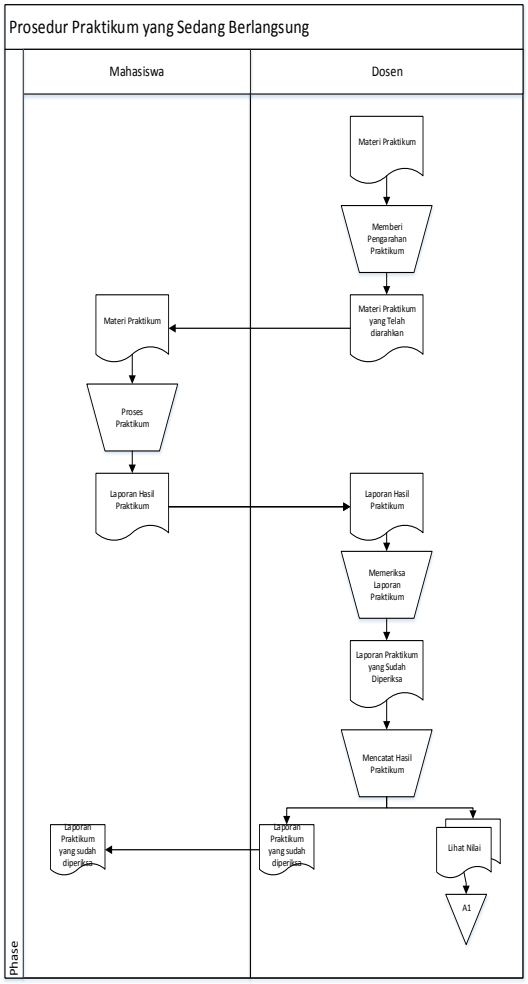
Analysis of problems explaining the process of problem identification. Described in the introduction that is the problem in the research is lacking practicum equipment made the students (in groups) can not perform practicum, students had difficulty in Pharmaceutical Chemistry course (Basic Analysis of Pharmaceuticals) because students need more time in doing practicum.

2.6 Ongoing Analysis System

Analysis of the current system aims to determine how the learning system is in progress, learning is done conventionally, the lecturer explains the material in class and then perform practicum in which students are expected to prepare with material related with lab materials, the student must come on time, not late, the students do chores preliminary specified in the section reserved in the module, students make progress reports in the section provided in the module. Analysis of the current system is described in the following flow charts and pictures



Pictures 2 Procedure Ongoing Learning



Pictures 3 Flowmap Ongoing Practical Procedures

2.6 Built Systems Analysis

In the analysis system to be built is divided into three including material analysis, analysis exercises and test analysis. For the analysis of the material in the system to be built consists of five items including:

1. Identification of Cations Group 1

Learning Identification cation aims to identify ions constituent organic compounds, metal salts are often used in pharmacy, both as nutritious substances or materials, in addition to checking the content of organic compounds and determine reactions that occur in the ions Group 1 . in the identification of cations group 1 contained the sample to be tested with public reaction or initial reagents (HCl) and a precipitate of white and proceed with reagent specific reaction that the determination of whether the solution is included in the group of Pb, Ag or Hg.

2. Titration Acid Alkali

Learning acid-base titrations aimed to determine the molarity of an acid-base using acid-base titration methods and understand the reactions that occur in acid-base titration. Acid-base titration is divided into two titration strong acid and a strong base titration weak acid strong base.

In the acid-base titration, Contained sample solution were added an indicator, then to freezing with HCl (acid) titration with a solution of HCl wait until the indicator changes color drops fenoftalein. As for freezing with NaOH (alkaline), titration with NaOH solution waiting to change color, then provide potassium are dried and then weigh up to 350g input into the pumpkin, then back titration with NaOH to change color.

3. Titration Precipitation (Argentometry)

Learning argentometry Precipitation titration (determination of chloride) aims to understand the reactions that occur preformance argentometry titration, is able to perform a quantitative analysis is to determine chloride and titration argentometry.

4. Titration Complexometry

Titration complexometry learning aims to understand the reactions that occur in complexometric titration and able to perform a quantitative analysis with complexometry.

5. Redox Titration (Iodometry)

Redox Titration iodometri learning aims to understand the reactions that occur in redox titration iodometric and iodimetric, and is able to perform a quantitative analysis with iodometric titration (determination of copper ions (II)).

Further training for analysis, analysis of virtual laboratory exercises in pharmaceutical chemistry will be described with matter - matter of each material. In one matter contained a practice that suits the material covered, while the exercises contained in the materials identification cation, acid-base titration, precipitation titration (argentometry), complexometric titration, redox titration (iodometric).

In the exercise, there are five multiple choice questions appropriate to the material chosen, the student can choose the answer that he says is true, but before the students towards the question the student must choose a button check beforehand to check the selected answer true or false, if the selected answer is wrong then notice where the correct answer, the student can proceed to the next question, and after completion of work on the problems contained correct answer, the answer wrong, many practice questions and also the values obtained from these exercises.

And the latter for the analysis of the exam, Exam Analysis on virtual laboratory pharmaceutical chemistry will be illustrated with questions that represent each material. In the exam there are ten questions from existing materials. Problem drawn at random from all the material. Students can choose according to which the correct answer until after then will appear a matter of right, wrong question, and the value obtained student.

2.7 Analysis of Non-Functional Requirements

Non-functional analysis is the analysis needed to determine the system requirements specification. This specification also includes elements or components of what is needed for the system to be built until the system is implemented. The needs analysis also determines the required input spesisifikasi system, outputs to be produced systems and processes needed to process inputs to produce a desired output. In the non-functional requirements analysis system is described software requirements analysis, analysis of hardware requirements, and user analysis.

2.8 Software Requirements Analysis

The software is used in a system are the commands given to the hardware in order to interact between them. Software owned by the students is as follows:

1. Windows 7 Operating System
2. Web Browser Google Chrome
3. Adobe Flash Player

While the software required is as follows:

1. Windows XP/7/8 Operating System.
2. Web Browser (Mozila FireFox version 10.0.0 or better, Google Chrome)
3. Adobe Flash Player

Based on the comparison of software owned by the student with the necessary software analysis, the software owned by the student meets the specifications required analysis software.

2.8 Hardware Requirements Analysis

The hardware is a very important component in supporting an application. Without the hardware that is eligible, an application will not run properly. As for the hardware that is owned by the students is:

1. A single laptop with the following specifications:
   a. CPU with speed of 2.0 GHz
   b. Ram Memory 2GB
   c. Storage 500 Gb
2. Modem

The minimum hardware specifications needed to build a virtual laboratory is :

1. A single laptop/PC with the following specifications :
   a. CPU with speed 2.0 GHz
   b. Graphic Card with 512Mb memory or better
   c. RAM with 1 Gb memory or better
   d. Storage harddrive 10 Gb
2. Modem

Based on the comparison of the hardware that is owned by the students with the analysis required hardware, the hardware that is owned by a student has met the minimum specifications required hardware analysis.

2.9 User Requirements Analysis

User needs analysis is an analysis of the students who will use the system to be built. The user specifications can be seen in table 2.

Table 2 Specifications User

User	Students
User Experience	1. The user can use the computer 2. Users can access the website 3. Users never perform laboratory experiments
User Job & Task	1. Users can understand commands or instructions given 2. The user can use the computer
User Physical Characteristic	1. Have a good vision 2. Not a color blind 3. Not having a physical obstacle

The specifications required that users can run virtual labs can be seen in Table 3.

Table 3 Specifications required users

User	Student
User Experience	1. The user can use the computer 2. Users can access the website
User Job & Task	1. Users can understand commands or instructions given 2. Users can use the computer
User Physical Characteristic	1. Have a good vision 2. Not a color blind 3. Not having a physical obstacle

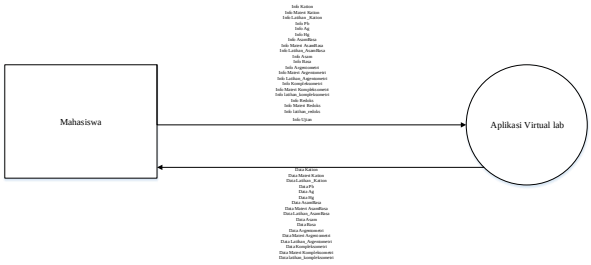
Based on the comparison of user specifications and the specifications required by the user, then the user specifications are in accordance with the specifications required by the user.

2.10 Analysis of Functional Requirements

Functional requirements analysis intended to analyze the process to be applied in the system to be built. Analysis of functional requirements in this application using a context diagram, DFD Manufacture and Process Specification.

2.11 Diagram Context

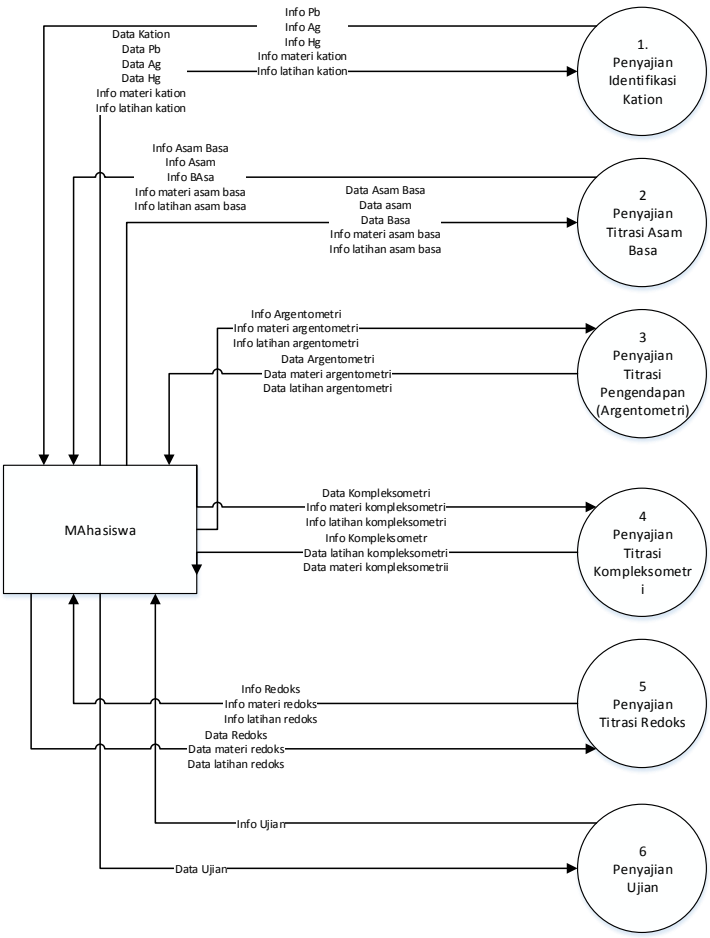
Diagram context is a data flow diagram and an information describing in a loop system and describes the process in an overall system.



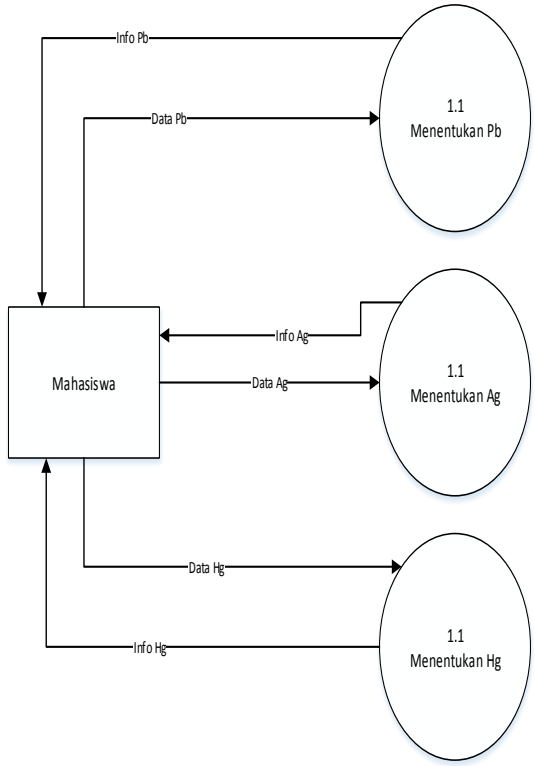
Picture 4 Diagram Context

2.12 Data Flow Diagram

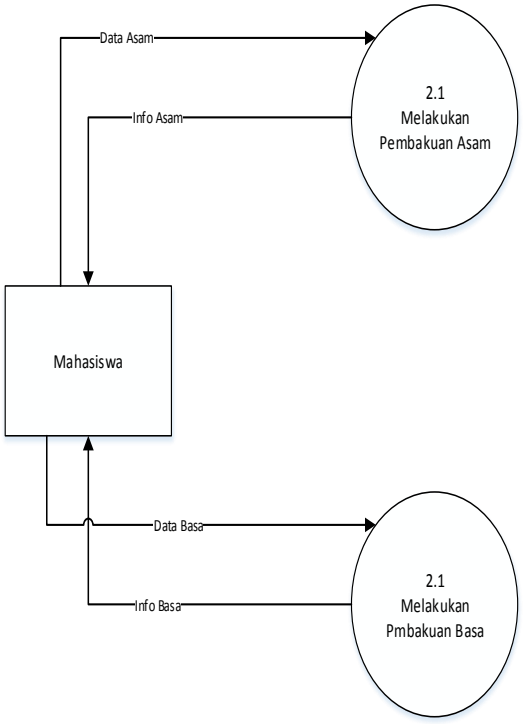
Data Flow Diagram is used to describe systems that already exist or will be developed, without considering the physical environment, the data flow and storage of data with structured development orientation. The data flow diagram of the system to be built is as follows:



Picture 5 Data Flow Diagram Level 1



Picture 6 DFD Level 2 Process Identification of Cations



Picture 7 DFD Level 2 Process Acid Base Titration

2.13 Testing System

Tests are used to test the virtual laboratory applications is conducted by alpha using black box testing and beta testing by means of interviews, questionnaires and pretest and posttest. For Blackbox Testing concluded that Based on test results with sample test cases can be deduced that the software is free of syntax errors and functionally produce results as expected.

As for the interview test method can be summed Based on the results of beta testing, it was concluded that the application of virtual laboratory pharmaceutical chemistry there is still a shortage, so that this application is almost in accordance with the expected objective is to facilitate the students perform practicum anywhere and anytime.

As for the conclusion of the testing pretest and posttest can be concluded that from the results of pretest and posttest given to classroom experiments can show that by the application of virtual laboratory chemicals web-based it can show that by the application of virtual laboratory pharmaceutical chemistry web-based cannot improve student understanding in pharmaceutical chemistry course (basic pharmaceutical analysis).

3. CLOSING

Based on the results of the implementation and testing can be summarized as follows:

1. Application of virtual lab web-based pharmaceutical chemistry can facilitate students to perform practicum activities virtually anywhere and anytime.
2. Statistically it can be seen that the application of this virtual laboratory cannot improve the understanding of students in course Pharmaceutical Chemistry (Basic Analysis of Pharmacy).

For future advice the utilization of virtual laboratory as learning chemistry will be more used and more interesting for student that could help them to learn chemistry as if learning at the real laboratory.

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