

Web-Based Virtual Laboratory for Food Analysis Course

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Abstract. Implementation of learning on food analysis course in Program Study of Agro-industrial Technology Education faced problems. These problems include the availability of space and tools in the laboratory that is not comparable with the number of students also lack of interactive learning tools. On the other hand, the information technology literacy of students is quite high as well the internet network is quite easily accessible on campus. This is a challenge as well as opportunities in the development of learning media that can help optimize learning in the laboratory. This study aims to develop web-based virtual laboratory as one of the alternative learning media in food analysis course. This research is R & D (research and development) which refers to Borg & Gall model. The results showed that assessment's expert of web-based virtual labs developed, in terms of software engineering aspects; visual communication; material relevance; usefulness and language used, is feasible as learning media. The results of the scaled test and wide-scale test show that students strongly agree with the development of web based virtual laboratory. The response of student to this virtual laboratory was positive. Suggestions from students provided further opportunities for improvement web based virtual laboratory and should be considered for further research.

1. Introduction

Laboratory is one of the most important learning infrastructure facilities, in the academic process in agro-industrial technology education study program, especially in the subjects of expertise that require learning of lab work in it. Currently, the laboratory conditions are insufficient to accommodate the large number of students so that the lesson is less than optimal. In addition, the equipment in the laboratory is still incomplete to undertake a wide variety of practicum activities in subjects such as food analysis.

Food analysis is a course that studies the principles of chemical analysis of food, both qualitative and quantitative analysis. After following the course of food analysis, students are expected to be able to explain the working principle and carry out foodstuff analysis, including proximate analysis. Implementation of learning courses in food analysis, one of which applies practicum method in the laboratory as an effort to achieve student's competence, both cognitive, affective and psychomotor. Many studies have shown that learning in the laboratory can improve student's ability and learning motivation in science learning [1,2]. In addition laboratory activities serve to link theory or concepts



and practices, increase attractiveness or interest, can correct misconceptions, and develop analytical and critical attitudes to learners [3].

Implementation of practical study of food analysis courses, in the laboratory of agro-industrial technology education study program, still faces the problems. The limited resources of practicum of food analysis course become one of the causes of less than optimal learning process, thus affecting the achievement of students' cognitive and psychomotor competence. In addition, the absence of self-learning means to be one of the causes of less optimal learning of food analysis courses such as the water content analysis and ash content analysis, because only supported by literature study, as an effort to achieve student competence.

Information and Communication Technology integration in teaching and learning process is no longer a luxury but has become a vital requirement to develop educational infrastructure/ structures. Technology offers qualitative leap in reformulating all educational process components [4]. Information and Communication Technology has had a positive impact on the innovation of learning style and teaching. Some other studies reported that computer simulation experiments are more affective [5-7]. Virtual lab provides some advantages in education. Virtual laboratories exist as a complement and substitute for real laboratories in overcoming the limitations of equipment and lab testing in real laboratories [8]. Virtual laboratory is a computing system that allows to share the physical resources available in a laboratory with remorw users connected on the internet [9]. Virtual laboratory helped student to understand concepts and theory in online course. It is particularly useful wheb some expriments involve equipment that may cause harm to human beings [10].

Therefore, virtual laboratory is expected to be an alternative solution of the limitations of agro-industrial technology education study program. Moreover, the potential of information communication technology owned by the students and the ease of internet access in the campus. This study aims to develop a virtual laboratory for food analysis courses on water content analysis and ash content analysis, as the development of instructional media for food analysis courses.

2. Methods

This research applied research and development approach which will use Borg & Gall model. This model is used to develop a product and test its effectiveness [11]. The research stages consist of needs analysis, product development, expert validation-revision, product trial-revision. Product trials conducted on students who follow lecture of food analysis as user of this product (web-based laboratory).

2.1 Data collections

The instrument used in this research is non test instrument in the form of questionnnnaire. Questionnaires used in this study is a closed questionnaire, which is the choice of answers already provides by researchers. Questionnaires for experts use Guttman scale, and questionnaires for respondents use Likert scale.

2.2 Data analysis

Data analysis used to determine the feasibility of virtual labs in this research is descriptive statistics. The result of data analysis interpreted based on predetermined interval.

3. Results and Discussion

3.1 Needs analysis of virtual lab development

Implementation of learning for water content analysis and ash content in food analysis courses were not only in classroom, but also in laboratory. Availability of practicum facilities was not proportional to the number of students so that laboratory could not be implemented in one lesson. In addition,

students did not have self-learning media for food analysis courses. On the other hand, Agro-industrial Technology Education Study Program had potency to support the development of web-based virtual laboratory, namely availability of wireless hotspot areas or wireless computer network services around campus. Moreover, student literacy in information communication and technology was very good. It became an opportunity for the development of learning media that can improve the quality of learning in the laboratory.

Web-based virtual laboratory was developed in accordance to syllabus of the food analysis course, in which there was an indicator of the achievement of water content analysis material and ash content analysis. The result of interview with laboratory assistant in Study Program of Agro-industrial Technology Education, it was known that it needs a self-learning media for students to improve understanding in food analysis course. Based on the indicator of material achievement in the syllabus of food analysis course, also interview result with laboratory assistants and lecturer, obtained information that component of virtual laboratory that need to be developed, consist of safety and job safety in laboratory, introduction of laboratory equipment and water content analysis method, as well as development of a simulated how to analysis watercontent of oven method and analysis of ash content of dried ash method.

3.2 Development of web-based virtual laboratory

Development of web-based virtual laboratory consists of three stages, namely design, development procedure and product testing (evaluation). This virtual lab development research refers to the development model of Borg and Gall [11], with modifications tailored to the field research conditions. Development of an effective virtual laboratory is used to present a practicum simulation with a scientific method. Simulation in a virtual lab can transform the abstract concept into concrete experience so that representatives in conveying the message [12]. Development of web-based virtual laboratory for food analysis courses aims to overcome the problem of limited laboratory facilities in real laboratory and lack of self-learning media for students. Designing was the first stage in the development of this web-based virtual lab. This stage consists of making flowcharts, storyboards, simulation and website layout designs, and content compilation. Making a flowchart aims to describe the flow of virtual lab processes that would be made as presented in Figure 1.

Making a story board aims to provide load information on simulation of water content analysis and ash content analysis. Preparation of learning materials aims to prepare the material to be loaded on the website. The composition materials consists of work safety in laboratory (Personal protective equipment, laboratory rules, Hazard Symbols, First Aid), introduction of lab tools for Analysis of water content and ash, lecture materials of food analysis. Making applications asset aims to prepare the required assets in the simulation component. This asset application was in the form of drawing tool design, materials and sample of practicum needed on analysis of water content and ash content. Design tools and materials tailored to the tools and materials contained in the laboratory of Agro-industrial Technology Education Study Program. In addition, created a virtual lab logo that serves as an identity as presented in Figure 2.

The second stage in the development of virtual web-based lab was a development procedure where there was a process of integrating laboratory components that have been designed into a complete media in accordance with the story board that has been made. Web-based virtual lab were created using wordpress.com with upi.edu domains so it has the URL <http://labvirtual.agroindustri.upi.edu>. Virtual laboratory outlook is presented in Figure 3.

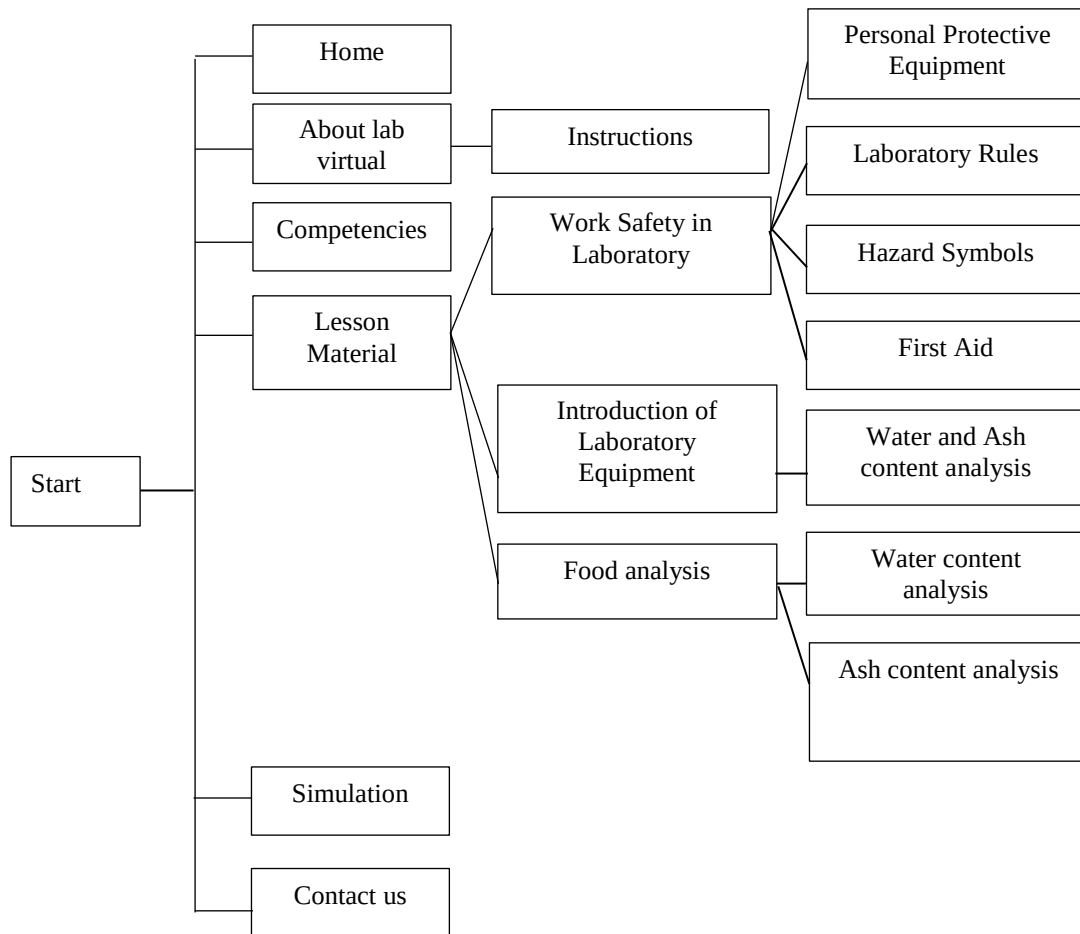


Figure 1. Flowchart of web-based virtual laboratory.



Figure 2. Virtual laboratory logo.

While simulation of water content analysis and ash content analysis in virtual lab using unity application. One of the characteristics of multimedia learning must be interactive that has the ability to accommodate user response [12]. Virtual lab as computer-based learning media can be considered as a complete messaging system such as drills and exercises, reference tools, tutorials, games, simulations and complex calculations [13]. Virtual laboratory facilitates students like studying in real laboratory. Providing feedback on a virtual laboratory can create two-way communication resulting in student learning motivation [14]. Evaluation was the final step undertaken in the development of a virtual laboratory. This stage consists of previewing and editing prior to validation by expert validator.



Figure 3. Outlook of web-based virtual laboratory <http://labvirtual.agroindustri.upi.edu>

3.3 Expert validation-revision

Expert validation on development of virtual laboratory, conducted to find out expert opinion and measure feasibility of developed virtual laboratory, before being tested to respondents. Assessment of media experts on the development of virtual laboratory, includes aspects of software and visual communication, referring to the media feasibility assessment guidelines. Media outlook is the result of visualization of investigations, simulations and materials so that integration of media and material view is a mutually supportive unit [15]. The expert's assessment of the feasibility of virtual laboratory is conducted using a questionnaire.

The results showed that media expert judges appropriately on web-based virtual laboratory, on aspects of software and visual communication. In addition, media experts provide suggestions for improvements such as adding program menu hints, adding a left-right scroll bar to the tool display, increasing the size of the logo on virtual laboratory home page display, moving the widget about the program to the main menu parallel on Home page and calendar menu deletion. Revisions have been made to create an interactive virtual laboratory as learning media. In addition, interactive learning media must have ability to accommodate user responses [12]. Moreover, one of criteria of software assessment on learning media is readability aspect, ease of use, display quality and program management quality.

Expert assessment for materials of web-based virtual laboratory is conducted to test the feasibility language of virtual laboratory materials, in terms of material relevance, material adequacy and language quality used. The results showed that the material experts stated feasible for web-based virtual laboratory, from material relevance aspect, adequacy of benefits and quality of language. Nevertheless, the material expert provides suggestions for material improvements in virtual laboratory, such as addition of an animated video tutorial on analysis of water content and ash content; addition of learning evaluation tools, addition of simulations on various methods of analysis of water content and ash content; addition of Good Laboratory Practice (GLP) materials; and addition of modules in the virtual lab. Revisions have been made to create an effective virtual laboratory as learning media. The principle that must be fulfilled in development of virtual laboratory as learning media is relevance. Developed media must have benefit as a tool in learning process, able to attract more students' attention so that it can generate learning motivation. In addition, the use of language in learning media such as virtual laboratory can affect effectiveness of information.

3.4 Product trial-revision

Product trials were conducted in two stages: on a limited scale and on a wider scale, which was performed after revision-expert validation. Web-based virtual laboratory was tested in limited scale to students who had been following food analysis course. This limited-scale trial was conducted to obtain information on feasibility of developed virtual laboratory that were measurable from student responses after trying to use virtual laboratory. The results showed that in terms of software, more than 75% of respondents stated strongly agree that virtual laboratory run smoothly when used (or not easily error), keeps running well even if used for a long time, easy to use. Obviously, the navigation keys used were consistent and work properly. This virtual laboratory is an innovation product that has never been developed before in agro-industrial technology education study program. It affected the responses of respondents. The majority of students responded positively after trying to use virtual lab. Web-based virtual laboratory, able to visualize experiments of water content analysis and ash content analysis conducted in real laboratories. In addition, respondents expressed their feasibility of the virtual lab software aspect and stated strongly in agreement with development of virtual lab, also very interested in learning to use Virtual lab.

The results of the study also showed that majority of respondents (70-80%) agreed to use of language and sentence in virtual laboratory because it was easy to understand, the text presented can be read clearly, the quality of color brightness was good, the animation was displayed well, the audio used nice to hear, and virtual lab display was pretty good. Virtual laboratory developed were equipped with simulation analysis that require input from user so that user can run the simulation own. Effectivity and efficiency of virtual laboratory was reflected from its ability to overcome the limitations of objects so as to provide ease, usefulness and security at an affordable cost [16].

The results also showed that students strongly agree if virtual lab can increase spirit and desire of students to learn. Respondents also stated that application of language and flow of virtual laboratory presentation was easy to understand and the material presented systematically, so it can help the students in understanding the content of water content analysis and analysis of ash content in food analysis courses. Increased motivation of attention aspect can cause interest in student learning that is the tendency to feel interested in learning or certain subject and feel happy to learn the material. In this trial, obtained suggestions from the respondents include software improvements, visual communications and learning materials.

Large-scale trial for virtual laboratory were performed after a limited-scale trial revision. This trial was conducted to determine level of virtual laboratory feasibility developed. The results of large-scale virtual laboratory trials seen from the software aspects were at 75% -82% intervals. It showed that students strongly agree that virtual laboratories (not easy to error when used), easy to use, user manual used is clear, navigation key used consistently and can function well. The result of research also showed that student very agree with development of virtual laboratory and very interested to learn using Virtual laboratory content analysis of water content and analysis of ash content of food analysis courses.

4. Conclusions

Web-based virtual laboratory for food analysis courses was developed through several stages: needs analysis; development of web-based virtual laboratory; expert validation; product trial- revisions. Expert validation results, both media experts and material experts, in terms of software engineering, visual communication, material relevance, adequacy of benefits and quality of language, indicated that web-based virtual laboratory, categorized as proper to use. As well as students as product trial respondents, expressed satisfaction with web-based virtual laboratory since it was easy to use, improved their learning motivation, also made it easier to understand food analysis course.

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