DEVELOPMENT VIRTUAL LABORATORY FOR ANALYTICAL CHEMISTRY COURSE

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ABSTARCT

Chemistry is an experimental science, the lessons are accompanied by laboratory experiments to prove the theory they have learned in class. Takes place in a laboratory practicum fact, the laboratory has weaknesses and problems, such as lack of tools and lab materials, lab materials that are sensitive to human skin which could pose a danger to the practitioner, in addition to the student also does not have an overview of practical activities.

The virtual lab is built as an alternative means students learn the material in analytical chemistry as well as to give students an idea before doing the lab without having to go to the lab and the purchase of materials and practical tools. This application also can minimize the occurrence of accidents that can result in injury praktikan. This application is also in support of the Ministry of Education regulations that encourage colleges use technology and information in the learning process. This application is built with Adobe flash programming and programming language ActionScript 3. Data collection techniques by way of literature study and observation. Methods of making software using waterfal Model, as well as data modeling using object-oriented method.

Based on the implementation and testing conducted on students who took the course analytical chemistry, with the construction of a virtual laboratory applications, can help students in the learning material analytical chemistry, as well as provide an overview of the practical analysis of qualitative and quantitative analysis before doing laboratory experiments.

Keywords: virtual laboratories, analytical chemistry, waterfall, Adobe flash, Action script 3

1. INTRODUCTION

Virtual laboratory is a series of laboratory equipment in the form of software (software) computer-based interactive multimedia, which is operated by using a computer and can simulate existing activities in the laboratory as if the user is in the actual laboratory. This virtual laboratory also supports the Ministry of Education and Culture Regulation No. 24 of 2002, concerning the implementation of distance education. In Article 4 states that the learning process of academic education based media utilizing information and communication technology as a learning resource that can be accessed at any time. Therefore, universities are expected to implement a distance education program in order to support government regulation as well as improving the quality of education.

The learning process that can take advantage of information and communication technology is chemical subjects. Chemistry is the science that is based on experiments. One of the subjects of Chemistry in college are of Analytical Chemistry. Analytical chemistry is the analysis of footage material to gain an understanding of the chemical composition and structure. Analytical chemistry incorporates standardized experimental methods in chemistry. These methods can be used in all subdisciplines of chemistry, excluding purely theoretical chemistry. The learning process chemistry in college taught about the theory and practice of laboratories that can be used to underpin the investigation and experimentation. Activities during the practicum can be simulated using the software is often called a virtual laboratory.

Chemistry is an exact science and applicable, must be accompanied by a lecture chemistry lab in order to better understand mahaiswa. Based on the facts lecturing activities in the field, not all laboratories have instruments, and materials for chemical lab activities are adequate. In addition, students have not had an idea what he would do

when he was in the lab, the students only mngetahui theory alone. Digunkan instruments also sensitive to membahyakan human skin.

In an effort to overcome the limitations of laboratory equipment, can be done by building a virtual laboratory capable of facilitating the practical activities. Students also can run on its own lab without having to be accompanied lab assistant and without any time limit.

1.1 Formulation Of Problems

Of the background described above researchers identified the problem as follows:

1. The instrument is sensitive to human skin

2. The procedure for practical activities.

Based on these issues, the formulation of the problem of this research is how to build an application that can support distance learning and help students learn the material in the lab.

1.2 Purpose and Objectives

1.2.1 Objectives

The intent of this study is to establish a Virtual Laboratory of Analytical Chemistry as a media / alternative learning tool for students.

1.2.2 Tujuan

The purpose of this study is

1. Reducing the impact of errors and unwanted incidents during the learning in the laboratory, because it is virtual.

2. Giving an overview of students to carry out practical activities while in the laboratory.

1.3 Research Methods

1.3.1 Data Collecting Methods

In the method of data collection was conducted research directly from the object of research. The data collection techniques were carried out as follows:

a. Study of literature
Literature is a method of data collection by collecting data through literature, journals, papers and readings that are related to final title. This process is done to find and collect all the information to build a virtual laboratory of sources on the Internet.

b. Questionnaire.
The questionnaire is one of the techniques of data collection is done by providing a set of questions or a written statement to the respondent to answer.
c. observation
Observation is the technique of collecting data by conducting research and review directly to the Analytical Chemistry Laboratory ITB to collect information on laboratory guidelines used in each of the Laboratory of Analytical Chemistry.

1.3.2 Software Development Methods

Data analysis techniques in the making software using the paradigm of the waterfall software modification, which includes several processes including:

a. analysis
Is the stage of analyzing the things that are necessary in the implementation of a software development project.
b. Design
Translation phase of the analyzed data into a form that is easily understood by the user.
c. coding
Translation phase data or solving problems t hat have been designed keadalam particular programming language.
d. testing
A testing phase of software built.
e. maintenance
The final stage in which a software which has been completed can undergo changes or additions in accordance with user demand.

1.4 Definition Laboratory Virtual

Virtual laboratory, or commonly referred to as virtual lab is a series of laboratory equipment in the form of software (software) computer-based interactive multimedia, which is operated by a computer and can simulate the activities in the lab as if the user is in the actual laboratory.
Virtual laboratory potential to provide a significantly improved and more effective learning experience. Development of a virtual laboratory is expected to solve the problems of learning experienced by learners and address the problems of costs in procurement of equipment and materials used to carry out practical activities for schools who are less able.
Learning through multimedia in the form of a virtual laboratory, the general benefits to be gained are learning to become more attractive, more interactive, the amount of teaching time can be reduced, the quality of learning can be improved and the learning process can be done anywhere and anytime. In addition, through virtual laboratories, research cost savings can be made, as well as research that were not possible, because of the limitations of conditioning system, is now possible.

1.5 Analytical Chemistry

Analytical chemistry is a branch of chemistry dealing with the identification and determination of the composition of a material. More specifically, there is a qualitative analysis and quantitative analytical chemistry and analytical chemistry instruments

1.6 Qualitative Analysis

Qualitative analysis is the chemical analysis only discusses the identification or the presence / absence of elements / substances in the ingredients. Analytical chemistry quantitative analysis related to the chemical composition or the amount of ingredient / substance within a material. Analytical chemistry instrument is the branch of chemistry dealing with the identification or determination of the composition with the aid of an instrument (tool) is typical; benefit analysis is rapid with minimal reagent type and amount, and weaknesses depend on the accuracy of tools. The following table cations and anions reaction to facilitate the determination of the type of solution

1.7 Analisis Kuantitatif

Quantitative analysis is a series of analytical work aimed to determine the amount of an element or compound in a sample that we analyzed. example: suppose we get tempeh and asked to determine levels of protein in the soybean. then to find out we do quantitative analysis.
When we look at the differences of qualitative and quantitative analysis of the most common is the goal and the results of the analysis. if the qualitative asked to determine the existence of a substance, on quantitative asked to determine the amount of a substance. and the results of the analysis, qualitative analysis generally results in an objective form of data, while the quantitative results in the form of data generally provide mathematical (numerical). The following picture steps in quantitative analysis.

1.8 Simulation Definition

According KBBI (Kamus Besar Bahasa Indonesia), Simulation is a training method that demonstrate something in the form of artificial similar to the real situation. Simulation is a method that aims to predict or learn something that has not happened by imitating or create a model of the system being studied and then to experiment with using a computer or something similar.
In the simulation method, we can estimate the impact of a decision, but it should be known where and when this simulation can be applied. So the simulation is the act of using the model. Then the scenario designed experiments to obtain simulation results are later processed into the system answers in fact. Simulation can predict the impact of a taken decision. Although the simulation method is very promising, but it should be known where and when this simulation can be applied.

1.9 Learning Simulation

Simulation is one way to solve the various problems encountered in the real world (real world). Many methods are built in Operations Research and System Analyst for the benefit of decision-making by using a variety of data analysis. The approach used to solve various problems of uncertainty and the possibility of long-term cannot be carefully considered by the simulation.
Simulation can be defined as a system that is used to solve problems or outlines in real life filled with uncertainty with no or using models or methods and more emphasis on the use of a computer to obtain a solution. The use of simulation in learning is one way of learning that can provide a more realistic estimate of the appropriate system operating conditions of a collection of work.
Learning simulation on a computer is a dynamic learning, interactive, so that students will gain a learning experience that resembles real life. Here are the characteristics of effective simulation applied to learning.
Learning to be shorter than the other methods.
Learning effectiveness is increased if the model or simulation is really close to reality.
Learning Biology that uses simulated media can bring students directly to the environment or certain situations, so students as if it were in such condition.
Simulation method is an alternative learning tool which is quite interesting, effective and efficient.

2. RESEARCH CONTENT

2.1 Analysis Probems

Analysis of problems explaining the process of problem identification and evaluation of a kind of virtual laboratories and to be built. Based on chapter 1 that have been described, that is the problem in this research is as follows:

1. The instrument is sensitive to human skin
2. The procedure for practical activities.

2.2 Analysis of Non-Functional Requirements

Non-functional analysis is the analysis needed to determine the system requirements specification. The 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 specifications of the 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

2.3 Analysis Software Specification

The software is used in a system are the commands given to the hardware in order to interact between them. The software required to access the Virtual Laboratory Based Desktop are as follows:

Tabel 1 Kebutuhan Perangkat Lunak

No	Perangkat Lunak	Spesifikasi
1	Sistem Operasi	Microsoft Windows 7
2	*Tools Compiler*	*Adobe flash* Player

2.4 User Needs Analysis

User needs analysis is an analysis of the user who will use the system to be built. The needs of users who will be using this application are:

Table 2 Use Needs

Pengguna	Hak Akses	Tugas Pengguna	Pengalaman
Admin/ Asisten Praktikum	Dapat melakukan proses edit, tambah dan hapus data	Mengelola data Materi dan Evaluasi	Pengguna dapat menggunakan komputer
Mahasiswa	Pengguna dapat menggunakan Laboratorium Vrtual	Pengguna dapat mengerti perintah atau instruksi yang diberikan	

2.5 Analysis Hardware Specification

So that applications can run well, then the required hardware according to application needs. The minimum hardware specifications needed to access the Virtual Laboratory are as follows:

Table 3 Hardware Specification

No	Perangkat Keras	Spesifikasi
1	Processor	Processor dengan minimal kecepatan 1.6 GHz
2	Monitor	Monitor dengan resolusi 1024 x 768 pixel
3	Graphic Card	VGA Minimum 512 MB
4	Harddisk	80 GB
5	Memory	Minimum RAM 1GB
6	Mouse, Keyboard dan Speaker	Standar

2.6 Analysis of Fucntional Requirements

Functional needs analysis aims to analyze the process to be applied in the system to be built. Analysis of functional requirements in this application using the Use Case diagrams, Activity diagrams and use case scenarios.

2.7 Analysis of Virtual Laboratory of Analytical Chemistry

Virtual laboratory to be built is a simulation lab activities containing some learning materials on the analysis of quantitative and qualitative analysis. Virtual laboratory course is intended for analytical chemistry college. The main objective of this virtual laboratory is to produce media that can overcome the limitations of existing props and helping students improve their understanding of the concepts of analytical chemistry courses.
Learning analytical chemistry would explain the material on quantitative analysis and qualitative analysis will be described with the components of the material in the delivery of interactive and simulation lab there is a menu of quantitative and qualitative analysis along with exercises.

2.8 Material Analysis

The use of simulation in this lab will be described based on each berkairan material is the material on quantitative analysis and qualitative analysis. The following materials will be described in terms of simulating.

1. Qualitative Analysis
Qualitative analysis is a process of identifying the presence of a chemical compound in a solution or unknown samples. The purpose of qualitative analysis is to isolate and identify a number of elements or compounds. Qualitative

analysis was also used to analyze the components or types of substances that exist in a solution.
2. Quantitative Analysis
The quantitative analysis is an analysis used to determine levels of a substance. Quantitative analysis relating to the determination of some lots of a specific substance contained in a sample. The main purpose of analysis kauntittatif is fatherly knowing the quantity (amount) of each of the components that make up the analyte.

2.9 Analysis Simulation Virtual Laboratory

In the laboratory simulation analysis described working steps of the virtual laboratory to be built. Virtual laboratory analytical chemistry consists of two main menus including menu menu qualitative analysis and quantitative analysis along with training.
1. Qualitative Analysis Simulation Menu When a user selects a menu qualitative analysis, it will display a virtual laboratory for material simualasi qualitative analysis, there are tools and materials, work steps.
2. Simulation of the analysis Quantitative Menu When a user selects a menu quantitative analysis, it will display a virtual lab for quantitative analysis simualasi material, there are tools and materials, work steps.
3. Menu Content When a user selects a menu of matter, it would appear the materials discussed in the course of analytical chemistry.
4. Menu Evaluation When a user selects a menu of evaluation, it will display the worksheets to work on the problems of analytical chemistry training material.

2.9.1 *Use Case* Diagram

Use case describes an interaction between one or more actors with the information system will be created. The following use case diagram application Virtual Laboratory of Analytical Chemistry.

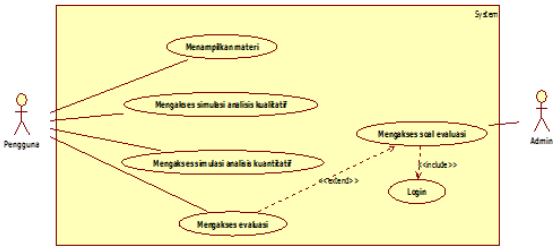


Figure 1 Use case diagram

2.9.2 *Activity* Diagram

Activity diagram is a diagram modeling the workflow or workflow of the order of activities in a process that refers to the existing use case diagram. Here is an explanation of each activity diagram:
Activity Diagram
1. Accessing Simulation
Activity diagram simulation workflows Qualitative Analysis users to perform simulations.

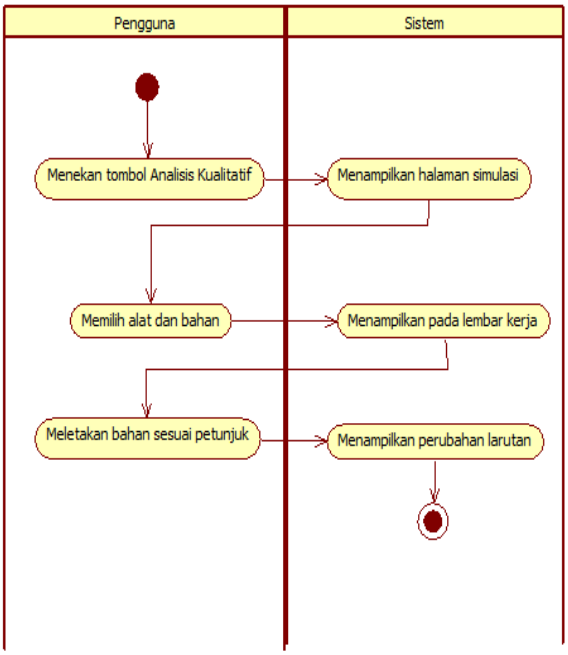


Figure 2 Activity Simulation Diagram

2.10 Perancangan Antarmuka

1. Designing Interfaces Home

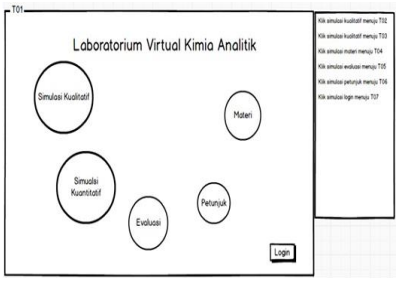


Figure 3 Designing Interfaces Home

2.11 Implementasi Antarmuka

1. Implementation Interface Home



Figure 4 Implementation Interface Home

2.12 System Testing Methods

Testing of the system is a critical element of software quality assurance and represents a fundamental study of the specification, design, and coding [3]. System testing method consists of testing Black-box.

Black-box testing focuses on the information from the software domain, by performing a test case with menpartisi input domain of a program in a way that gives coverage testing mendala

Black box testing focuses on functional requirements of software. Thus, the black box testing allows the software engineer to get 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 to reveal the error class than white box method [8].

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

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

2.13 *Black-box Testing*

Black box testing is testing conducted only observe the execution results through the test data and functional check of the software. Black box testing, evaluating only from the outside look and functionality. Without knowing what actually happens in the process details. Black box testing is done on application

Based on the results of black box testing the test case above it can be concluded that there are errors in the application process and functionally not run as expected..

2.6 *Beta Testing*

Beta testing is testing conducted objectively, where testing is done directly in the study. The method used in the beta testing by providing questionnaires and interviews to the analytical chemistry lab assistant.

1.Questionnaire

The questionnaire was given to the virtual laboratory applications are taking courses in analytical chemistry samples were taken each user as many as 30 students, and the results of the questionnaire will be calculated for assessment conclusions will be drawn.

2.Interview

Interviews were conducted in person by Abednego as an analytical chemistry lab assistant to the virtual laboratory applications. Based on the results of beta testingn.

2.7 Measurement Scale

To measure the variables that have been established in research, it takes a 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 the instruments when used in measurement will generate quantitative data. With this measurement scale, then the value of the measured variable 10 with certain instruments can be expressed in numbers, so it would be more accurate, efficient, and communicative. The scale used for this study is a Likert scale.

2.8 Likert Scale

Likert scale indicate agreement or disagreement with each statement in the instrument. Each response was given a numerical score, showed favourableness or unfavourableness, and the scores are summed to measure the attitudes of respondents. In other words, the overall value is the respondent in a position continuum favourableness or unfavourableness to problems.

CLOSING

3.1 Conclusion

Based on the results of the implementation and testing has been done, then the conclusion of a thesis entitled "Development of a Virtual Laboratory for Analytical Chemistry Course" is as follows:

1. Application of Virtual Laboratory has not been able to reduce the occurrence of accidents when laboratory experiments, because when testing applications Blackbox failure
2. Application Laboratory gives an overview to the students before the lab

3.2 Sugestion

Based on the above conclusions, the suggestions are expected to do a development including:

1. Development of a virtual laboratory chemicals better built using HTML 5, Adobe Flash and PHP due to less compatible when implemented on the web.
2. The addition of all materials on the analytical chemistry learning media to be more complete without seeing the curriculum.
3. Shape the appearance of the application must be closer to the real world with the use of three-dimensional technology so it can be viewed from all angles.

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